THE ROLE OF GROWTH FACTOR IGF1 AND CD34+ STEM CELLS ON BIOMECHANICS IN THE SPEED OF HEALING OF A MINOR MUSCLE INJURY FOR VOLLEYBALL PLAYERS

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ABSTRACT

Growth factor IGF1 is a hormone secreted by the liver in response to the effect of growth hormone secreted by the pituitary gland. The purpose of this study is to determine the effect of the growth factor IGF1 in the speedy recovery of mild muscle injury in Volleyball Players and Reveal the role of aerobic and anaerobic training programs on CD34+ stem cells and chosen physiological variables. The researchers select the research sample by the deliberate method from muscle-injured patients of the simple degree of volleyball players, as the age, height, and weight are measured to equal the two study groups. The mean age is 22.4 years while the training age is 9.11 years. which indicates the existence of significant differences between the pre and post measurements of the balance level in favor of the post-measurement, level of muscle strength, and level of the range of motion in favor of the post-measurement. Conclusions: The proposed rehabilitative exercise program has shown high efficiency in restoring the normal functions of the affected joint. Growth factor hormone (IGF1) has an effective role in the speedy healing of muscle injury, as it increases from its normal rates during the injury and returns to its normal state after recovery from the injury also as stem cells. CD34+ SC counts were increased in peripheral blood injured muscle compared to control due to stress; it indicated better adaptation to exercise and modulation of bone marrow activity to rehabilitative training.

Key Words: Growth, IGF1, CD34+, Stem Cells, Volleyball, Muscle Injury and Speed of Healing

Significance for public health

The study aims to determine the effect of the growth factor IGF1 in the speedy recovery of mild muscle injury in Volleyball Players and Reveal the role of rehabilitative training programs on CD34+ stem cells and chosen physiological variables. age, height, and weight are measured to equal the two study groups. The main test for determining the hormone under investigation, range of motion tests under investigation, and strength tests under consideration.

I. INTRODUCTION:

Skeletal muscle is a complex tissue that is subjected to the will and control of man, as it moves it according to his desire and will and is connected to the skeleton such as the trunk, limbs, and spine, and among the most important characteristics of these muscles is the speed of contraction and extension and the ability to move with self-will without external stimulation. (1). They add that the injury is damage to the locomotor system (muscles and bones) and impedes the dynamic development of the athlete and prevents his continuation in sports participation and that traumatology is related to other sciences such as physiology, biochemistry, kinesiology, biomechanics, anatomy, and the role of biomechanics is important in knowing the mechanism of injury occurrence, to work. To choose the most appropriate means to deal with the affected part, so that the diagnosis and treatment are based on facts through which the period of treatment and rehabilitation can be reduced. growth factor IGF1 is a hormone secreted by the liver in response to the effect of growth hormone secreted by the pituitary gland. Growth hormone affects metabolism by increasing the breakdown of fats and increasing fatty acids in the blood, while IGF1 increases growth-related effects such as increased cell division and increased cell growth. Protein production as well as
greater growth increase, meaning that IGF1 is concerned with the healing of muscle injuries and the role of growth hormone for metabolism only. (2)

Pasanen and others (2008) indicate that the growth factor IGF1 plays a fundamental role in wound healing and tissue repair, and that the use of this hormone helps to speed up the healing of muscle injuries when used alone or with growth hormone, and that its use only does not have an effect. It is effective in healing and repairing muscle tissue. (3).

Doral and others (2011), as well as Saad. (2002) confirm the role of effective growth factors in treating muscle injuries. (4). Through its action on adult stem cells, exercise may act on the regenerative potential of tissues by altering the ability to generate new stem cells and differentiated cells that can carry out tissue-specific functions (Al-Rawi 2012) (1). Strength and power are important aspects of fitness, sport, and everyday activity. However, much debate remains as to how these qualities should be evaluated. Much of the debate originates from the definition of strength and power as well as the different terminology used across laboratories. it defined strength as the force exerted under a given set of conditions during a maximal voluntary contraction (MVC).(1)

There is no straightforward definition of an EPC marker because these cells seem to be a heterogeneous group associated with different cell surface antigen expression profiles. The most commonly described molecules that serve as biomarkers for recognition of an EPC population include CD34+, CD133, and VEGFR2. The pioneering study of Al-Rawi. (2012) (1) recognized EPCs as mononuclear cells (MNCs). (1)

Human CD133 antigen is a membrane glycoprotein of which expression is related to hematopoietic stem cell differentiation into EPCs (Mellor et al. 2011). (5) The third marker proposed for EPC identification is VEGFR2, a protein predominantly expressed on the endothelial cell surface. Urbich and Dimmeler (2004) and Birn et al. (2005) claimed that EPCs were positive for CD34+, CD133, and VEGFR2 markers. (6)

