



## THE EFFECT OF REHABILITATIVE EXERCISES USING INTERMITTENT HOT CURRENTS INSIDE THE WATER MEDIUM ON THE RANGE OF MOTION OF THE ANKLE JOINT FOR TEAM SPORTS ATHLETES

**Yasir Adnan Shakir, Prof. Dr. Aqeel Moslem, Abdulhussain, Assistant Prof. Dr. Nagham Salman Kareem**

College of Physical Education and Sport Sciences, Al-Muthanna University, Ministry of Higher Education and Scientific Research, Iraq

[Shakiryaseradnan@gmail.com](mailto:Shakiryaseradnan@gmail.com)

### **Abstract**

Injuries are considered one of the most important obstacles that prevent athletes from continuing their sports activities in a normal manner, and among these injuries is joint injury, as joint injury is one of the most common sports injuries because it is the axes on which parts of the human body rest and move.

Injury is one of the main problems facing the progress of sports levels and their transition from one level to another, where the lack of knowledge of a group of athletes and coaches about the causes of injuries and how to avoid their occurrence often leads players to make mistakes that may be skillful or tactical or lack of interest in preparing the body for the effort that occurs. It is the responsibility of the athlete, and injuries are not limited to the upper levels, but they include all levels, and the injury may occur in training or in the match. Ankle joint injuries are sprains, ruptures, which are the most common, and it is difficult to obtain (dislocation) due to the anatomical composition of the joint. Rehabilitation exercises work in the treatment and rehabilitation of sports injuries by removing cases of dysfunction in the affected part by taking care of weaknesses in some muscles and ligaments and developing and improving muscle strength and flexibility. The joint, the degree of neuromuscular compatibility, an increase in the rate of tissue healing, and the speed of getting rid of adhesions and cartilaginous calcifications that accumulate within the joint capsule.

### **Introduction**

The ankle joint is one of the important joints, which has a great responsibility in carrying the weight of the body and in the process of kinetic transmission from the feet to the torso and controlling the strength required for the motor performance. It is at the ends of the muscles that feed the nervous system with the necessary information to maintain balance. Sports injuries often occur during competitions and training and increase as the competition intensifies due to the pressures placed on the joint represented by ligaments and tendons, causing acute or chronic injuries to the joint.

Both Adel Abu Quraish Abdel-Maaboud (2001 AD) and Walid Hussein Hassan (2002 AD) confirm that "the sprain of the ankle joint occurs in a large way because the foot is considered the basic base on which the human body rests and provides it with movement. The percentage of the ankle joint being sprained is about 58% of the total Injuries to the joint, whether for

athletes or non-athletes, and 4 out of 5 cases of them involve the lateral ligament of the ankle joint. The foot is considered one of the most important components of the skeletal and muscular systems in the human body, as it is the basic base on which the body rests, and it also plays an effective role in the individual's performance of any motor activity, and as a result of the increased load placed on the skeleton of the foot, the weight of the body may put great pressure on the ankle joint Which leads to injuries to the ligaments of that joint, and sports injuries to the ankle joint occur commonly and repeatedly in various sports activities, and the presence of a relative deficiency in the movement of the ankle joint contributes to their occurrence. Therefore, there was a need to use modern means and new methods to treat injuries and rehabilitate them faster in order to return to sports activity. Recently, hydrotherapy, which is a method of physical therapy, has become widespread, and includes all external means. It is used for multiple purposes and in the treatment of many injuries and to remove Muscular contractions, and is used to strengthen the muscles, because it resists movement and helps to relax the muscles, and the importance of the research lies in the numbers of rehabilitative exercises and (hot water currents) and the water medium for ankle injury, which would work on rehabilitating the athlete from the injury that impedes the performance of his duties in the specialized sport, because these means are easy to perform, as they do not lead to pain or the risks of use as a result of excessive use because they are without weights. This is why they are motivated to practice by the injured athlete, in addition to the fact that they are new modern tools that stimulate the athlete's desire to use these modern means, which make him feel help, which reflects positively on the speed of response of the injured player.

