

The Effect of Rehabilitation Exercises Using Certain Physiotherapy Techniques on Improving Range of Motion and Muscle Strength in Patients with Partial Tears of the Carpal Tunnel Ligament

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ABSTRACT

The introduction and significance of the research on rehabilitation exercises lie in the fact that they are one of the fundamental therapeutic methods in the field of integrated treatment of injuries. The researcher also addressed the research problem, which lies in the lack of interest in therapeutic exercises among patients in general, and particularly those with ligament tears in the wrist joint that restrict its movement. The researcher employed an experimental approach, as it was deemed suitable for the nature of the research problem, at the Physical Therapy Rehabilitation Centre in Kirkuk Governorate. The research sample was selected using a purposive sampling method following diagnosis by a specialist doctor, comprising four patients with partial tears of the carpal tunnel ligament. A set of rehabilitation exercises was prepared using various physiotherapy methods, including (paraffin wax, non-resistance exercises and resistance exercises). These were applied over 21 rehabilitation sessions, three days a week (Sunday, Tuesday and Thursday), to assess their impact on range of motion, muscle strength and sensory function in the area affected by the partial tear of the carpal tunnel ligament. The results were analysed using SPSS, and the researcher reached several conclusions, the most important of which is that the rehabilitation exercises used in the study are highly effective in restoring the range of motion and muscle strength of the wrist joint, thereby increasing its flexibility, stability and sensory perception during use. The researcher's key recommendation is to use these exercises in the rehabilitation of injuries to other joints in the body.

Keywords: Rehabilitation exercises; Range of motion; Muscle strength.

ABSTRAK

Pengenalan dan signifikansi penelitian tentang latihan rehabilitasi terletak pada kenyataan bahwa mereka adalah salah satu metode terapeutik mendasar di bidang pengobatan cedera terpadu. Peneliti juga membahas masalah penelitian, yang terletak pada kurangnya minat pada latihan terapeutik di antara pasien pada umumnya, dan terutama mereka yang memiliki robekan ligamen di sendi pergelangan tangan yang membatasi gerakannya. Peneliti menggunakan pendekatan eksperimental, karena

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Volume 2 Nomor 1 Februari 2026

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dianggap cocok untuk sifat masalah penelitian, di Pusat Rehabilitasi Terapi Fisik di Kegubernuran Kirkuk. Sampel penelitian dipilih menggunakan metode pengambilan sampel yang disengaja setelah didiagnosis oleh dokter spesialis, yang terdiri dari empat pasien dengan robekan parsial ligamen terowongan karpal. Serangkaian latihan rehabilitasi disiapkan menggunakan berbagai metode fisioterapi, termasuk (lilin parafin, latihan non-resistensi dan latihan ketahanan). Ini diterapkan selama 21 sesi rehabilitasi, tiga hari seminggu (Minggu, Selasa dan Kamis), untuk menilai dampaknya pada rentang gerak, kekuatan otot dan fungsi sensorik di area yang terkena robekan parsial ligamen terowongan karpal. Hasilnya dianalisis menggunakan SPSS, dan peneliti mencapai beberapa kesimpulan, yang paling penting adalah bahwa latihan rehabilitasi yang digunakan dalam penelitian ini sangat efektif dalam mengembalikan rentang gerak dan kekuatan otot sendi pergelangan tangan, sehingga meningkatkan fleksibilitas, stabilitas, dan persepsi sensorik selama penggunaan. Rekomendasi utama peneliti adalah menggunakan latihan ini dalam rehabilitasi cedera pada sendi lain di tubuh.

Kata Kunci: Latihan rehabilitasi; Rentang gerak; Kekuatan otot.