CD34+ cells are multipotent progenitors that can engraft in several tissues (Freeman, 1965) (4), circulating CD34+ cells can be used to indirectly estimate hematopoiesis based on CD38, human leukocyte antigen (HLA), and CD33 markers. (4)

Sports injuries are considered one of the most important obstacles to accessing sports achievement and higher levels of sports. Therefore, injuries have become the main focus of attention for sports medicine men and physical education scientists to try to reach a system, whether in terms of preventive or therapeutic for all injuries problems. (5)

II. RESEARCH AIMS:

To determine:

1. The role of the growth factor IGF1 gene in the speedy recovery of mild muscle injury in Volleyball Players.
2. Reveal the role of rehabilitation training programs on CD34+ stem cells and chosen physiological variables.
3. The role of biomechanics in tracking the speed of recovery of a simple muscle injury in Volleyball Players.

Study Questions:

1. Does the growth factor IGF1 have a role in the speedy healing of mild muscle injury in Volleyball Players?
2. Do the CD34+ stem cells give better adaptation to exercise on rehabilitation training programs.
3. What is the role of biomechanics in tracking the speed of recovery of a simple muscle injury in Volleyball Players?

Definition of some terms:

Functional instability:
The individual's feeling that both or one of his feet is bent or bent with the inability to prevent it from tilting. (6)
Sports injury:
Damage to the motor system (muscles, joints, and bones) impedes the dynamic development of an athlete and prevents him from continuing to participate in sports. (6)

Cell Biology:
It is a scientific laboratory method for studying the exact cellular structure of the nucleus. (2)

Sports Qualification:
Restoring or maintaining the lost function of the affected part, so that the injured person can easily and conveniently perform his daily needs. (2)

Gene Therapy:
A modern method in treating sports injuries and diseases by using specific genes, such as the use of growth genes to treat damaged tissues. (7)

DNA:
A double tape containing the genes, which contains the genetic information. (7)

Genes:
It is a set of DNA duplicates of four letters A T C G and a gene is carried on a chromosome. (7)

Muscle Contraction:
It is a contraction of the skeletal muscles accompanied by pain, and this contraction cannot be controlled voluntarily. (8)

The Pain:
It is an external emotional sensation that leads to an injury in the human body or the feeling of an injury and is usually accompanied by psychological emotions. (9)

III. METHODOLOGY OF THIS STUDY:
In this study there are 20 participated players are grouped into two groups:

1. Control group: contain 10 players
2. Experimental group: contain 10 players use IGF1 and CD34+ stem cell.

The results explained:
1. Using IGF1 alone (100 mcg / k) twice increases protein metabolism, and IGF1 with prednisone helps improve glucose metabolism.
2. It is concluded that IGF1 could help treat protein degradation in humans.
3. CD34+ cells are multipotent progenitors that can engraft in several tissues, circulating CD34+ cells can be used to indirectly estimate hematopoiesis based on CD38, human leukocyte antigen, and CD33 markers.

Research Procedures:
1- Research Method:
The researchers use the descriptive approach to suit the nature of the study.

2- Research sample:
The researchers select the research sample by the deliberate method from muscle-injured patients of the simple degree of volleyball players for 10 injuries from one group, and also uses a group of 10 non-injured Volleyball Players a control group, as the age, height, and weight are measured to equal the two study groups.
• **The Human Being Field of Research:**

The injured group of Volleyball Players, as well as the control group of the current Volleyball Players, are using minor muscle injuries.

• **Pre-analogy:**
  - IGF1 is measured in patients with a mild muscle injury.
  - IGF1 and CD34+ for both groups.
  - Measuring muscle strength in dynamometers for the control group.
  - Biomechanical measurements of the two study groups.
  - Physiotherapy operations are carried out in a private hospital under the supervision of a specialist doctor who supervises all affected cases, and rehabilitation processes include:
    1. Use of special ointments.
    2. Rehabilitation devices (infrared radiation) and ultrasound.
    3. Suitable massage for cases.

• **Post Measurements:**

After reaching the normal conditions and the disappearance of the injuries, telemetry measurements of hormone concentration and biomechanical measurements are made in addition to measuring muscle strength with a dynamometer.

• **Study Tools and Devices:**
  - The Rasta meter device.
  - Weight sensitive scale.
  - 5 cm syringes, tubes, and a special cap beside EDTA anti-clotting.
  - Measurement of the hormone IGF1 and CD34+ by the method of Eliza and flow cytometer
  - PCR devices for genetic diversity.
  - Special devices for biomechanics.
  - Dynamometer.

