The Effect of Using a Device Designed to Rehabilitate Stroke Patients and Increase Their Motor Abilities

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Abstract

Stroke is one of the leading causes for disability worldwide. Motor function deficits due to stroke affect the patients' mobility, their limitation in daily life activities, their participation in society and their odds of returning to professional activities. All of these factors contribute to a low overall quality of life. Rehabilitation training is the most effective way to reduce motor impairments in stroke patients. This multiple systematic review focuses both on standard treatment methods and on innovating rehabilitation techniques used to promote upper extremity motor function in stroke patients. With these protocol patients has been a significant improvement in the level of physical efficiency, especially in the way of walking and the patient's ability to walk closer to normal walking. The rehabilitation program has also achieved a substantial improvement in the muscle strength of the muscles working on the upper limb (such as arm muscles) and also on the lower limb (such as the hip, knee and ankle).

Keywords: Stroke, rehabilitation program, device designed

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Introduction:

It is obviously for all that in an age filled with tensions, emotions, responsibilities and duties that deplete the physical and intellectual energy, which leads to a lot of diseases. Stroke is one of these diseases, which emerged and spread significantly in recent times, resulting in motor failure, and lead the patient to put him in an open prison, sees everything in front of him and cannot do anything and here the feeling of pain and reach a state of sadness, frustration and isolation because he doubted that he could not move them again and that he has reached the stage of disability and mattress.

Stroke is the third cause of death in the world, requiring several studies to try to identify the factors of its occurrence and speed of diagnosis and receive appropriate treatment to avoid reaching late stages, or complete disability. (3.2). Doctors distinguish between two categories of stroke: ischemic stroke, which accounts for 80% of cases of stroke, and occurs as a result of blockage in one of the arteries of the brain.

Hemorrhagic stroke, which accounts for 20% of cases, is caused by a rupture of a blood vessel, as blood seeps into brain tissue. In both cases, the patient suffers untreatable damage. The average age of stroke is 70 years for men and 75 years for women. 9
Some sources also report that partial healing occurs for 85% of stroke survivors. (10) The number of infected people is steadily increasing worldwide. For example, the number of stroke’s sufferers in Iraq has more than doubled in just eight years. Diabetes, obesity, high blood pressure and nervousness are among the causes of stroke.

The available scientific literature suggests that post stroke rehabilitation intervention is significantly more impact when it is discovered in the early phase of recovery (<6 months). Evidence backup that better functional outcome is specific by rehabilitation that is initiated promptly [11] and based on intensive, especially multisensory, stimulation [12]. This type of stimulation is associated with increased adaptive plasticity of the brain in the early post stroke stages [13–14].

The use of robotic systems to complement post stroke multidisciplinary programs is a recent approach that looks very promising; robotic devices can provide high-intensity, repetitive, task-specific, interactive treatment of the impaired limb (passive and/or active-assisted exercises) and can objectively and reliably monitor patients’ motor progress, measuring changes in movement kinematics and forces [15].

The importance of the research lies designing an innovative rehabilitation device and know its impact on patients with strokes and help them by reducing the impact of gravity associated with the mass of the patient and help to carry out rehabilitation and walking without the need for a wheelchair or crutch or cushions and early to help them adapt and retrieve Motor and physical abilities.

By examining the rehabilitation methods, and observing how to carry out the rehabilitation exercises that the patient undergoes after treatment, they noticed that these exercises held in rehabilitation centers are done either with the help of a therapist or supplementary tool and do not take into account the external impact of the impediment of the movement represented by the force of gravity of the earth and specifically the force of gravity. (Body weight) that can pose some difficulties in the application of these exercises, especially the lower limbs, which carry all the body weight, so the patient needs in this period to a wheelchair or rests help him to walk because it reduces the weight on the injured limb, but delays the process Walking and build on the infected foot and slow return movement in a similar manner to normal until after leaving these cushions help to not block foot on weight-bearing and this need for not a few causing muscular atrophy and inability sometimes to re-walk and walk again.

Therefore, the researchers designed a rehabilitation device that helps to reduce the force of gravity by reducing the weight of the patient, where the device works to raise the victim and reduce weight in a safe way to allow the patient to carry out walking and safe movements and carry weight on the injured leg and gradually without any need for assistive crutches.

**Research Objectives**

1- Designing a rehabilitation device for stroke patients
2-Identifying the impact of using the device designed in the rehabilitation of patients with strokes to return to normal life and their ability to walk by affecting on :

A-Improving muscle strength B- Improving static and motor balance
**The research hypothesis:** There are significant statistical differences between the pre and post tests in the ability of patients with stroke to walk in terms of improving muscle strength and improve the balance of equilibrium and motor balance.