### **Research problem**

Injury constitutes a barrier for athletes, as it becomes an obstacle in achieving performance or achievement in order to reach the higher levels. Through the continuous follow-up of the researcher and his work in the field of training and rehabilitation and his monitoring of the players, he noticed that many athletes in particular are exposed to this injury, for several reasons, including the players' lack of interest in a good warm-up. Before the start of training or matches, in addition to the lack of interest of some coaches in strengthening muscle groups only during the training period, without considering that the athlete's body consists of muscles, bones, joints, and tendons. Also, the lack of interest in warm-up and stretching exercises and neuromuscular compatibility exercises affects the performance of the players and exposes them to injury. On the other hand, the researcher finds that the complete lack of knowledge of the coaches and players in the fields of stadium injuries and sports medicine, and the lack of therapists, technicians, nurses and physiotherapists is what made the player pay the price for that. Most of the injured players resort to treatment through the advice of the coach or players with the same injury previously, or treatment methods by non-specialists, and they did not do rehabilitation in the correct and scientific way used by the developed teams in their work. Through the work of the researcher in this field (rehabilitation), he sees It is necessary to do rehabilitative exercises for the (injured) ankle joint in a new way by using (hot water currents, intermittent waves).

### **Research Aims**

The research aims to identify:

1. Preparing rehabilitative exercises using intermittent hot currents inside the water medium to improve the range of motion of the ankle joint.

2. To identify the effect of exercise and the use of intermittent hot currents within the water medium in improving the range of motion of the ankle joint after a sprain.

**Research hypotheses :**

The proposed rehabilitative exercises and the designed hot intermittent water currents had a positive effect on restoring the range of motion of the sprained ankle joint.

**Research areas.**

- The human field: Athletes with sprained ankle joint in individual games, their number is (6).
- Time range: From (4/15/2022) to (5/1/2023)
- The spatial field: Department of Youth and Sports - Al-Zahraa Sports Forum, Al-Hussein Teaching Hospital, Samawah Specialist Laboratory

**Research Methodology and Field Procedures:**

**Research Methodology:**

The study of the problem is what determines the correct approach that the researcher follows in reaching solutions to the research problem. Experimental "an approved or controlled change of the specific conditions of a case and the observation and interpretation of the resulting changes in the same case" (2) in the design of one group.

**Research community and sample:**

The researcher identified the research community, who are the players participating in the Iraqi league clubs for individual games, the category (applicants) for the sports season (2020\_2023), whose number is (4) players

Before starting work, the sample members were presented to a specialized doctor to ensure that they are safe from any disease\*. Then the researcher determined the type of injury and Table (1) shows that.

Table 1

| Ligament injured ankle |       | injured | Game type  | No |
|------------------------|-------|---------|------------|----|
| the left               | right |         |            |    |
| 1                      | 0     | 1       | wrestling  | 1  |
| 2                      | 1     | 3       | boxing     | 2  |
| 0                      | 2     | 2       | basketball | 3  |

**Tools, devices and methods used in the research:**

Research tools are the means by which the researcher can collect data and solve the problem to achieve the goals of the research, whatever those tools are like data, samples, devices, etc... (1)

Data collection methods

- 1- Arabic and foreign references and sources
- 2- Personal interviews\*
- 3- International Information Network (Internet)

- 4- A form for collecting information from the sample\*\*
- 5- Test forms used\*\*\*

Devices and tools:

- Goniometer device to measure the range of motion of the joint.
- Medical balance device to measure weight (kg).
- A metal tape to measure length (the unit of measurement is the meter and its parts).
- A digital electronic stop watch (1/100) of a second to measure the exercise time (made in China), one number
- The visual analogue scale (V.A.S) to measure the intensity of pain (cm)\*\*\*\*
- Medical syringes (5 ml).
- A square water basin with a depth of 2 m and a diameter of 5 m
- German water pumps
- Pipes to drive water currents
- A device for measuring water pressure of German origin
- Thermometer to measure water temperature originating in China
- 3tds device - a device for measuring the quality of water and dissolved substances
- A special form to record the injured person's data
- Colored tapes
- Swedish seats
- Oscillating plate
- mattresses
- cones
- stopwatch
- Ground ladder

**Measurements used in the research: tests, 4-3**

**Determination of physical and biochemical variables:**

For the purpose of identifying the most important physical and biochemical variables and their tests, the researcher prepared the first forms that included a test and its tests, as shown in the appendix.

