

The Effect of Using Shock Wave Rehabilitative Exercise on Impaired Collagen Structure after Chronic Achilles Tendinitis in Basketball Players

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Introduction and research problem:

The practice of sport has become a science that has its origins, goals, rules and philosophy, and since the human being is considered an integrated body, mentally and psychologically, the necessity of understanding this person and preserving his safety has become necessary, and therefore caring for the health and safety of players in all respects has become a matter of scholarly concern.

Sameh Dos (2016) indicates that the Achilles tendon is a fibrous tissue, which is the largest and most powerful tendon in the human body. The collagen fibers within its tissues have the ability to stretch and stretch within 4% without causing any injuries, but if the tensile strength exceeds 8%, this will inevitably lead to the Achilles tendon being injured. (19: 62) (22) (23)

Usually, the inflammation that affects the Achilles tendon is completely different from other known types of infections, it is a type of nerve inflammation, where microscopic examinations indicate that Achilles tendon infections are a loss in the normal composition of the collagenous fibers that make up the tendon, and statistics indicate that the rate of occurrence of Achilles tendon infections It represents 11% of the total sports injuries. (26)

The researcher believes that the Achilles tendon is exposed to two

types of infections, namely acute Achilles tendinitis and chronic Achilles tendinitis. As for acute Achilles tendinitis, it means that the occurrence of pain and the development of symptoms took only a few days as a result of the increase in training rates and the effort on the joint and the tendon, the sudden increase in the rate of Physical activity carries the Achilles tendon with increased pressure in a short time, and this causes micro-injuries to the tendon fibers and with the increase in pressure exerted, the body loses the ability to repair these repeated injuries to the tendon fibers, which leads to continuous pain as a result of these repeated micro-injuries causing acute inflammation of the tendon, especially in Sports that require continuous jumping and changing directions, such as in basketball.

While both Jeffre B-Kreher indicate that a chronic injury is that injury that may last for more than six months and that chronic Achilles tendinitis may have its onset acute inflammation that has not been treated well and the injured has not taken a sufficient period of rest, and the injury may occur. At the point where the tendon meets the ankle bone or in the medial region of the tendon (about 4 cm) above the ankle bone. (24)

Hakan Alfred Son also points out that as a result of chronic

inflammation in the Achilles tendon, many changes can be observed when dealing with the injury, such as the presence of an abnormal green color in parts of the tendon with a loss of tendon fibers in many locations. As for the parts surrounding the tendon, it may be normal or swollen as a result of inflammation. When those parts of the tendon are examined under a regular microscope, a change in the nature of the collagen fibers, which is the structural unit of the tendon, is observed, and as a result of inflammation it is noticed that the healing process is weak and slow as new tissue is formed. As a kind of healing, this tissue is rich in nerve endings, which makes it a source of increased pain and thus the patient feels comfortable after getting rid of that tissue. (24) (25)

While Saimon Wood points out the positive and effective effects of shock waves using shock wave devices on tendon infections, especially chronic Achilles tendon infections. (27)

From the previous standpoint, the problem of this research crystallized in being one of the scientific attempts by which a program of rehabilitative exercises accompanied by shock waves is developed using a shock wave device and to identify the effect of this program on the imbalance of the collagenous structure of the Achilles tendon after exposure to chronic inflammation in order to accelerate the process of neuromuscular healing. For the tendon and the group of muscles of the front and back leg attached to it, which may

contribute to the restoration of functional competence with the ability of the injured to perform his specialized activities efficiently and competently and to the same degree that it was before the injury.

Research aims:

Designing a diverse program of rehabilitative exercises associated with shock waves using a shock wave device to treat the structural defect of the Achilles tendon after chronic inflammation, with the aim of studying the effect of the proposed program on that injury to reach the affected limb as close to the normal state as possible by measuring the following variables:

- 1- The level of pain at the site of the injury.
- 2- Muscular strength of the anterior and posterior leg muscles for both the affected and the healthy limb.
- 3- Leg circumference around the gastrocnemius muscle, for both the affected and healthy limb.
- 4- The degree of total body equilibrium.
- 5- The motor range of the ankle joint of the foot to which the affected tendon is attached

Research hypotheses:

In light of the objectives of the research and its procedures, the researcher assumes the following:

- 1- There were statistical differences between the pre-, tracer and post measurements of the pain level at the site of the injury.
- 2- There were statistical differences between the pre-, posterior and postural measurements in the muscular strength of the front and back

leg muscles of both the injured and healthy limb.

3- There are statistical differences between the pre, tracer and post measurements of the leg circumference around the twin muscle of both the affected and the healthy limb.

4- There are statistical differences between the pre, consecutive and dimensional measurements in the degree of total body equilibrium.

5- There were statistical differences between the pre-, post-, and post-measurements in the motor range of the ankle joint to which the affected tendon is attached.

Terms used in the search:

Chronic Achilles tendinitis:

It is an injury that lasts for a period of more than six months and in which the pain coincides with the beginning of the exercise and does not go away at all throughout the exercise

period, and the pain continues with simple physical activity such as normal walking, and its intensity increases significantly during climbing stairs, accompanied by the presence of swelling and redness of the skin.

Search procedures

Research Methodology:

The researcher used the experimental method using the method of pre-measurement, tracer measurement, and post-measurement on one experimental group, due to its suitability to the nature of the research objectives.

Community and Sample Research:

The study sample was chosen by the intentional method from the basketball players of Al-Hiwar Sports Club and Al-Mansoura Sports Club. The study was carried out on (3) players who had suffered this injury through medical diagnosis.