**2- Research Methodology and Field Procedures**

According to the type of the research problem and its objectives, Researchers used the experimental method using one experimental group by the method of pre and post measurement to suit the nature of the research. The study sample was chosen by deliberate method of stroke patients who had not been infected for one month, and included 8 cases of patients with stroke, who are attending the specialized center for physical therapy and physical rehabilitation in Wasit province, and their age between 50-65 years men.

**Table (1) research sample description**

<table>
<thead>
<tr>
<th>Basic variables</th>
<th>Statistical significance of characterization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SMA</td>
</tr>
<tr>
<td>Age (years)</td>
<td>56</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>172.83</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>77.83</td>
</tr>
<tr>
<td>Injury duration (day)</td>
<td>19.33</td>
</tr>
</tbody>
</table>

:Sample selection condition

Sample selection criteria are adopted in the following manner:

1) Personal desire and volunteer to study.
2) Be Paraplegia by stroke.
3) Be infected for the first time and the sample is free of any other diseases may interfere with the application of the program.
4) That the participants with sufficient cognitive and linguistic abilities to understand the instructions.
5) To be newly infected and not treated naturally before.

-The following exclusion criteria were adopted for the study:
(1) Cardiovascular instability (acute and uncontrolled hypertension; acute coronary artery disease; etc.) or bone or nervous system conditions;
(2) At early onset of marked spasticity or pain in Patient joints
(3) Acute neuropsychological insufficiency

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MATERIALS AND TOOLS:

The researchers used the following devices and tools: the device designed, a form for each player to record the sequential measurements, a device to measure the length of the meter, a medical balance to measure weight, Dynamometer device to measure muscle strength (kg), stopwatch, and whistle.

MEASURED:

The researchers used a number of standardized tests that fit the study objectives:

1- Test’s name: walk on the wooden parallel between two round trips

Test’s Purpose: to measure the motor balance

Tools and materials: whistle, stopwatch, wooden piece 30 cm wide and 6 m long and 10 cm high, two wooden beams 40 cm wide and 6 m long and 90 cm high.

Performance Description: The experimenter stands on the wooden walk, holding both hands of the wooden beams. When the whistle is heard, the experimenter will walk on the wooden walk for a distance of 5 m, back and forth for the same distance.

Recording: Calculates for each laboratory time traveled back and forth to the nearest fraction of a second.

2-Test name: test stand on the uninfected foot

Test’s Purpose: to measure the constant balance

Tools and materials: whistle, stopwatch

Performance Description: When hearing the start whistle, the experimenter stands on the uninfected foot as long as possible.

Recording: Recording the longest time taken by the experimenter from the beginning of standing on the uninfected foot to the loss of balance

3-Medical ball push test (3 kg) with two hands

Test’s Purpose: To measure the muscular strength of the arms and shoulders

Tools and materials: flat space area. Medical balls weighting 2 kg. A chair. Tape measurePerformance Description: The experimenter sits on the chair holding the medical ball with two hands so that the ball is in front of the chest and below the chin level. The trunk should be adjacent to the edge of the chair. -A rope is placed around the chest of the experimenter so that it is held from behind by an airtight in order to prevent any movement for the experimenter forward while pushing the ball with the hands.

4-Test Name: Fist Force Test
Purpose of the test: To measure the strength of the left or right fist muscles of the patient’s hand

Tools: A hand dynamometer with an included scale

Performance Description: From the sitting position, the experimenter holds the dynamometer with one fist.

Press the fist on the dynamometer trying to bring out the maximum force possible.

Registration: Each experimenter is given two consecutive attempts the best is counted

5- Test name: Test the strength of the injured leg

Purpose of the test: To measure the strength of the quadriceps muscle of the patient’s leg

Tools: Muscle Strength Development Chair.

Performance Description: The patient sits on the chair and puts the appropriate weight and extends the leg forward full stretch.

Registration: Each experimenter is given two consecutive attempts the best one is counted.

The Designed Device

It is a rehabilitation device that works to reduce the impact of gravity by reducing the weight of the body as well as allowing the patient to move his hands and feet smoothly through the stationary bike.

The designed device consists of two main parts; the first part consists of an iron frame and the second part of the stationary bike.

A - First part Components

1-Iron structure: consisting of iron columns of different lengths and dimensions installed in the middle of the electric lifting device, which works to reduce the weight of the patient by raising it to the top.