• **Statistical processors:**

The nature of the research requires a comparison between Pre- and post-measurement to study the significant differences and study the variance between research groups. The statistical treatment included:
  - SMA.
  - Standard deviation.
  - Analysis of variance.

• **The Research Sample:**

The researcher chose his target date for the research, using the deliberate method, to straighten the sprain of the leg of the foot in the simple degree of the player of the Volleyball for a number of 20 players. Show the results of the sample in the age, height, weight, training age, degree of injury, degree of affected extremity (left - left), for the parity of the study group and the challenge of the severity of the injury and the location of the injury.

Table (1) shows that the mean age is 22.4 years while training age is 9.11 years, in case of the mean of height and weight is (174.1 and 72.53) respectively and BMI is 22 kg/m2. it is evident that the time of the distortion coefficients as measured by the results of two (± 3), where the value of the twisting coefficients is respectively (-0.8, 0.85, -0.11, 0.29, and 0.56), which is indicative of the circumcision of the subjects of the sample age, height, weight, BMI, and training age.
The tests used in the research:

Growth rate measures:
- refer to the dates of birth as soon as possible through the list of club records and certificates of birth of players.
- Weight: using a medical scale to the nearest 1/2 kilogram.
- Height: using the record holder to close to 1/2 cm.
- Training period: go back to the beginning of the flying game practice through the club records.

Balance test (the metatarsal test):
- The laboratory withdraws pre-post blood from each injured player.

Muscle strength test:

a) the extensor muscles of the ankle joint:
b) the flexors of the ankle joint:
c) the inward flexor muscles of the ankle joint
d) the outside flexor muscles of the ankle joint

The kinematic range test:

Extension and flexion

the exploratory study:

An exploratory study was conducted on a sample of (3) players (two players) who were outside of the research sample (who were injured by a rupture of the outside of the abrasion joint), and the special conditions were applied. Matching with the original research sample to determine the following:

- Determine the measuring devices and tools used.
- Determine the anthropometric and physical measurements of the proposed program under discussion.
- Determine the method for analyzing the hormone IGF 1 and CD34+.
- Determine the actual time taken to implement the proposed program.
- Determine the location of the program implementation.
- Designing the measurements registration form.

The Basic Study:
The researcher conducted the basic research experiment as follows:

A- Pre-measurements:
- Pre-examination is performed on a research sample to measure the muscle strength of the ankle joint, as well as the range of motion of the ankle joint.
- The blood sample was withdrawn from the players and the plasma was separated in the laboratories and saved.

B- Basic Experiment:
The basic experiment has been applied to the research to confirm the researcher's complete confidence in the application of therapeutic exercise on his research sample for (30) days and during the application of the program on the sample of the research. The basis for determining the number of training units and their timing for therapeutic exercises for all players.

IV. PROGRAM GOALS:

Among the defective recognition of the importance of rehabilitating exercises and expert opinion polls (attached 5), a specialist in the field of specialization and physical therapy, the qualifying program is considered who has completed blocks of a stage that takes a week and the total period required for the implementation of the program is three weeks in addition to the week of training with the team. Each stage contains specific rehabilitative exercises to suit the stage the injury is going through.
The aim of the therapeutic program is as follows:

- Reducing the occurrence of weakness or atrophy in the muscles surrounding the affected joint.
- Reducing spills and blood pools around the affected joint.
- Reducing inflammation and swelling resulting from the injury.
- Developing and improving the range of motion until reaching the normal range.
- Early protection of the muscles involved in the ankle joint.
- Developing and improving the balance component until reaching the normal rate.
- The development and improvement of the muscle strength component until it reaches the normal range.
- There is a sense of the multiplicity of the affected party in a special way, which is in general terms for the return stage of training and competitions.
- Attention to raising the level of physical fitness in general.

V. THE PROPOSED PROGRAM:

1- The first stage:
The duration of the first stage (a week) was implemented by the exercises attached to the schedule daily, for the joint, as mentioned by the physiotherapist.

Conditions to be followed when implementing the program:

- Warm-up well before applying the training module.
- Performing stretching and flexibility exercises for all muscles and joints of the body.
- Adequate explanation of each exercise and interest in applying the proper rules of performance during the implementation of each exercise.
- Training the muscles of the healthy member during the resting.
- Performing exercises, the range of motion until the limits of pain so that complications do not occur.
- Do not continuing exercise if you feel pain or fatigue.

2- The second stage:
The duration of the second phase (one week) by doing the exercises attached to the schedule daily.

3- The third stage:
The proposed period (one week) during which during this phase the proposed exercises will be implemented within the rehabilitation program (attached 6).