First: Measuring the range of motion of the ankle joint: The researcher used the gnomometer to measure the range of motion of the ankle joint during the movements of fist, extension, inward rotation (pronation) and outward rotation (pronation).



The researcher used the gnomometer to measure the range of motion of the ankle joint during the movements of grasping, extension, inward rotation (pronation) and outward rotation

(pronation).

Measurement of the gripping and extension movements of the ankle joint:

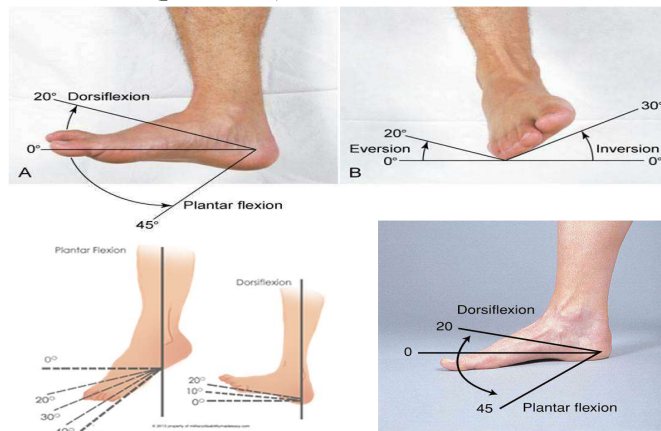
The injured player takes a sitting position lengthwise on the ground, and a goniometer is installed next to the thumb downward to the heel at an angle of 90 degrees.

The injured player grips the foot as far as possible, and the difference between the reading of the device takes place between the angle of 90 degrees and the angle of the maximum grip of the ankle joint.

The injured player extends the foot as far as possible, and the reading difference is taken between the angle of 90 degrees and the angle of maximum extension of the joint.

The measurement is repeated three times to choose the best measurement.

Measurement of the outward (pronation) and inward rotation of the ankle joint:



- The goniometer is installed from the sitting position along the outside of the thumb and foot.
- The injured person rotates his foot outwards (pronation) and the reading difference is taken between the angle of 90 degrees and the angle of rotation.

The exploratory experiment The exploratory experiment is a practical training for the researcher to find out for himself the negatives and positives that he encounters during the test in order to avoid them. (1)

The most important thing that scientific research experts recommend for the purpose of obtaining accurate and reliable results is to conduct an exploratory experiment, which is defined as "a preliminary experimental study conducted by the researcher on a small sample, the aim of which is to choose research methods and tools (2) The researcher conducted more than one exploratory experiment Each of them has a specific purpose, as follows:

### 1- The first reconnaissance experiment

The researcher conducted the first exploratory experiment on 7/1/2022 on two injured athletes from outside the research sample. The aim of this experiment is as follows:

- The researcher conducted the first exploratory experiment to learn how to use water currents and other auxiliary tools inside the water basins, and to introduce the assistant work team to the nature of the work and other obstacles that the researcher might encounter.

- The researcher conducted rehabilitative water exercises designed to treat an ankle injury of the second degree for athletes, and their suitability for the research sample, and to ensure the safety of the devices and tools used with the rehabilitative water currents, and to stand on the accuracy of the procedures and to know the extent of their suitability and the readiness of the injured

### **The scientific basis for the tests**

#### **First: honesty**

The validity of the test is “the ability of the test to measure the characteristic that was developed for its measurement, as it is not permissible to apply any test for any scientific purpose unless there is sufficient evidence of its validity, otherwise the results of scientific research are subject to doubt, so the validity of the test is considered the most important condition for its use” (1).

Therefore, the researcher used two types of validity, as he used content validity (content) by taking the opinion of experts in determining the candidate tests, as the validity of the content is defined as “measuring the extent to which the test represents aspects of the measured aspect of its research and logically analyzing the test materials and its elements to determine the functions and aspects represented in it and attributing each of them to the entire test” (2), and subjective validity Extracted from the square root of the stability coefficients.