The steel structure consists of 12 pieces of iron with a total weight of 50 kg and consists of an upper part consisting of a 120 cm long iron rod that is securely attached to the rest of the iron structure, and at a height of 250 cm, with a device installed in the middle called the electric lifting device.

2- Mechanical lifting device: It is an electric motor attached to a spin by a motor containing a metal rope connecting from the other end of a rotary pulley to reduce the impact of weight has the ability to bear an estimated weight of more than 100 kg and is installed on the top of the device with four screws, can be controlled Using the control points, and can be set to stop at a certain limit, reduces the percentage of weight by pulling the spring length and increase the spring tensile strength.

3-Belt suit worn by the casualty: A suit worn by the patient to reduce the proportion of body weight, and the belt is made of fabric and adhesive belts around the chest, abdomen and thighs and are subject to zoom out and
enlargement according to the measurement of the person and does not cause any obstruction in movement, which is an iron holder of Top for installation in electric lifting device.

4-Buttons control of the electric lift device: Buttons that control the reduction and lifting of the person with the required weight by controlling the electric lift motor and contains a safety point when any problem occurs in the device by disconnecting the power when you press this switch.

**B- Second part Components:**

Stationary bike: ChineseStationarybike type KNC has been transformed from a mechanical bicycle to electric, and the stationary bike contains a control panel through which the speed, distance and time meters are controlled with a variety of speed from the slowest to the fastest, as the speed is adjusted with the possibility of patient motor and quality Exercises used.

It also contains two moving levers from the top where the hands of the patient are fixed and the stationary bike to move hands and legs in one format, allowing them to move freely and this helps to restore the motor program stored in the brain, which was lost as a result of stroke.

Components of the whole machine:

1. Iron structure
2. Mechanical lifting device
3. Belt suit for lifting the patient
4. Electric lifting device control buttons
5. Stationary bike
6. Hand rests
7. Footstools
8. Electronic control screen for stationary bike
9. Rotating wheel
10. Transmission track
11. Rotating motor

**Research Steps:**

The researcher has implemented the research experiment according to the following steps:

**Main experience**

The basic search experience was applied individually on a case-by-case basis, which took 12 weeks. The researcher has taken into account during the application of stabilization conditions related to the tests as following:

1. Measurements were made for all sample members in one way
2. The researcher used the same measurement tools for all the sample members.
3. The measurement was done in the same order and in a uniform sequence
The proposed rehabilitation program was divided into three phases over the total duration of the three-months program, each stage lasts four weeks each week, which includes 5 rehabilitation units, each rehabilitation unit lasts 60 minutes. For a period of four weeks aimed to stimulating blood circulation - elasticity of the joints and not stiffness - stimulation of nerves and muscles (including stimulation exercises, functional rehabilitation, walking training, occupational therapy, passive and active mobilization with the help of the hand, wrist, hip and knee), either in the stage The second and third focused on the use of the device designed under the supervision of a physiotherapist, where the therapist initially took care to reduce the speed of the stationary bike until the victim gained a sense of comfort and fear and then began to increase the speed gradually every week until the maximum speed of the device (9 km / h).

**Pre measurements:** Pre-measurements and tests were conducted on a group of members of the experimental research sample consisting of (8) patients, at the specialized center for physical therapy and physical rehabilitation at Al-Kut Sports Club on Friday 21/12/2018.

**Post measurements:** The measurements and tests were carried out on the members of the research sample on Thursday 21/3/2019 in the same order of pre measurements and in the same circumstances and for each individual.

**Statistical treatments**

Arithmetic averages, Mediator. Standard deviations, Rate of improvement, T-test

4- Results and discussion

**Table (2) Computational Media, Standard Deviations, Calculated Value (T) and Significance Level between Pre and Intermediate Tests in Kinetic Equilibrium Variable**

<table>
<thead>
<tr>
<th>Statistical significance</th>
<th>pretest</th>
<th>Intermediate test</th>
<th>The difference between the two averages</th>
<th>(T) value</th>
<th>Rate of improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor balance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test the walk on the wooden parallel</td>
<td>66.875</td>
<td>3.516</td>
<td>53.88</td>
<td>2.368</td>
<td>12.995</td>
</tr>
<tr>
<td>Fixed balance test</td>
<td>3.25</td>
<td>0.97</td>
<td>13.38</td>
<td>1.11</td>
<td>10.13</td>
</tr>
</tbody>
</table>

Significant at 0.01

Table (2) clarifies the differences between the pre and intermediate measurement in (balance test) and the existence of differences between the two measurements at the level (0.01) and in favor of the average measurement, where the
value of (T) (13.26) and this value is greater than the value of (T) tabular at The level of (0.01) as the rate of improvement (24.13%).

