

effect of using therapeutic exercises in improving certain physical abilities of patients with hemiplegia.

أثر استخدام التمارين العلاجية في تحسين بعض القدرات البدنية للمرضى المصابين بالشلل النصفي الطولي

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Abstract: The aim of this study was to investigate the effect of therapeutic exercises on improving certain (coordination) in segment paraplegia (muscle strength, neuromuscular c-physical abilities in patients with long patients with complete paraplegia. The research sample consisted of six patients, selected using a purposive -group design for pre-sampling method. The researchers employed an experimental approach using a single hars used a dynamometer to measure muscle strength, The results showed tests. The researc-and post tests in muscle strength and neuromuscular -and post -statistically significant differences between the pre test showing superior results-coordination, with the post.

term paraplegia-euromuscular coordination, therapeutic exercises, longn -Keywords: - .

المخلص: هدف البحث التعرف الى أثر استخدام التمرينات العلاجية في تحسين بعض القدرات البدنية للمرضى المصابين بالشلل النصفي الطولي (القوة العضلية، التوافق العصبي العضلي) للمرضى المصابين بالشلل النصفي الطولي تكونت عينة البحث من (6) مرضى، تم اختيارهم بالطريقة العمدية واستخدم الباحثان المنهج التجريبي باستخدام تصميم المجموعة الواحدة للقياسات القبليّة والبعدية باستخدام جهاز الدينامومتر لقياس القوة العضلية وأظهرت النتائج وجود فروق دالة إحصائية بين القياسين القبلي والبُعدي في القوة العضلية والتوافق العصبي العضلي ولصالح الاختبار البُعدي.

الكلمات المفتاحية: - التوافق العصبي العضلي، التمرينات العلاجية، الشلل النصفي الطولي.

Introduction and Research Problem:

erapy play a vital and central role as a branch of Physical rehabilitation and physioth injury treatment or surgical-sports medicine and as a complement to post

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intervention. As is well known, physiotherapy involves the use of therapeutic methods, such as manual and electrical and techniques based on various natural factors: massage and rehabilitative exercises, which form the basis of rehabilitation and the return of the affected part to its normal state (Hadi, 2015, p. 14-Al).

Methods in the field Controlled movement therapy is one of the fundamental natural methods of integrated therapy, which is of particular importance in the field of rehabilitation and physiotherapy; motor therapy and rehabilitation rely on exercises of various kinds. (Amri, 2014, p. 82-Mohammed Ibrahim Al)

People live by Furthermore, human beings Moreover, people today live in an age fraught with stress, emotional turmoil, responsibilities and duties that drain both physical and mental energy, leading to a host of illnesses; Stroke is one such illness that has recently in recent times, resulting in motor impairment and emerged and spread significantly the cessation of daily activities. It confines the affected individual to an open prison where they can see everything around them but are unable to do anything. This leads to a state of sadness, frustration and isolation, intensifies the sense of pain and is fuelled by the fear that they may never move their limbs again, and that they have reached a stage of helplessness and bedriddenness. (Mousa, 2023, p. 2)

of investigating the impact of a motor Hence, researchers recognised the importance of a rehabilitation programme, combined with certain physiotherapy techniques, on improving muscle strength and neuromuscular coordination in patients with spastic paralysis. This programme helps them with paralysis resulting from a stroke, and to demonstrate how they can return to their active lives, work and previous routines by strengthening weak muscles and restoring their strength and flexibility in the study sample.

tation for Through their work and experience in the field of physiotherapy and rehabilitation of people with disabilities, the researchers have observed an increase in the incidence of

hemiplegia resulting from strokes and the associated complications, which stem from a lack of various factors such as poor daily habits, a sedentary lifestyle, and a lack of physiotherapy and therapeutic exercises. Hence, the study's focus emerged on the importance of physiotherapy and movement therapy as a safe and effective alternative in the treatment and rehabilitation of such cases, given that the movement therapy and rehabilitation using modern methods has combination of many proven its significance and effectiveness in the recovery and rehabilitation of many different movement disorders. From this perspective, the researchers undertook this study at findings and recommendations that would contribute study in the hope of arriving to the rehabilitation of stroke patients and their gradual return to leading a normal or normal daily life-near.

with a view to arriving at findings and recommendations that will alleviate and this phenomenon in all physiotherapy and rehabilitation centres and address hospitals.

Significance of the research:

Scientific significance:

To highlight motor paralysis as a significant condition requiring comprehensive care in of therapeutic exercises for patients with motor all respects; to explore the use paralysis; and to provide further information on the importance of therapeutic exercises in the treatment of paralysis.