Laboratory Procedures:

- Samples were taken from the players, whether in the stadium or the laboratory, according to the conditions of injury.
- Separation of the blood for the components of the equipment that is not destroyed in the parameters of the centrifuge (3000) turns / minute for (10) minutes.
- Serum samples should be placed at (-20) C until analysis within 30 days.
- Hormone measurement (IGF 1) using the ELISA system.
- CD34+ measurement using the flow cytometer system
- All variables were at the lab.

VI. POST MEASUREMENTS:
The researcher performed the post measurements on the sample of the basic research sample in all the variables of the search results, such as age - height - weight. He also measured the balance of the subjects of the research sample in the post-measurement only.

Statistical Analysis:
The researcher used the statistical program package for the social and human sciences (SPSS).

Presentation and discussion of results:
First: Presentation of results:

Presentation of the results of the first hypothesis:

The tabular (z) value at the level of statistical significance (0.05) equals 20

It is clear from Table (2) for the significance of the statistical differences of the Wilcoxon test for the sample under investigation between the pre and post measurements of the equilibrium level, that the value of (z) computed from the Wilcoxon test all of it is less than the tabular (z) value of (20) at the level of statistical significance (0.05), While the level of significance is less than the value of (5%), which indicates the existence of significant differences between the pre and post measurements of the balance level in favor of the post measurement.

For strength tests under consideration

The tabular (z) value at the level of statistical significance (0.05) equals 20

It is clear from Table (3) for the significance of the statistical differences of the Wilcoxon test for the sample under investigation between the pre and post measurements of the level of muscle strength, that the value of (z) computed from the Wilcoxon test all of which is less than the tabular (z) value of (20) at the level of statistical significance (0.05). While the level of significance is less than the value of (5%), which indicates the existence of significant differences between the pre and post measurements of the level of muscle strength in favor of the post measurement.

For a range of motion tests under investigation

The tabular (z) value at the level of statistical significance (0.05) equals 20

It is clear from Table (4) for the significance of the statistical differences of the Wilcoxon test for the sample under investigation between the pre and post measurements of the level of the motion range, that the value of (z) computed from the Wilcoxon test is all less than the tabular (z) value of (20) at the level of statistical significance (0.05). While the level of significance is less than the value of (5%), which indicates the existence of significant differences between the pre and post measurements of the level of the range of motion in favor of the post measurement.

For the hormone and CD34+ under investigation

The tabular (z) value at the level of statistical significance (0.05) equals 20

It is clear from Table (5) for the significance of the statistical differences of the Wilcoxon test for the sample under investigation between the pre and post measurements of the growth factor hormone level, that the value of (z) computed from the Wilcoxon test is less than the tabular value of (z) of (20) at a significant level A statistic (0.05), while the level of significance is less than the value of (5%), which indicates the existence of significant differences between the pre and post measurements of the IGF hormone level and CD34+ in favor of the pre measurement.

Presentation of the results of the second hypothesis:

It is evident from the results of Table (6) the interconnection matrix between the growth factor hormone and the speed of injury healing that there are (37) correlation factors, which are as follows: The test for the elbow of the injured foot (3) is a negative correlation coefficient at the level of significance (0.05) and the number (2) A non-significant negative correlation coefficient, while there are (2) a non-significant positive correlation coefficient, while there are (1) a positive significant correlation coefficient at a level of statistical significance (0.05), and (2) a non-significant negative correlation coefficient, while there are Number (3) non-significant positive correlation coefficient for testing grip of the injured foot, and there are (1) positive correlation coefficient at a level of statistical significance (0.05) and (2) negative correlation coefficient that is not significant, while there are (3) correlation coefficient A positive non-significant bending of the injured foot inwardly, while there are (1) a negative correlation coefficient at a level of statistical significance (0.05), and a number (2) a non-significant negative correlation coefficient, while there are (1) a non-significant positive correlation coefficient for the test. Bending the affected foot outward, while there are (1) negative significant correlation coefficient at a statistical significance level (0.05), and (2) negative non-significant correlation coefficient to test the grip of the injured foot While there are (1) positive significant correlation coefficient at the level of statistical significance (0.05), and (1) non-significant positive
correlation coefficient for the testing grip of the injured foot, while there are (1) positive significant correlation coefficient at the level of statistical significance (0.05) for the test Balance.

**Discussing the results:**

It is also clear from Table No. (2) regarding the significance of the statistical differences in the variables of the balance test.