Table (3) Computational Media, Standard Deviations, Calculated Value (T) and Significance Level between Intermediate and Dimensional Tests in Kinetic Equilibrium Variable

<table>
<thead>
<tr>
<th>Statistical significance</th>
<th>Intermediate test</th>
<th>post test</th>
<th>The difference between the two averages (T) value</th>
<th>Rate of improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor balance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test the walk on the wooden parallel</td>
<td>53.88</td>
<td>2.368</td>
<td>40.375</td>
<td>1.317</td>
</tr>
<tr>
<td>Fixed balance test</td>
<td>13.38</td>
<td>1.11</td>
<td>27.38</td>
<td>1.58</td>
</tr>
</tbody>
</table>

Significant at 0.01

Table (3) clarifies the differences between the intermediate measurement and the post measurement in (balance test) there are differences between the two measurements at level (0.01) for the post measurement, where the (T) value is (13.26) and this value is greater than the value of (T) tabular at The level of (0.01) as the rate of improvement (33.43%).

Table (4) Arithmetic Media, Standard Deviations, Calculated (T) Value and Significance Level between Pretest and post Tests in Kinetic Equilibrium Variable

<table>
<thead>
<tr>
<th>Statistical significance</th>
<th>pre test</th>
<th>posttest</th>
<th>The difference between the two averages (T) value</th>
<th>Rate of improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor balance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test the walk on the wooden parallel</td>
<td>66.875</td>
<td>3.516</td>
<td>40.375</td>
<td>1.317</td>
</tr>
<tr>
<td>Fixed balance test</td>
<td>3.25</td>
<td>0.97</td>
<td>27.38</td>
<td>1.58</td>
</tr>
</tbody>
</table>

Significant at 0.01

Table (4) clarifies the differences between pre-measurement and post measurement in (balance test) there are many differences between the two measurements at level (0.01) and for the post-measurement, where the value of (T) (18.66) and this value is greater than the value of (T) tabular at level (0.01) and the rate of improvement (65.62%).
Table (5) Computational Media, Standard Deviations, Calculated Value (T) and Significance Level between Pre and Medial Tests in Muscular Force Variable

<table>
<thead>
<tr>
<th>Statistical significance</th>
<th>pre test</th>
<th>Intermediate test</th>
<th>The difference between the two averages</th>
<th>T value</th>
<th>Rate of improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscular Force</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fist force</td>
<td>1.463</td>
<td>0.245</td>
<td>-3.51</td>
<td>17.6</td>
<td>70.68%</td>
</tr>
<tr>
<td>Medical thrust ball strength</td>
<td>1.6</td>
<td>0.235</td>
<td>-1.54</td>
<td>13.05</td>
<td>49%</td>
</tr>
<tr>
<td>The injured leg strength</td>
<td>2.3</td>
<td>0.187</td>
<td>-2.55</td>
<td>23.18</td>
<td>52.58%</td>
</tr>
</tbody>
</table>

Significant at 0.01

Table (5) clarifies the differences between the pre-measurement and the intermediate measurement in the (fist force test) there are differences between the two measurements at level (0.01) for the intermediate measurement, where (T) value is (17.6) and this value is greater than the value of (T) the level of improvement was (70.68%).

In the test of medical ball thrust there are differences between the two measurements at level (0.01) for the intermediate measurement, where (T) value is (13.05-) and this value is greater than (T) value at level (0.01) and the rate of improvement (49%).

In the test of the momentum of the injured leg, there are differences between the two measurements at level (0.01) for the intermediate measurement, where the value of (T) is (23.18) and this value is greater than the value of (T) tabular at the level (0.01) and the rate of improvement (52.58%).