#### **Secondly, stability**

The stability of the test is “the extent of accuracy, perfection, or consistency with which the test measures the phenomenon for which it was developed” (3), and because there are three ways to find the stability of the test, the researcher used the best method, which is the application of the test and the re-application of the test, as Nizar Al-Talib and Kamel Al-Wis confirm that the fixed test is A test that gives the same result if given more than once to the same sample and under the same conditions.

Where the researcher applied the tests on the sample of the exploratory experiment and re-applied the tests again on the same sample on Monday corresponding to 7/7/2022, that is, after six days, in the closed pool of the Youth and Sports Forum, and by processing the results statistically and using Pearson’s simple law to find a significant correlation between the two applications It appeared that all the tests are significant, that is, the tests are of high stability.

#### **Third, objectivity**

The objectivity of the test is “the extent of clarity of the instructions for applying the tests and calculating the scores” (3) and also means “the assessors do not differ in judging something or a specific topic” (4), and the fact that all tests depend on muscular strength, motor range and biochemical variables. The use of validity and reliability, so the tests are highly objective.

### **Field experiment procedures**

#### **Pre-tests**

Pre-tests were conducted for the research sample on Monday, 1/8/2022 at exactly three o'clock in the afternoon, by conducting measurements before the program on the research

sample over a period of two days:

The first day: drawing a blood sample from the injured (4) and before the rehabilitation program, in the Samawah specialized laboratory, as samples are taken from the forearm area from venous blood from sitting (EDTA). The sequence of the injured, with the help of a chemist specialized in this field, provided that all temporal and spatial conditions are fixed to standardize them and avoid any error.

The second day: The researcher made special measurements of the weight of each injured person, then his height, and fixed that data, and then tests related to the range of motion of the ankle joints, as well as muscle strength tests. After that, the researcher explained how to perform the rehabilitation exercises associated with the water currents, so that the injured person is fully aware of the nature of rehabilitation.

### **Prepared qualifying curriculum:**

Correct testing and strict rationing of rehabilitative exercises are effective means of rehabilitation, as rehabilitative exercises are considered one of the best means to raise the efficiency of the work of the vital organs of the athlete, which helps to return to the normal state, and the rules that guarantee the desired benefits of rehabilitative exercises must be followed:

1. The following rules must be observed in performing the exercises.
2. One patient from each group begins to perform the rehabilitation exercises associated with the (intermittent) hot currents.
3. Performing all movements and exercise positions calmly and smoothly, and not resorting to excessive systolic movements or fast timing.
4. The performance is accompanied by leaning on the edge of the basin or sitting.
5. The number of repetitions of each exercise must be gradual.
6. Start with the water currents with a slight pressure, then gradually move up until the patient feels completely comfortable
7. Give a positive rest after performing all the exercises, and rest is by walking.
8. It is preferable to start the rehabilitation exercises by walking in the water
9. Taking into account the sequence in performing the exercises, i.e. from easy to difficult.
10. The (hot) water currents accompany the rehabilitative exercises
11. Rehabilitation exercises start at 5 pm
12. The repetitions in each exercise (5)
13. Rest time between groups (30 seconds)
14. Unity time each day (12\_15 minutes)
  
15. The duration of the qualifying curriculum is 8 weeks.
16. Number of total qualifying units (24) training units.
17. The number of rehabilitation units per week is three rehabilitation units.
18. Rehabilitation days per week, Sunday, Tuesday, Thursday.
19. Rehabilitation unit time (10-20 minutes).
20. The curriculum included appropriate repetitions for the severity of the injury.

The curriculum prepared by the researcher was applied to the sample on Tuesday, 4/8/2022

at three o'clock in the afternoon, and the exercises used in the curriculum were in the form of different and varied exercises inside the water with hot water currents accompanying each exercise performed by the injured

It includes (6) exercises for each rehabilitation unit, which includes a group of exercises for the muscle groups and ligaments surrounding the joint, as the rehabilitation exercises for the first and second weeks contain fixed exercises and the gradation was from easy to difficult, as the exercises in the first and second weeks do not use large resistances, while the third week is the fourth and fifth It includes exercises using currents of different resistances and degrees higher than the previous two weeks,

Inside the water for purposes, and the curriculum was graded according to the capabilities and endurance of the injured until the pain appears. The prepared and designed curriculum depends on muscle strength exercises, stretching, flexibility, and flexion and stretching exercises for the injured ankle using higher resistances (hot water currents) from the first and second weeks.