INTRODUCTION

Prevention and health are of paramount importance in preventing injury to the individual, and modern sports medicine focuses on injury prevention, seeking to minimise the incidence of injury and to treat it should it occur, through the development of modern rehabilitation programmes and a focus on healthy nutrition. However, a lack of awareness regarding the causes of injuries and how to avoid them often leads those affected to make mistakes, which may be technical or tactical in nature, or result from poor organisation of training loads, inadequate conditioning of the body's internal and external systems, or the musculoskeletal system's inability to withstand the strain placed on the individual with a wrist ligament injury. The incidence, types, severity and mechanisms of these injuries vary, Therefore, we must always bear in mind the principle of 'safety first' and utilise all available resources to prevent the occurrence or recurrence of injuries and to minimise their severity. This is achieved by taking all necessary precautions whilst working and being fully prepared to provide immediate first aid should an injury occur, as predicting the location and timing of an injury is very difficult because they occur suddenly (Alaa El-Din, 2018, 12). Furthermore, neglecting immediate first aid at the time of a minor injury—which plays a vital and important role—leads to adverse consequences and can significantly increase the severity of the injury, potentially affecting the individual's future. and injury prevention is the most important aspect of sports medicine; furthermore, attention to prevention programmes can protect individuals from workplace injuries. Medical rehabilitation for sports injuries has contributed to providing specialised care for the injured, maintaining range of motion, and enabling the injured person to return to work and resume their duties following the injury.

Hence, the importance of this research lies in the researcher's work to develop a set of rehabilitation exercises using certain physiotherapy techniques to improve range of motion and muscle strength in patients with partial tears of the carpal tunnel ligament.

Research Problem:

Jurnal Pendidikan Kepeleatihan Olahraga: Pejuang

Volume 2 Nomor 1 Februari 2026

E-ISSN: 3090-1278

People currently live in an era of rapid development, where many tools, machines and devices needed for daily life are readily available; however, these require safety measures to prevent injuries that affect human health. The researcher has observed a lack of attention to safety measures whilst carrying out work and daily tasks, leading to numerous injuries among people. Among these injuries is a partial tear of the carpal tunnel ligament, which leads to a restricted range of motion in the wrist joint, weakness in the muscles controlling it, and a loss of sensation when touching objects. This requires a series of rehabilitation exercises to restore the range of motion, muscle strength and function of the wrist joint.

The researcher therefore decided to develop rehabilitation exercises using certain physiotherapy techniques to improve range of motion and muscle strength in the study sample of patients with partial tears of the carpal tunnel ligament

Research objectives:

1. To develop rehabilitation exercises using certain physiotherapy techniques to improve range of motion and muscle strength in patients with partial tears of the carpal tunnel ligament within the study sample.
2. To determine the effect of rehabilitation exercises using certain physiotherapy techniques on improving range of motion and muscle strength in patients with partial tears of the carpal tunnel ligament within the study sample

Research Hypothesis: There are statistically significant differences between the pre- and post-tests in the range of motion and muscle strength of the wrist joint.

Research population: Non-athletes with partial tears of the carpal tunnel ligament in Kirkuk Governorate, numbering four. Time frame: 3 January 2022 to 5 March 2022. Spatial scope: A physiotherapy rehabilitation centre in Kirkuk Governorate.

METHODS

The researcher employed an experimental approach using a single-group design with pre- and post-tests, as this was deemed appropriate for the nature of the research. (Mohsen et al., 2023, p. 606), stating that the research population "is what matters most in the research process, as it consists of all individuals, events or objects that form the subject of the research problem".

The appropriate sample for the study was selected at the researcher's discretion to fulfil the study's objectives (Eidan et al. 2024, 305). The study population comprised four patients with partial tears of the carpal tunnel ligament in Kirkuk Governorate, all of whom had injuries specifically affecting the wrist joint (wrist), The injuries were diagnosed by the attending physician and a specialist in physiotherapy and rehabilitation. As for the research sample, it was selected using a purposive sampling method, comprising four patients, representing 100% of the study population.

Equipment, tools and data collection methods used in the study:

The researcher utilised the following equipment, tools and methods:

1. A goniometer used to measure the range of motion of the wrist joint.
2. A Canon camera.
3. A Dell laptop.
4. Tests and measurements.
5. Paraffin wax.
6. Dumbbells suitable for the injury.

Jurnal Pendidikan Kepeleatihan Olahraga: Pejuang

Volume 2 Nomor 1 Februari 2026

E-ISSN: 3090-1278

Research procedures:

The research was conducted to determine the range of motion of the wrist, whereby the research team, used a goniometer to measure angles in order to identify the degrees and angles of injury in the patients.

Tests used: Measurement of wrist range of motion: (Hatem, 2020, 65)

After reviewing numerous scientific sources and references, the researchers identified a set of specific tests for the wrist joint and applied them to the study sample.