Practical significance:

habilitation and To provide those interested in and working in the field of re - physiotherapy with the research findings and recommendations, and to attempt to answer some of the questions under investigation regarding the improvement of

to goals certain physical abilities in patients with paraplegia, and to identify appropriate and methods that contribute to the development of the rehabilitation process to achieve the best and most suitable outcomes.

Research objective:

The objective of the research is to identify the effect of therapeutic exercises on strength in the affected area and neuromuscular coordination in improving muscle strength in patients with spastic paraplegia.

Research Hypothesis:

The researcher hypothesises that there will be statistically significant differences in motor abilities (muscle tests in terms of improvement and post-test) between the pre-test strength in the affected side, neuromuscular coordination) test -with the post-test . showing greater improvement.

Research Terminology:-

Stroke: a sudden neurological disorder caused by an interruption in the blood supply to the brain. (Aoun, 2011, p. 16)

g the lateral half of the most common type of paralysis, affecting the lateral half of the body with total or partial weakness (Abdul Ghani, 1999, p. 77)

:Neuromuscular coordination

This is an individual's ability to control the functioning of different parts of the body for a task, and to integrate these parts into that are involved in performing a specific motor task. a single, fluid movement with sufficient force to accomplish that motor task (Mousa, 2023, p. 9) (citing Hamdan Sari, 2001)

Therapeutic exercises:

utic movements prescribed These are scientifically based and planned therape according to the patient's condition with the aim of stimulating or restoring the natural functions of the affected part, maintaining its current condition, or increasing its efficiency. ((Samia Muhammad Khalil, 2010, p. 190)

arch scopeRese:

Human scope: The human scope included patients with thrombosis in the Internal Medicine Inpatient Ward at Dr Abdul Wahab Ajlan Specialist Hospital.

Spatial scope: The research was conducted and implemented in the Inpatient Ward at b Ajlan Specialist Hospital and in the homes of some patientsDr Abdul Waha.

Temporal scope: This research was conducted during the academic year 2025.

Previous studies:

Moussa(2023)conducted a study aimed at investigating the effect of a proposed programme, combined with certain physiotherapy techniques, motor rehabilitation on improving specific motor abilities in patients with hemiplegia resulting from stroke muscle strength on the affected side, grip strength, static balance, dynamic balance,) ation, and walking ability). The study sample consisted of 10 neuromuscular coordin patients selected using a purposive sampling method from the original research and -group experimental design was employed, utilising pre-population. A single -istically significant differences between the pretests, The results showed stat-post tests in the following variables (muscle strength of the affected arm and leg, -and post static balance, walking ability, and neuromuscularcoordination)tests -with the post . yielding better results.

Mustafa(2019) a study aimed at investigating the use of a proposed rehabilitation programme torelated physical fitness components and -develop certain health

h hemiplegia resulting from esteem in patients wit-improve body image and self stroke, and to determine the relationship between them. The experimental approach was used as the appropriate method for testing the research hypotheses, as the study om a stroke, aged included a sample of 12 patients with hemiplegia resulting fr between 55 and 65 years. The sample was divided into two groups: an experimental group who performed the usual rehabilitation exercises and were also subjected to ly the the proposed rehabilitation programme, and a control group who performed on usual rehabilitation exercises at a specialist clinic for functional rehabilitation using electrical stimulation. The results revealed that applying the rehabilitation programme to the studysample ledysical to an improvement in their psychological and ph ,conditionaswell as increasing their ability to work and enabling them to resume their normal activities, or as close to normal as possible.

Khader and Mamouni-Also conducted: "Al(2013)conducted a study aimed at rehabilitation programme on improving certain identifying the impact of a motor motor abilities in patients with hemiplegia resulting from strokes. The researchers used an experimental approach on a sample of eight patients with hemiplegia, most significant findings were that selected using a purposive sampling method. The the motor rehabilitation programme had a positive effect on improving certain motor abilities (walking, balance and neuromuscular coordination) in the sample group.

Foreignstudies:

Hancock et al(2011) aimed at conducted a study identifying theeffect of early intervention using therapeutic exercises to improve the function and rehabilitation of the lower limbs; it also focused on the lower limbs to restore and reorganise brain of mitigating subsequent (motor and function early after a stroke, with the aim psychological). The researchers used an experimental approach, with the study deliberately targeting patients who had recently suffered a stroke, numbering

They were divided .approximately 24 patients with hemiplegia or weakness in the UK into an experimental and a control group, The results showed that the patients in the experimental group achieved significantly better outcomes than the control group. g them to Furthermore, the programme was well received by the patients, helping them to regain a degree of independence and attempting to restore brain function through the movement of large muscles in the lower limbs at an early stage following the stroke.