**Post-tests:**

The researcher conducted the post-tests on the research sample on Monday // 2022 at five o'clock in the afternoon, after applying the qualifying program of 24 qualifying units in the Youth and Sports Forum and the Samawah Specialist Laboratory, in order to determine the effect of the prepared exercises in the same conditions in which the pre-tests were conducted as follows:

The second day: Examination of the range of motion of the ankle joint.

Statistical means The researcher will use the statistical bag (spss).

1. Arithmetic mean
2. Standard deviation
3. t-value

**Presentation, analysis and discussion of results**

Presenting the results of the pre and post tests for the first experimental group sample

Presenting the results of the pre and post tests in the motor range of the sample of the first experimental group

Table (4) The arithmetic mean, standard deviations, (t) value, and the significance of the differences between the pre and post tests for the sample of the first experimental group in the motor range.

| Statistical significance | significance level | T Value | Post-test |        | Pretest |        | measruing unit | variants       |
|--------------------------|--------------------|---------|-----------|--------|---------|--------|----------------|----------------|
|                          |                    |         | p         | s      | p       | s      |                |                |
| moral                    | 0.013              | 5,377   | 0.506     | 25,575 | 2,630   | 18,250 | degree         | inversion      |
| moral                    | 0.013              | 5,286   | 0.603     | 15,650 | 2,696   | 8,025  | degree         | flipping out   |
| moral                    | 0.013              | 5,297   | 0.568     | 15,675 | 2,647   | 8,075  | degree         | Dorsal flexion |



|       |       |       |           |            |           |            |        |                    |
|-------|-------|-------|-----------|------------|-----------|------------|--------|--------------------|
| moral | 0.004 | 7,946 | 0.95<br>7 | 41,25<br>0 | 2,42<br>3 | 29,02<br>5 | degree | plantar<br>flexion |
|-------|-------|-------|-----------|------------|-----------|------------|--------|--------------------|

Table (4) shows that the significance level of the (t) test for correlated samples was less than the error percentage (0.05), and this means that there are significant differences between the pre and post tests for all motor range variables and in favor of the post test.

### Discuss the results

It turns out that the level of development has appeared to the sample members who used the intermittent current, and the researcher explains the reason for this because the water currents have advantages that differ from other methods in providing gradient resistances, in addition to that they have the possibility of increasing the resistance by varying the amount of water paid during the rehabilitation unit, and this provides gradual resistances on The length of the movement path was then reflected in increasing the force in two directions, the first (muscular) by increasing the cross-section as a result of the resistances it generates, and the second (nervous) by providing nerve impulses for the crisis to work that leads to strengthening the joint ligaments, in addition to that the water is in the form of intermittent batches, which helps to stimulate The blood circulation is good, which improves blood flow to the affected area and brings oxygen to the damaged tissues, which helps to start the rehabilitation process in the right way, and the flow of water to the injured part in the form of batches gives time for the injured part to resist the water current and reduce pressure on the joint.

### Conclusions and recommendations

#### conclusions

Based on the results obtained by the researcher through the application of rehabilitative exercises that he prepared on the affected research sample and through statistical treatments and within the limits of the study, the researcher reached the following conclusions:

- 1- The rehabilitative exercises inside the water medium prepared by the researcher using (intermittent hot water currents) had a positive effect, as it contributed to relieving pain, removing swelling, and improving the ankle joint injury of the research sample.
- 2- Rehabilitation exercises by the researcher in the water medium and (intermittent hot water currents) using different times have a positive effect in developing and improving the range of motion for players with ankle joint injury.
- 3- The rehabilitative exercises prepared by the researcher contributed to reducing the rehabilitation period for players with ankle joint injuries and ensuring their speedy return to their normal lives that they had before the injury occurred.