The researchers believe that the inability to perform a pre-test of balance due to fixation of the joint for a period of time so that the injury does not increase, and this is consistent with what Muhammad Nader Shalaby (2012) (10) confirmed that minor injuries must be placed in the plaster for a period that may reach two weeks. (10,11). Which negatively affects muscle strength and leads to tissue damage Bonsignore et al., (2002) (12) asserts that fixation has damages to the injured as it works to reduce the size of tissues and increase the harmful fibers, which leads to weakness of the muscles working on the affected joint. (12,13) And there is a weakness in the subjective sensory reception, which leads to a weakening of the balance variable in the joint in addition to the fear factor that controls the injured players and fear of using the injured foot. (14,15). As well as increasing the efficiency of the work of the sensory receptors and their reflection on the nervous-muscular system, which means an increase in the balance of the joint due to the balance exercises that contribute to the elimination of the muscular imbalance that the patient suffers from, and this is consistent with what Nasra (2008) (16) mentioned that balance exercises contribute to ending the state of lack Muscular balance existing between the muscles surrounding the affected joint by increasing the efficiency of the sensory receptors and their reflection on the nervous system, which leads to an increase in joint balance. (30)

Table No. (3) regarding the significance of the statistical differences indicates the increase in the muscle strength of the post-measurement from compared the pre-measurement in the grasp and extension movements and the inward and outward movements of the ankle joint using a dynamometer.

The researchers attributed this improvement to the rehabilitation program, which contains 21 treatment training units at the rate of one unit per day for 3 weeks and consists of a group of rehabilitative exercises. The intensity of the exercises for muscle strength in the first week ranged from 10 to 15 seconds, and the intensity was proven in the second and third weeks. 15 seconds, while the repetitions in the first week were 5 repetitions of the exercise, it increased to 10 repetitions in the second and third week, with an interval of 15 seconds in the first week, then it became 10 seconds in the second week and became 5 seconds in the third week between each repetition and the repetition of groups was 2, 4, 6, for a single exercise, and the appropriate and standardized resistance was used in each stage, as well as with the use of different tools and devices that were used in the rehabilitation program, such as the fixed wheel and ice packs in the first and second stages. This helped to accept the different exercises of the program and the first stage of the rehabilitation program also led to the development of strength in the muscles working on the ankle joint, and this is consistent with what was mentioned by Zoch (2003) (18), quoted by Mattacola (2002) and Caine (2005) (19,20) (That performing constant strength exercises for the muscles surrounding the joint in all directions in the first stage of the program is one of the necessary means to maintain and develop muscle strength, and it is best performed using the hand of a therapist. (18–20)

It is evident from Table (4) regarding the significance of the statistical differences to the increase in the kinematic range of the post-measurement over the pre-measurement in grip and extension movements using the Goniometer.

This is due to the positive role of the program of standardized therapeutic exercises based on scientific foundations and the topic by the researcher and its positive impact through stretching and flexibility exercises. The researchers attribute the improvement in the range of motion of the members of the research sample to the link between the exercises used and strength exercises in the various stages of the program and are consistent with what Muhammad Ismat referred to. Mohammed Nader et.al (2012) (21) that the improvement in the range of motion of the joint is due to the positive role of stretching and standardized flexibility exercises, and that improvement coincided with a decrease in the degree of pain and an improvement in strength. (21,22).

It is also evident from Table No. (5) regarding the significance of the statistical differences of the growth factor hormone and CD34+ variant between the pre-and post-measurement of the individuals of the sample.

This increase among the members of the sample under study, which helps in the speedy healing of the muscle injury, and the stem cells and hormone secretion rates have returned to normal after recovery from the injury, as
the stem cells and hormone work to influence more during the injury to help increase cells and increase protein production, which leads to muscle growth. (2006) growth factor IGF1 increases the effect associated with growth, such as increasing cells and their division, increasing protein production, and also increasing growth, meaning that IGF1 is concerned with muscle injury and the role of growth hormone-related metabolism only. (23).

The application of the treatment program is one of the factors that combine to increase and regulate the secretion of growth hormone from the pituitary gland and the hormone that stimulates the secretion of growth hormone is the hormone GHRH and this hormone is secreted during the treatment program (physical training) as well as during hunger, sleep, hypoglycemia, and muscle injury and this is confirmed by Hume. (1999) (24) that there are factors that combine to regulate the secretion of growth hormone from the pituitary gland and the first of these factors is the GHRH hormone secretion of growth hormone, which is secreted during physical training and some other conditions during sleep and during injuries, hunger and hypoglycemia, which leads to inhibition of the hormone methyl growth hormone itself when it is increased and thus reduces the secretion of the hormone which stimulates the growth hormone. (20,24–26).