Table (6) Arithmetic Media, Standard Deviations, Calculated Value (T) and Rate of Improvement between Intermediate and post- Tests in Muscular Force Variable

<table>
<thead>
<tr>
<th>Statistical significance</th>
<th>pre - test</th>
<th>posttest</th>
<th>The difference between the two averages</th>
<th>T value</th>
<th>Rate of improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscular Force</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fist force</td>
<td>4.975</td>
<td>0.468</td>
<td>8.875</td>
<td>0.349</td>
<td>13.5</td>
</tr>
<tr>
<td>Medical thrust ball strength</td>
<td>3.138</td>
<td>0.250</td>
<td>5.163</td>
<td>0.239</td>
<td>3.91</td>
</tr>
<tr>
<td>The injured leg strength</td>
<td>4.85</td>
<td>0.212</td>
<td>9.187</td>
<td>0.262</td>
<td>2.02</td>
</tr>
</tbody>
</table>

Significant at 0.01
Table (6) clarifies the differences between the pre-test and the post test in the (fist force test) there are differences between the two tests at level (0.01) for the benefit of the post test, where (T) value is (13.17) and this value is greater than the value of (T) tabular At level (0.01) the rate of improvement (33.43%).

In the test of the thrust of the medical ball there are differences between the two measurements at the level of (0.01) for the post measurement, where the value of (T) (17.77) and this value is greater than the value of (T) spreadsheet at the level (0.01) and the rate of improvement is (43.91%).

In the test of the momentum of the injured leg, there is a difference between the two measurements at level (0.01) and for the post measurement, where (T) value is (15.53) and this value is greater than the (T) value at level (0.01) and the rate of improvement (39.15%).

Table (7) Computational Media, Standard Deviations, Calculated Value (C) and Improvement Ratio between Pre-test and post Tests in Muscular Force Variable

<table>
<thead>
<tr>
<th>Muscular Force</th>
<th>Pre-test</th>
<th>Post test</th>
<th>The difference between the two averages</th>
<th>(T) value</th>
<th>Rate of improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fist force</td>
<td>1.463</td>
<td>0.245</td>
<td>8.875</td>
<td>0.349</td>
<td>7.42-</td>
</tr>
<tr>
<td>Medical thrust ball strength</td>
<td>1.6</td>
<td>0.235</td>
<td>5.163</td>
<td>0.239</td>
<td>3.56-</td>
</tr>
<tr>
<td>The injured leg strength</td>
<td>2.3</td>
<td>0.187</td>
<td>9.187</td>
<td>0.262</td>
<td>6.89-</td>
</tr>
</tbody>
</table>

Significant at 0.01

Table (7) clarifies the differences between pre and post-test at 0.01 level and the improvement rate is 83.56%

It is clear from Table (7) the differences between the pre-measurement and the post measurement in the (fist force test) there are differences between the two measurements at level (0.01) and for the post measurement, where the value of (T) (41.22) and this value is greater than the value of (T) tabular At level (0.01) and the rate of improvement (83.56%).

In the test of thrust of the medical ball there are differences between the two measurements at the level of (0.01) and in favor of the post test, where the value of (T) (10.41) and this value is greater than the value of (T) at level (0.01) and the rate of improvement is (68.99%).

In the test of the momentum of the injured leg, there is a difference between the two measurements at level of (0.01) for the post measurement, where the value of (T) (54.68) and this value is greater than the value of tabular (T) at level (0.01) and the rate of improvement is (74.97%).

Discuss the results of muscle strength

It is clear from the tables (5,6,7) between the averages of the three measurements (pre, middle and post) in the muscle strength variable of the research sample there are significant differences between the three measurements and for the benefit of the middle and post measurement in all measurements of muscle strength, which indicates the positive effect of the designed device, the researchers attribute this improvement to the use of the device to reduce the effect of stroke.
gravity and stationary bike with some rehabilitation exercises where this device worked to increase muscle strength and strengthen the connective tissues of both arms and legs.

The use of the designed device led to positive results in the development and improvement of muscle strength as quickly as possible due to the positive effects created by the use of this device in improving the muscle strength of the muscles of the upper and lower extremities and fist force as a result of improvement in the efficiency of the nervous system of muscles resulting from the exercises of the system and fixed balance exercises. And mobile are the two components of the proposed rehabilitation program.

This is due to the regulation of weight during the period of application of the rehabilitation program, which aims to develop maximum muscle strength, where the exercise of gradual resistance puts pressure on both bones and muscles, and the muscles respond by increasing the size and number of muscle fibers and improve blood and nervous nutrition of the muscle, which improves the efficiency. Their work while the bones respond by increasing protein and components, thus showing the significance of the regulated load intensity within the program to develop steady muscle strength in the treatment and rehabilitation of muscle weakness (7: 175).