1. First: Palmar wrist extension test:

The patient sits on a chair holding a pen, with the elbow bent at a 90-degree angle; the axis of the device aligns with the direction of the head of the third metacarpal bone, and the arm is held vertically towards the floor, such that the movement of the arm is parallel to the pen, which is perpendicular to the floor; the forearm rotates outwards and upwards (with the palm facing upwards).

2. Second: Palm-down test:

The patient sits on a chair holding a pen, with the elbow joint at a 90-degree angle, the device's axis aligned with the direction of the head of the third metacarpal bone, and the arm held vertically towards the ground, with the arm's movement parallel to the pen, which is vertical to the ground; the forearm rotates outwards and downwards (with the palm facing downwards).

3. Third: Wrist flexion test:

The palm faces upwards, the forearm rests on the table, and the hand lies flat on the table. The axis of the device is on the ulna; the movement of the arm is about the axis connected to the fifth metacarpal; the fingers are extended and relaxed, and the palm moves towards the palm side of the wrist.

4. Fourth: Wrist extension test:

The palm faces upwards, the forearm rests on the table, and the hand lies flat on the table. The axis of the device is on the ulna; the movement of the arm is around the axis connected to the fifth metacarpal; the fingers are extended and relaxed; and the movement of the palm is towards the back of the wrist.

Preliminary experiment:

Ghaith, Mohammed Karim et al. (2023, 290) state that the pilot study "is a practical exercise to identify difficulties that may arise during the main experiment in order to overcome them". Therefore, the researcher conducted a pilot study applying the rehabilitation exercises on Sunday, 3 January 2022, on a sample of two players. These two players were not excluded from the main study due to the small sample size, as the aim of the pilot study was to identify the following:

1. To prepare the sample to understand how the research procedures work.
2. To determine the time required to conduct the research (the duration of the study).
3. Identify the obstacles and difficulties the researchers will face and work to resolve them.
4. Assembling the support team.

A number of points were identified through the pilot study, namely: The suitability of the exercises for the research sample.

Main experimental procedures

The researcher supervised the pre-tests, which were conducted by the support team on the research sample at 10:00 am on Thursday, 6 January 2022, at the

Jurnal Pendidikan Kepeleatihan Olahraga: Pejuang

Volume 2 Nomor 1 Februari 2026

E-ISSN: 3090-1278

Physiotherapy Centre – Department of Rehabilitation for People with Disabilities in Kirkuk Governorate.

Implementation of the programmed:

The researcher applied the rehabilitation exercises they had devised to four patients with partial tears of the carpal tunnel ligament, over a period from 9 January 2022 to 24 February 2022. The researcher used physiotherapy methods to rehabilitate the injuries, employing paraffin wax and exercises without resistance – as well as resistance exercises. Each session lasted between 20 and 40 minutes, in accordance with the instructions of the specialist doctor or the physiotherapists. (i.e. paraffin wax is used alongside non-resistance exercises during the first few days of the rehabilitation sessions; the duration of the first session is 20 minutes, then gradually increases to 40 minutes, with rest periods between exercises and between sets; Resistance is introduced after the twelfth session, using paraffin wax, and is gradually increased until the final session, in order to strengthen the muscles, tendons and torn ligaments, which in turn increases muscle flexibility and strength, reduces muscle spasms, and increases blood flow to the affected areas. The rehabilitation programmed consists of 21 days, with three sessions per week on Sundays, Tuesdays and Thursdays.

The duration of each rehabilitation session ranged from 20 to 40 minutes. In the rehabilitation sessions used by the researcher, the rest period between exercises was 15–30 seconds, and the rest period between sets was 30 seconds. The warm-up lasted 5 minutes and was performed before the exercises to prepare the muscles and body systems, particularly the affected joint. Cool-down exercises lasted 5 minutes and were performed after the exercises. The programmed consists of three sessions per week. The number of repetitions per exercise ranges from 4 to 8.

The post-tests were conducted by the research team on the sample under the supervision of the researcher at 10:00 am on Sunday, 27 February 2022, at the Rehabilitation Centre for the Physically Disabled in Kirkuk Governorate. The same conditions as in the pre-test were maintained in terms of location and time.