Kirk. (2009) (27) stated that blood consists of a protein-rich fluid known as plasma, in which cellular elements are suspended: white blood cells, red blood cells, and platelets. The normal total circulating blood volume is about 8% of the body mass (5600 ml in a 70 kg man). About 55% of this volume is plasma. Red blood cells, white blood cells, and platelets are formed in the bone marrow, which is one of the largest organs in the body, approaching the size and weight of the liver. Hematopoietic stem cells (HSCS) are bone marrow cells that are capable of producing all types of blood cells. They differentiate into committed stem cells (Progenitors cells). The HSCS are derived from uncommitted, totipotent stem cells that can be stimulated to form any cell in the body. Adults have a few of these, but they are more readily obtained from the blastocysts of the embryo. (21,40)

It is evident from Table (6) that there is a relationship between hormone secretion and muscle injury, as during the injury the hormone secretion increases to help speed healing of the injury and this is consistent with what was mentioned by Nader Shalaby (2012) (29) that there are factors that combine to regulate the secretion of growth hormone from the pituitary gland and the first of these Factors are the hormone GHRH secretion of growth hormone, which is secreted during physical training and some other conditions during sleep and injuries, hunger and hypoglycemia. (12,13,29).

Through the inter-correlation matrix between growth factor hormone and muscle injury, we find that there are (28) correlation coefficients that differed between negative and non-significant negative and positive and non-positive.

This is confirmed by Mohammed Nader (2012) (30), that the mechanism of action of growth factor hormone after being affected by growth hormone performs two main processes:

The influence of the skeletal system, which leads to an increase in cartilage formation, which contributes to muscle growth.

An effect on the muscular system, which leads to an increase in protein production and an increase in cell growth. (1,30,31)

Nader Shalaby (2012) (30) indicates that the growth factor hormone (IGF1) helps the growth of muscles and bones. While there are (2) negative non-significant correlation coefficients and (2) positive Gerdal correlation coefficient between the test for the stretchy foot affected and the growth factor hormone.

The role of the growth factor hormone is very important in tissue repair and wound healing, and this is consistent with what Bonato et al. (2018) (32) stated that the growth factor hormone plays an essential role in wound healing and tissue repair and that the use of this hormone helps to speed healing of muscle injuries. When used alone or with growth hormone, growth hormone alone does not have an effective effect on healing and tissue repair. (2,32)

Ristolainen and others (2009)(33), emphasize the effective role of growth factor hormone in treating muscle injuries.

Through the results of the previous four different muscle strength tests, the researchers show that training in general and resistance exercises in particular lead to a change in muscle protein qualitatively and quantitatively, and regular
strength exercises lead to an increase in muscle size due to an increase in the systolic protein, so the researchers was keen to focus on light resistance to therapeutic exercises using The hand of the therapist reaches the limits of pain, and this was indicated by William Cramer and Stephen Lake (Heshmat (2021)) (34) that resistance training increases muscle strength within the muscles, which leads to an increase in hormonal changes.

Hussein Heshmat (2021) (34) confirms that training in general and resistance exercises in particular lead to a quantitative and qualitative change in muscle protein, as well as regular strength, exercises to increase muscle size as a result of increasing the systolic protein and partial biology that helps in how to control the exercises, which allows the athlete to plan appropriate programs and identify on its suitability for players by the amount of protein produced in the form of the hormone, especially growth hormone.

The researchers attributed the improvement in the speed of injury healing to the use of strength exercises through various resistances, whether by using the hand of the trowel, light weights, or strength and resistance exercises through the various tools used in the treatment program.

As for the range of motion tests used (the elbow test _ the grip of the injured foot test), there are (2) negative non-significant correlation coefficients and (1) negative significant correlation coefficient in the test for the grip of the injured foot. A positive non-significant correlation coefficient and (1) a positive significant correlation coefficient, through the correlation coefficients for the range of motion tests, we find that there is a marked improvement in the range of motion of the affected joint as it is normal for the joint to be negatively affected as a result of the injury, which affects its range of motion as A physiological change occurs in the joint tissues as a result of a lack of fluid and water, and the researchers agree with Mohammed Nader (2021) (35) that any injury is followed by a decrease in the range of motion and this decrease in the impact of the injury and that affects the tissues and cells of the joint where physiological changes occur in these tissues (the place of injury) And there is a shortage of water and fluids, which leads to a lack of joint movement. (1,7,20,26,27).

Since the growth factor hormone is responsible for repairing the affected tissues, there was a clear improvement in joint mobility and range of motion as a result of the increase in hormone secretion, as well as the patient's subjection to the proposed treatment program.

The researchers believe that the relationship between the stem cells and growth factor hormone and the speed of healing of the muscle injury is positive, so the more muscle injury increases, the more stem cells and growth factor hormone secretion increases to help speed healing of the muscle injury, and thus the second assumption is achieved.