#### Recommendations

According to the conclusions and in the light of the methodology used, the research sample, the data collection tools and the statistical treatments used, the researcher

recommends:

- 1- The use of intermittent hot water currents within the aqueous environment for all sports injuries.
- 2- The need to provide the aquatic medium and include it in many rehabilitation programs that require that, and to take advantage of the hot water currents to achieve the required rehabilitation goals.
- 3- The therapist and rehabilitation specialist must follow the injured person while performing the rehabilitation exercises and not let the injured person perform the exercises by himself.
- 4- Ensure complete recovery before returning to the stadiums to avoid recurring injuries.
- 5- Preparing rehabilitative exercises inside the aquatic medium for other various injuries in the important joints in the body in particular.
- 6- Emphasis on rest periods for the purpose of prevention and prevention of recurrence of injury and diversification in choosing exercises for flexibility, balance, strength and speed.

## References

- 1- Adel Abu Quraish Abdel-Maaboud; The effect of a rehabilitative program designed on the sprained foot joint of some team sports players. (Unpublished master's thesis, Faculty of Physical Education for Boys, Helwan University, 2001), p.4.
- 2- Walid Hussein Hassan; Effect of an exercise program designed to prevent some ankle injuries in soccer players. (Unpublished master's thesis, Faculty of Physical Education for Boys, Minia University, 2002), p.5
- 3- Zainab Abdel-Hamid Al-Alam: Massage and Sports Injuries, 5th edition, Cairo, Dar Al-Fikr Al-Arabi, 1998, p. 79.
- 4- Mezan, S. O., Jabbar, A. H., Hamzah, M. Q., Tuama, A. N., Hasan, N. N., Roslan, M. S., & Agam, M. A. (2019, August). Synthesis, characterization, and properties of polystyrene/SiO<sub>2</sub> nanocomposite via sol-gel process. In AIP Conference Proceedings (Vol. 2151, No. 1, p. 020034).
- 5- Abdullah Hasan Jabbar, Maytham Qabel Hamzah, Salim Oudah Mezan, Amira Saryati Binti Ameruddin, Mohd Arif Agam, "Green Synthesis of Silver/ Polystyrene Nano Composite (Ag/ PS NCs ) via Plant Extracts Beginning a New Era in Drug Delivery," Indian J. Sci. Technol., vol. 11, no. 22 June, pp. 1–9, 2018.
- 6- Bazar Ali Jokl: Principles and Fundamentals of Sports Medicine, 2nd edition, Amman, Dar Dijla for Publishing, 2009, p. 85.
- 7- [HTTP: // TRANSLATE .GOOGLE .IQ/TRANSLATE ?HL = AR & LANGPAIR = EN % 7CAR&U = HTTP: // EN.WIKIPEDIA.ORG/WIKI/FLEXIBILITY\\_\(ANATOMY](http://TRANSLATE.GOOGLE.IQ/TRANSLATE?HL=AR&LANGPAIR=EN%7CAR&U=HTTP://EN.WIKIPEDIA.ORG/WIKI/FLEXIBILITY_(ANATOMY)
- 8- <http://WWW.ALGERIENHANDICAP.COM/T937-TOPIC>.
- 9- <HTTP://FORUM.BRG8.COM/T8746.HTML>.

10- ABBOTT H.G. AND KRESS G. ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION, NEW YORK UNIVERSITY , 1969, p.332

11- DOROTHYE. , MARJORRIEK; PROPRIOCEPTIVE NEUROMUSEULAR COPY RIGHT. CO, 3rd , 1985, p.9.

**supplements**

| total time | current used | Rest between groups | totals | Rest between repetitions | Repetition | The time of performing the exercise or stability | exercise number |
|------------|--------------|---------------------|--------|--------------------------|------------|--|-----------------|
| s 390      | ---          | sec 90              | 2      | 6:1                      | 3          | 10s  | 1               |
| 390s       | ---          | sec 90              | 2      | 6:1                      | 3          | sec 10   | 2               |
| s 390      | ---          | sec 90              | 2      | 6:1                      | 3          | 10s  | 6               |
| 390s       | ---          | 90s                 | 2      | 6:1                      | 3          | 10s  | 12              |
| s 390      | ---          | 90s                 | 2      | 6:1                      | 3          | 10s  | 10              |

From a standing position, the leg is extended, the leg is raised to the top.