Research Methodology:

The researcher employed a quasi-experimental design using a single-group pre-test and post-test approach, as it is the most appropriate methodology for the nature and objectives of the current study.

Research Sample:

The research sample was selected using a purposive sampling method, consisting of (6) patients diagnosed with longitudinal hemiplegia. The participants were recruited from the Physical Therapy Unit at Dr. Abdulwahab Ajlan Specialized Hospital in the Capital Secretariat, Sana'a. The age of the participants ranged between 40 and 60 years. Table (1) provides a detailed description of the research sample's characteristics, including demographic variables (age, height, and weight) and the primary research variables under investigation.

Table (1) Mean, Standard Deviation, and Skewness Coefficient for assessing sample homogeneity in the investigated variables (N = 6)

Variables	Measurement Unit of	Mean (M	Standard Deviation (SD)	Coefficient Skewness)
Age Chronological	Year	63.38	6.47	0.71-
Height	Cm	72	8.85	0.13-
Weight	Kg	8.85	3.53	0.00-

Statistical Homogeneity

As illustrated in Table (1) ,homogeneity is observed across all research sample members regarding the aforementioned variables. The skewness coefficients fell within the range of (-3 to 3+) ,indicating that the data for the selected variables are normally distributed. This distribution confirms the suitability of the sample for the subsequent experimental procedures.

Data Collection Instruments

To achieve the research objectives, the following tools and methods were utilized:

Literary Sources and References: A comprehensive review of related literature.

Data Collection Forms: Structured forms for recording participant information.

Observation: Clinical observation of patients' motor performance.

Testing and Measurement: The researcher conducted the following standardized measurements:

Stature (Height) measurement.

Body mass (Weight) measurement.

Muscular Strength: Assessment of the upper and lower extremities on the affected side (Anterior and Posterior).

Neuromuscular Coordination Test.

Pilot Study

A pilot study was conducted on a sample of (3) patients outside the main research sample. These participants were stroke survivors referred by their attending physicians for physical therapy at the Physical Therapy Unit in the Capital Secretariat, Sana'a.

The pilot study aimed to:

Assess the suitability and feasibility of the proposed program for the target population.

Determine the optimal positions and protocols for measuring the research variables.

Identify and mitigate potential procedural errors before commencing the main experimental trial.

Administrative and Ethical Procedures

Informed Consent: Prior to the commencement of the intervention, the researcher obtained written informed consent from all participants. This procedure was conducted to ensure their voluntary participation, full awareness of the study's nature, and commitment to completing the rehabilitation program.

Institutional Approvals: Formal administrative procedures were followed through the Deanship of the College to coordinate with the relevant authorities. Official correspondence was issued to facilitate access to the study population and to ensure

the necessary cooperation for the successful implementation of the program within the clinical settings.

Main Experimental Trial

Pre-test Measurements:

The researcher conducted individual pre-test measurements for each participant in the research sample. The initial assessment was recorded on September 5, 2025. These baseline measurements encompassed the primary research variables, including demographic data (Stature and Body Mass) and functional capacities (Chronological Age, Muscular Strength of the upper and lower extremities, and Neuromuscular Coordination).

Health-Related Physical Fitness Tests

Instruments Used in the Research:

A- Muscular Strength Test,

B- Neuromuscular Coordination Test.

Assessment of Upper and Lower Extremity Muscular Strength.

Test Objective: To measure maximum isometric muscular strength.

Equipment: A calibrated hand-held or back-leg-chest dynamometer.

Procedures: The participant is provided with standardized instructions and a practical demonstration on the correct execution of the measurement to ensure reliability.

Targeted Muscle Groups (Affected Side):

Affected Arm Musculature: Assessment of pulling (retraction/posterior) and pushing (protraction/anterior) strength.

Affected Leg Musculature: Assessment of pulling (flexion/posterior) and pushing (extension/anterior) strength.

Neuromuscular Coordination Test:

The study utilized the coordination test developed by Fisher (1990), which consists of 20 items. The test requires the participant to execute a series of verbal commands by identifying or touching specific bilateral body parts (e.g., ear, arm, eye). This assessment is designed to evaluate body schema and lateral orientation (Allawi & Radwan, 1997).