VII. CONCLUSIONS:

Within the limits of the research sample, and considering the available capabilities of used tools and statistical processes, the researcher reached the following conclusions:

1. The proposed rehabilitative exercise program has shown high efficiency in restoring the normal functions of the affected joint.
2. Bringing the element of strength, range of motion, and balance in the affected joint to the normal range.
3. High-efficiency balance exercises are very important to improve the condition of the position receptors at the ankle joint, as these exercises showed a clear improvement in joint balance as well as an improvement in the strength of the performance of the ankle joint for all its movements.
4. The passive and then the positive range of motion exercises of the ankle joint since the beginning of the injury helped the return of the full range of motion of the joint.
5. Growth factor hormone (IGF1) has an effective role in the speedy healing of muscle injury, as it increases from its normal rates during the injury and returns to its normal state after recovery from the injury also as stem cells.
6. There is a positive relationship between stem cells and IGF1 and muscle injury.
7. CD34+ SC counts were increased in peripheral blood before training when compared to the post-training and control due to stress; it indicates better adaptation to exercise and modulation of bone marrow activity to rehabilitative training.
Recommendations:

Through the results of the research, the researchers recommend the following:

1. Be guided by the rehabilitation program when treating a rupture of the external collateral ligament of the ankle joint.
2. Interest in understanding the structure and vital functions of the ankle joint.
3. Paying attention to balance exercises, improves the strength of muscle performance, and restores the ability of the joint to correct its position to its normal image.
4. Paying attention to exercises to develop muscle strength throughout the sporting season to protect the joints from injury.
5. Attention to the range of motion exercises, stretching exercises, and flexibility of all joints and muscles of the body during the warm-up period.
6. Paying attention to good follow-up by the treating physician during the prescribed therapeutic and rehabilitative stages, specifically in the last period for the decision to participate in the competition.
7. Measuring hormone (IGF-1), as it has been proven to increase secretion during injury. It is recommended that the patient be injected with the hormone under the supervision of a doctor, which helps in the speedy healing of muscle injury.
8. Conducting more research in the field of rehabilitative exercise after the occurrence of various kinds of ankle injuries.
9. Conducting more research in the field of hormones during sports injuries in general, to reduce the treatment period as well as the physical aspects.

Contributions:

The authors of this original article. Collected, organized, and analyzed all of the data utilized in this article and concluded from the results of the data analysis.

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The authors declare no conflicts of interest.

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Ethical Clearance: Obtained from the departmental committee.

REFERENCES

16. Nasra WMM. Body Components and Their Relationship with Skill Performance within Top Level Wrestlers.
36. Saad AH. ACE gene variation and its relationship with physical, physiological, and skill variables for free swimming juniors.

Table (1): The arithmetic mean, standard deviation, minimum and upper limits, and the twist coefficient in each of the age, height, weight, and training age of the research group

<table>
<thead>
<tr>
<th>N</th>
<th>variables</th>
<th>Unit</th>
<th>Research Group Mean</th>
<th>SD</th>
<th>minimum</th>
<th>maximum</th>
<th>Twist Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age</td>
<td>year</td>
<td>22.4</td>
<td>1.54</td>
<td>18</td>
<td>25</td>
<td>-0.8</td>
</tr>
<tr>
<td>2</td>
<td>Height</td>
<td>cm</td>
<td>174.1</td>
<td>4.4</td>
<td>169</td>
<td>183</td>
<td>0.85</td>
</tr>
<tr>
<td>3</td>
<td>the weight</td>
<td>kg</td>
<td>72.53</td>
<td>3.12</td>
<td>67</td>
<td>78</td>
<td>-0.11</td>
</tr>
<tr>
<td>4</td>
<td>BMI</td>
<td>kg/m2</td>
<td>22</td>
<td>1.4</td>
<td>19.5</td>
<td>24.2</td>
<td>0.29</td>
</tr>
<tr>
<td>5</td>
<td>Training age</td>
<td>year</td>
<td>9.11</td>
<td>2.84</td>
<td>6</td>
<td>14</td>
<td>0.56</td>
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</tbody>
</table>

Table (2): Significance of statistical differences in the Wilcoxon test between pre-and post-measurement to test the balance under consideration

<table>
<thead>
<tr>
<th>N</th>
<th>variables</th>
<th>Unit</th>
<th>The number of mentions</th>
<th>Total ranks</th>
<th>Average ranks</th>
<th>The z-value computed from the Luxen test</th>
<th>The level of statistical significance</th>
<th>Indication level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Balance</td>
<td>Sec</td>
<td>1</td>
<td>19</td>
<td>133</td>
<td>1</td>
<td>7</td>
<td>-2.99</td>
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</table>