The researcher relied on the SPSS statistical package for statistical analysis.

RESEARCH RESULTS

The results are presented and discussed in light of the statistical data obtained through the procedures carried out by the researcher.

Table 1. Shows the Arithmetic Means, Standard Deviations and t-values for the pre- and post-tests

Variables	Pre-test		Post		t-value		Significance level of differences
	p-	p	S-	A	Calculated	Table	
Grip strength	14.750	2,251	23.125	3,681	4,726	3.18	Moral
Range of motion	32,500	8,088	42,000	11,801	20,500	3.18	Moral
Wrist extension	33,500	8,831	36,500	7,874	9,922	3.18	Moral

Wrist flexion	22.125	5.303	37,500	4.000	9.275	3.18	Mean
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Significance level (0.05) and degrees of freedom (3)

Table (1) shows that there are statistically significant differences between the pre- and post-tests for 'grip strength', as the calculated T-value was 4.726, whilst the critical value was 3.18 at a significance level of 0.05 and a degree of freedom (3). As the calculated T-value is greater than the critical value, this indicates that the difference is significant in favour of the post-test. The researcher attributes these differences to the fact that rehabilitation exercises greatly assist in restoring wrist stability, and that "the body's ability to resist fatigue during sustained exertion, which is characterised by its duration and its association with various levels of muscular strength" (Kemper, 1996, 87) also contributed to this level of improvement.

DISCUSSION

In terms of 'range of motion', the calculated T-value was 20.500, whilst the tabulated value was 3.18 at a significance level of 0.05 and a degree of freedom (3). As the calculated T-value was greater than the critical value, this indicates a statistically significant difference in favour of the post-test. The researcher attributes these differences to the fact that the rehabilitation exercises, repetition of movements, encouragement and progressive training contributed to the observed development "One of the benefits of this type of exercise is the restoration of the range of motion in the affected area; indeed, it leads to an increase in muscle strength as well as an improvement in neuromuscular coordination, which are important factors for athletes and in the field of rehabilitation as well. (www.Ankle-cute-injuries.com)

In the wrist extension test, the calculated T-value was 9.922, whilst the critical value from the table was 3.18 at a significance level of 0.05 and a degree of freedom of 3. As the calculated T-value was greater than the table value, this indicates that the difference is statistically significant in favour of the post-test. The researcher attributes these differences to the sample's adherence to the rehabilitation programme's protocols, as well as the continuous monitoring of the research sample to ensure they performed the strength exercises, given that 'increased muscle strength helps the muscle withstand the loads placed upon it' (Al-Hassanat, 2008, 174)

In the wrist flexion test, the calculated T-value was 9.275, whilst the critical value was 3.18 at a significance level of 0.05 and a degree of freedom of 7. As the calculated T-value was greater than the critical value, this indicates a statistically significant difference in favour of the post-test. The researcher attributes these differences to the components of the programme applied to them to develop wrist function, as "muscular ability to resist the body's weight when moving from one place to another and to resist external factors and influences during physical exertion". (Waqas, 2009, 69)

CONCLUSIONS AND RECOMMENDATIONS

Conclusions:

1. The therapeutic exercises used are highly effective in restoring the range of motion of the wrist joint, which contributes to increased stability and aids arm movement.

Jurnal Pendidikan Kepeleatihan Olahraga: Pejuang

Volume 2 Nomor 1 Februari 2026

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2. The use of rehabilitation exercises in conjunction with certain physiotherapy techniques has contributed to the observed improvement, as these exercises have a positive effect on this progress.
3. The exercises applied to patients and the progression of the exercises have an effective impact on reducing the stiffness in the wrist joint.

Recommendations:

1. Emphasis should be placed on the use of rehabilitation exercises combined with certain physiotherapy techniques for wrist contracture.
2. Research should be conducted into other rehabilitation approaches for different age groups, as well as for the same injury, using assistive devices and equipment.
3. Emphasis should be placed on the monitoring of injuries by specialists in order to develop rehabilitation programmes for these injuries without delay.
4. The use of assistive devices and tools to treat many other conditions.

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Jurnal Pendidikan Kepeleatihan Olahraga: Pejuang

Volume 2 Nomor 1 Februari 2026

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