Test Administration Protocol

The examiner must administer the verbal instructions in a clear, measured tone. To ensure the participant's sustained attention and spatial orientation, the examiner should emphasize the specific direction required during the command. It is mandatory to record the participant's actual response accurately, regardless of whether it is correct or incorrect.

Scoring System:

One point (1): Awarded for each correct response.

Zero (0): Awarded for incorrect or failed responses.

Proposed Therapeutic Exercise Program

Following an extensive review of specialized scientific literature and previous research—specifically the protocols established by Hancock et al. (2011), and Mustafa (2019)—the researcher designed a structured therapeutic exercise program. The selection of the program's principles and application phases was based on established rehabilitation frameworks for hemiplegic patients.

The program encompasses the following interventions:

Muscular Strengthening Exercises: Targeted exercises for the upper and lower extremities on both the affected and unaffected sides.

Flexibility and Range of Motion (ROM) Exercises: Aimed at improving joint mobility and muscle elasticity across both sides of the body.

Neuromuscular Coordination Exercises: Focused on enhancing motor control and synchronization.

Balance and Gait Improvement Exercises: Designed to stabilize posture and optimize stepping mechanics.

Methodological Progression of the Program:

The proposed rehabilitation program emphasizes motor functions that the patient cannot perform independently, as identified by the baseline assessments. The intervention follows a systematic physiological progression:

Passive Movement: Initiated according to the patient's clinical status to maintain joint integrity.

Active-Assisted Movement: Transitioning to free active movements, often with the researcher's assistance, to achieve the maximum possible range of motion.

Resisted Movement: Advancing to strengthening exercises against resistance, utilizing either manual resistance from the researcher or specialized rehabilitation tools, customized to each patient's functional capacity.

Consequently, the program integrates appropriate therapeutic modalities tailored to the specific clinical presentation of each case.

Program Implementation and Training Load

The therapeutic interventions focused on enhancing neuromuscular control and joint integrity through the following physiological mechanisms:

Muscle Activation: Implementing controlled contraction and relaxation cycles to stimulate muscle fibers.

Joint and Tendon Mobilization: Executing rotational, elevation, and depression movements for the joints and associated tendons. This was performed with strict adherence to the principle of progressive loading and within the safe Range of Motion (ROM) for each patient.

The program utilized three distinct therapeutic modalities:

Passive Exercises: Performed entirely by the researcher (manual mobilization).

Active-Assisted Exercises: Performed by the patient with partial assistance from the researcher to facilitate movement completion.

Active-Resisted Exercises: Performed independently by the patient using external resistance or specialized rehabilitation tools.

The training protocol targeted both the affected and unaffected extremities to ensure bilateral symmetry and functional balance.

Training Load Parameters.

In designing the program, key training load variables were precisely calibrated, including: Intensity, Rest Intervals, Volume (Repetitions), Session Duration, and Weekly Frequency. These parameters are detailed in Table (3).

Table (3) :Training Session Components and Load Distribution

Elements	Includes	Notes
Intensity	55%–70%	Variable increase/decrease according to the patient's maximum tolerated capacity
Number of Repetitions	8–20	Variable increase/decrease
Rest Intervals (Negative and Positive)	30 sec – 2 min	Variable increase/decrease
Training Session Duration	40 min – 1.5 h	Up to maximum limit
Number of Training Sessions	36 sessions	
Total Program Duration	3 months	Individually tailored for each patient

Follow-up measurements:

All procedures followed in the initial measurements were repeated. The researchers conducted follow-up measurements for each patient individually after completion of the proposed treatment program for the variables under study, on April 8, 2025.

Research variables:

Independent variable: therapeutic exercises used.

Dependent variable: muscle strength, neuromuscular coordinatio.

-Statistical methods used in the study

Arithmetic mean.

Skewness.

Standard deviation.

T-test for significance.

Percentage of improvement calculated using the following formula:

$$\text{Post-test} - \text{Pre-test} / \text{Pre-test} * (100))$$
 Hassani, 2002

Presentation of Results:

Within the scope of the research objective, and to verify the hypothesis stating that “there are statistically significant differences between the pre- and post-tests in the improvement of motor abilities (muscle strength, neuromuscular coordination), with the post-test showing better results,” In light of the statistical procedures and methods employed, the following results were obtained, as shown in Tables 4 and 5 .