Table (3): Significance of statistical differences in the Wilcoxon test between pre-and post-measurement
<table>
<thead>
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<th>variables</th>
<th>Unit</th>
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<th>Total ranks</th>
<th>Average ranks</th>
<th>The z-value computed from the Luxen test</th>
<th>The level of statistical significance</th>
<th>Indication level</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>1</td>
<td>A stretchy test for the injured foot</td>
<td>Kg</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>130</td>
<td>0</td>
<td>6.5</td>
</tr>
<tr>
<td>2</td>
<td>Injured foot grip test</td>
<td>Kg</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>130</td>
<td>0</td>
<td>6.5</td>
</tr>
<tr>
<td>3</td>
<td>Inward flexion test</td>
<td>Kg</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>130</td>
<td>0</td>
<td>6.5</td>
</tr>
<tr>
<td>4</td>
<td>Flexing the affected foot outward</td>
<td>Kg</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>130</td>
<td>0</td>
<td>6.5</td>
</tr>
</tbody>
</table>

**Table (4):** Significance of statistical differences in the Wilcoxon test between pre-and post-measurement

<table>
<thead>
<tr>
<th>N</th>
<th>variables</th>
<th>Unit</th>
<th>The number of mentions</th>
<th>Total ranks</th>
<th>Average ranks</th>
<th>The z-value computed from the Luxen test</th>
<th>The level of statistical significance</th>
<th>Indication level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>1</td>
<td>Injured foot grip test</td>
<td>Degree</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>130</td>
<td>0</td>
<td>6.5</td>
</tr>
<tr>
<td>2</td>
<td>A stretchy test for the injured foot</td>
<td>Degree</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>130</td>
<td>0</td>
<td>6.5</td>
</tr>
</tbody>
</table>

**Table (5):** Significance of statistical differences in the Wilcoxon test between pre-and post-measurement

<table>
<thead>
<tr>
<th>N</th>
<th>variables</th>
<th>Unit</th>
<th>The number of mentions</th>
<th>Total ranks</th>
<th>Average ranks</th>
<th>The z-value computed from the Luxen test</th>
<th>The level of statistical significance</th>
<th>Indication level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>1</td>
<td>Hormone IGF1</td>
<td>Ng/ml</td>
<td>1</td>
<td>19</td>
<td>1</td>
<td>133</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>CD34+ cells</td>
<td></td>
<td>1</td>
<td>19</td>
<td>1</td>
<td>133</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>
Table (6): Intercollection matrix between growth factor hormone with CD34+ and injury healing rate

<table>
<thead>
<tr>
<th>N</th>
<th>variables</th>
<th>Metatarsal stand test</th>
<th>A stretchy test for the injured foot</th>
<th>Injured foot grip test</th>
<th>Inward flexion test</th>
<th>Examining the flexion of the injured foot</th>
<th>Injured foot grip test</th>
<th>A stretchy test for the injured foot</th>
<th>Measurement of IGF1 concentration.</th>
<th>CD34+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Balance measurement</td>
<td>Metatarsal stand test</td>
<td>-0.339</td>
<td>0.628</td>
<td>0.28</td>
<td>0.1</td>
<td>0.591</td>
<td>-0.075</td>
<td>-0.613</td>
<td>0.581</td>
</tr>
<tr>
<td>2</td>
<td>Muscle strength tests</td>
<td>A stretchy test for the injured foot</td>
<td>0.39</td>
<td>-0.397</td>
<td>-0.365</td>
<td>0.487</td>
<td>0.161</td>
<td>*0.596</td>
<td>*0.643</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Injured foot grip test</td>
<td>Inward flexion test</td>
<td>-0.435</td>
<td>-0.536</td>
<td>0.412</td>
<td>0.045</td>
<td>*0.637</td>
<td>*-0.627</td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td>Examining the flexion of the injured foot</td>
<td>Injured foot grip test</td>
<td>0.207</td>
<td>-0.355</td>
<td>-0.088</td>
<td>-0.601</td>
<td>-0.643</td>
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<tr>
<td>5</td>
<td>I tested the range of motion</td>
<td>A stretchy test for the injured foot</td>
<td>-0.09</td>
<td>-0.531</td>
<td>*-0.590</td>
<td>*0.599</td>
<td>*0.620</td>
<td>*0.613</td>
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<td></td>
</tr>
<tr>
<td>6</td>
<td>Biochemical</td>
<td>Measurement of IGF1 concentration.</td>
<td></td>
<td></td>
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<td>7</td>
<td>CD34+</td>
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</tbody>
</table>