Strength is one of the most important physical elements necessary for daily human movements where the ability of the muscles to resist fatigue depends on it is the pillar on which movement depends, as it is an important factor for the physically disabled to protect against injuries. Strong muscles enable the person to move quickly while avoiding collision and injury, and increase the stability of joints. The result is an unbalanced force in the muscle groups working on this joint. (5:14)

The results of motor balance fixed Discussions’

It is clear from tables (4,3,2) differences between the mean of the three measurements (pre, middle and post) in the dynamic and constant equilibrium variable of the research sample, there are statistically significant differences between the three measurements and for the favor of the middle and post measurement in all measurements of motor and constant equilibrium, which indicates the positive effect of the designed device, the researchers attribute this improvement to the positive reflection due to the use of gravity reduction device and stationary bike with some rehabilitation exercises where this device has worked to increase the static and mobile balance of the lower limbs.

This explains the improvement of the work on the stationary bike and the various equilibrium exercises used in the rehabilitation program had a positive effect on increasing the equilibrium time in the fixed equilibrium, and reducing the number of falls and walking properly and balanced in the moving balance, where these exercises play an important role in improving the sense Physical or kinesthetic sensation, which led to the improvement of deep sensory receptors in the joint and regain balance and increase the synergies and compatibility between the nervous and musculoskeletal systems, and this is agreed with Farrag Tawfiq (2007) that equilibrium exercises have a role in the development of neuromuscular compatibility to improve motor and functional stability and contribute to the rehabilitation of sports injuries. (6-74).

It is also because the balance of both types affect and are affected in each other improved one will lead to the improvement of the other. (8:86).

This is consistent with the results of Tayssir Nasr study (2003) that the provision of medical rehabilitation services helps the physically disabled to social adjustment and adaptation with increasing the ability to balance as
well as to be more willing to join the work, and recommends the need to continue to provide medical rehabilitation services for the disabled Kinetically to achieve social and professional compatibility. (2:15)

The conclusions of this study were consistent with several previous studies in which robots were used to rehabilitate stroke sufferers. The possibility equivalence of robotic and conventional interventions is suggested as well by a recent study by Reinkensmeyer et al. [17], who used robotic treatment in substitution of unassisted movement training of the paretic upper limb in a chronic-phase setting. In this activate, a computational model of motor plasticity in chronic stroke patients is presented (based on experimental evidence) that expect an exponential-like motor recovery driven by practice, regardless of range or speed of the practiced movement, suggesting that robotic and no robotic techniques can result in comparable improvement in movement ability after stroke. The same premise is supported by a recent multicenter RCT by Hesse et al. [16], who used robotic training of the upper limb with a mechanical arm trainer as an alternative to electrical stimulation of the paretic wrist extensors in subacute stroke patients. In this study, no statistically significant difference between groups was found in the primary outcome.

4-Conclusions

According to the aims and results of this study and within the limits of the research sample and characteristics and the results of statistical treatments and after the presentation and discussion of the results we reached to the following conclusions:

1- A significant improvement in the level of physical efficiency, especially in walking and the patient's ability to walk in a way similar to the normal walking.

2- The rehabilitation program has achieved substantial improvement in muscle strength of the muscles working on the hip, knee and ankle.

3- The rehabilitation program has achieved a substantial improvement in the muscular strength of the muscles of the arm working on the wrist joint.

4- Quickly start the implementation of the proposed rehabilitation program after consulting the doctor and before reaching the stage of muscular dystrophy and stiffness of the joint.

5- Attention to rehabilitation after physical therapy as the lack of attention to this aspect leads to a decrease in the physical efficiency of patients with paraplegia caused by stroke.

6- Conducting further studies in the rehabilitation of such cases from a psychological and social point of view due to their importance in the return of the individual to his normal pre-injury status after improved physical efficiency.

7- Using the designed device in all physiotherapy centers because of its great importance in the speed of rehabilitation of stroke sufferers and return to normal life as soon as possible.
### References

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<tr>
<td>3- Hamad Mustafa Fadl Mohamed</td>
<td>Study of morphophysiology changes associated with patients - paralysis resulting from stroke injury as a basis for the program of sports rehabilitation,&quot; Unpublished Master Thesis, Faculty of Physical Education, Tanta University, 2007</td>
</tr>
<tr>
<td>4- Zaki Mohamed Mohamed Hassan</td>
<td>The foundations and rules of health in the training of group games, Dar al-Kitab al-Hadith, Cairo, 2011</td>
</tr>
<tr>
<td>5- Fathi Ahmed Ibrahim Ismail</td>
<td>Scientific principles and foundations of physical exercise and sports performances, Dar Al Wafaa for the world of printing and publishing, Alexandria, 2007.</td>
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