Table (4) Mean, Standard Deviation, Improvement Percentage, and T-Value for Muscular Strength Measurements in the Research Sample (N = 6)

Variable	Pre-test		Post-test					
	Mean	SD	Mean	SD	Difference	Improve ment %	t- value	p- value
Arm Muscle Strength (Pull Backward)	2.21	2.83	3.51	2.99	-1.30	58.82	-3.55	.016
Arm Muscle Strength (Push Forward)	2.07	2.42	3.09	2.78	-1.02	49.28	-1.22	.276
Injured Leg Muscle Strength (Pull Backward)	2.18	2.54	5.16	3.23	-2.98	136.70	-4.24	.008
Injured Leg Muscle Strength (Push Forward)	2.55	2.98	6.45	3.85	-3.90	152.94	-4.15	.009

Table 4 show statistically significant differences between the pre- and post-tests in favor of the post-test for all muscle strength measurements in the study sample, where the calculated t-value was greater than the critical t-value at the 0.05 significance level, except for the forward push arm muscle strength measurement, although there was an improvement in favor of the post-test measurement, it was not statistically significant. The highest improvement rate was observed in the forward push muscle strength measurement of the affected leg, reaching 152.94%, while

The smallest improvement was observed in the forward push arm muscle strength test, with an improvement rate of 49.28%, which was the lowest among all measurements.

Table (5) Mean, Standard Deviation, Improvement Percentage, and T-Value for Neuromuscular Coordination Measurements in the Research Sample (N = 6)

Measurement	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Difference	Improvement %	Sig.
Neuromuscular Coordination	10.00	3.74	14.50	1.97	4.50	45.00	0.003

Table 5 show that there are statistically significant differences between the pre- and post-tests, with the post-test yielding better results in measuring neuromuscular coordination in the study sample; the calculated t-value was greater than the critical t-value at the 0.05 significance level, and the improvement rate was 45%.

The results of Tables 4 and 5 confirm the research hypothesis, which states that “there are statistically significant differences between the pre- and post-tests in the improvement of motor abilities (muscle strength, neuromuscular coordination), with the post-test showing greater improvement.

Discussion of Results:

Table 4 show that there are statistically significant differences between the pre- and post-tests in terms of the improvement rate, with the highest improvement rate observed for the variable of leg muscle strength during the forward push. The researcher attributes these differences to the safety and consistency of the therapeutic program, which led to improved muscle strength; indeed, the muscle strength of some individuals in the study sample was zero at the pre-test, and the duration and integrity of the program led to a significant improvement in these variables, which the researchers explain by the rate of improvement It exceeded 100%, as confirmed by the study by Musa (2023) and the study by Mustafa (2019).

This led to improved muscle strength in the affected area of the patient. Furthermore, implementing the rehabilitation program for the study participants improved their mental and physical well-being, enhanced their ability to work, and enabled them to resume their normal activities or come as close as possible to their normal .

Table (5) show statistically significant differences in the means between the pre- and post-tests, with the post-test scores being higher for the“ neuromuscular coordination” variable . The researcher attributes these differences to the fact that the therapeutic program included sessions specifically and purposefully designed to develop neuromuscular coordination, and to the therapeutic exercises included in the treatment program, which took into account the progression in the volume and intensity of training appropriate for the age of the sample participants, as well as the implementation of warm-up and conditioning exercisesby the unaffected side of the body before performing therapeutic exercises, which led to improved neuromuscular coordination in patients who had suffered strokes. This was confirmed by a study by Moussa, (2023) and Al-Khader and Mamouni (2013), which indicate that the use of

therapeutic exercises had a positive and effective impact on improving certain motor abilities in stroke patients.

Conclusions.

1. In light of the research objectives and hypotheses, and after reviewing, presenting, and discussing the results, the following conclusions were reached:
2. Therapeutic exercises had a positive effect on the functional and physical variables under study in patients with paralysis resulting from stroke.
3. Therapeutic exercises led to improvement and strengthening of both the affected and unaffected limbs in patients with paralysis resulting from stroke.
4. Therapeutic exercises led to improvements in muscle strength and muscle coordination in patients with stroke-induced paralysis.
5. Therapeutic exercises have a positive effect on weight loss in patients with stroke-induced paralysis.

Recommendations: In light of the findings, the researchers recommend the following:

1. The use of therapeutic exercises for patients with lower limb paralysis, given their positive effect on improving muscle strength and neuromuscular coordination in these patients.
2. The systematic application of the therapeutic exercises described in this study to patients with paraplegia will yield positive results.
3. Early intervention is essential for the rehabilitation of patients with spastic paraplegia, and it should begin as soon as possible after the onset of the condition.

4. Specialized rehabilitation centers should be established for patients with spastic paraplegia, and seminars, conferences, and informational brochures should be organized to raise public awareness among specialists, patients, and the general public regarding the severity of this condition and its complications.

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