Table (1)

The arithmetic mean, standard deviation and skewness of search variables (n = 3)

Variables	Measure unit	SMA	standard deviation	skewness
Age	Year	18.00	1.00	.000
Height	Cm	185.667	8.621	.837
Weight	Kg	81.667	8.082	-.722

The previous table shows the arithmetic mean and standard deviation for each of (age - length - weight), and the torsion coefficient for each of them

has been limited between (3, -3). This indicates the homogeneity of the sample in the variables of age, height and weight.

Table (2)

The arithmetic mean, standard deviation and skewness of search variables

Variable	SMA	standard deviation	skewness
Balance	4.667	.577	-1.732
Pain	8.000	1.000	.000
Calf circumference of the affected limb	37.667	1.152	-.935

Follow Table (2)
The arithmetic mean, standard deviation and skewness of search variables

Variable		SMA	standard deviation	skewness
The circumference of the calves of the healthy limb		39.662	1.527	-.908
The range of motion of the ankle joint of the affected limb	Stretch the muscle	75.000	5.000	.000
	Contract the muscle	97.333	2.516	.586
The range of motion of the ankle joint of the healthy limb	Stretch the muscle	95.00	3.000	.000
	Contract the muscle	97.00	2.000	.000
Muscle strength of the affected limb	Stretch the muscle at a speed of 30	18.7667	3.33217	-.702
	Contract the muscle at a speed of 30	18.1333	1.43643	-1.499
	Stretch the muscle at a speed of 60	22.9000	9.24554	-1.622
	Contract the muscle at a speed of 60	21.1333	1.53731	1.658
Muscle strength of the healthy limb	Stretch the muscle at a speed of 30	42.967	2.402	-.249
	Contract the muscle at a speed of 30	28.133	2.013	-.586
	Stretch the muscle at a speed of 60	37.033	4.602	-1.518
	Contract the muscle at a speed of 60	28.233	4.528	-.917

The previous table shows the arithmetic mean and standard deviation of the pre-measurement for each of (balance - pain - calf circumference of the affected limb - calf circumference of the healthy limb - muscle strength of the injured limb - muscle strength of the healthy limb) and the torsion coefficient for each of them was limited to (3, -3) ; This indicates the

homogeneity of the sample in the pre-measurement of the research variables.

The human field of research:

The human field of research included basketball players with chronic Achilles tendinitis.

Time domain for research:

An exploratory experiment was conducted on (1) injured basketball player at Al-Hiwar Sports Club from 1/12/2019 to 3/12/2019 and the basic

research experiment was applied from 4/12/2019 to 2/4/2020.

Geographical area:

Pre, tracer and dimensional measurements were performed at the Sports Medicine Unit at Mansoura Sports Stadium, while the research was carried out in the fitness hall and basketball courts at Mansoura Sports Stadium.

Methods of data collection:

The data was obtained through theoretical reference sources, research and studies related to the research topic - the global network of information - expert opinion survey form on the axes of the proposed rehabilitation program and its suitability for the nature of the injury.

Devices and tools used:

Alrustometer device to measure the total length of the body - medical scale to measure weight - visual symmetry scale to measure the degree of pain - joniometer to measure the range of motion - biodex device to measure the total balance of the body - isokinetic device to measure muscle strength - medical tape measure (cm) to measure the muscle circumference - fixed wheel - Running conveyor belt - Leg Press propulsion device - Shock wave device - Swimming pool - Stop watch - Crushed ice bags - A set of weights with different weights.

Search variables:

In order for accurate results to be reached in that study, the researcher set the independent variable (independent variable) of the proposed rehabilitative exercise program and shock waves, which may affect the dependent variables represented in

both (degree of pain - muscle strength of the ankle joint and posterior leg muscles - leg circumference. About the gastrocnemius muscle - the degree of total body balance - the range of motion of the ankle joint to which the affected tendon is attached)

The proposed qualification program for shock waves:

The program is based on taking into account the stages of its implementation and the scientific, physical, therapeutic and rehabilitative foundations that accompany each stage individually (Individual) according to the condition of each patient during the following stages.

First: the first phase (preventive rehabilitative exercises)

And it lasts for (4) weeks with (3) weekly training units with a total number of units (12) training units coinciding with one weekly shock wave session using the shock wave device with a specific session time of (40:30) minutes depending on the level improvement.

It aims to:

Eliminate fear of using the affected limb.

Maintaining the level of neuromuscular competence.

-Overcoming structural changes of the Achilles tendon by loosening the tendon calcifications resulting from inflammation.

Training the muscle groups surrounding the ankle joint to prevent muscular atrophy.

Second: The second phase (the functional rehabilitation phase) and continues for a period of (4) weeks with (3) weekly training units with a

total number of units (12) training units coinciding with one weekly shock wave session using the shock wave device with a specific time for the session from (60:40) Minutes depending on the level improvement. This stage is divided into two periods:

A- The first period:

It lasts for a period of (3) weeks and includes constant and moving exercises in rhythm for the muscles of the lower extremity in addition to free exercises for the ankle joint in different rhythms in all directions with gradual resistive exercises to use weights similar to what was used by the injured before the injury occurred using the Leg Press pushing device with an emphasis on exercises Walking, running and jumping.

It aims to:

Work to restore the basic functions of the affected member.

Gradual increase in muscle strength of the affected organ.

A gradual increase in the range of motion of the ankle joint.

-Work to stimulate the sensory receptor systems of the Achilles tendon in preparation for increasing the degree of overall balance of the body.

Restore the injured limb to about 70-90% of its pre-injury capacity.

B- The second period:

And it lasts for a period of (a week) and includes running exercises in all directions, rise and fall, with the performance of stretching exercises throughout that period, with the practice of various skills of basketball to gradually restore them on the field to include the player with his colleagues

Presentation and discussion of research results:

First: Presenting and discussing the results of the first hypothesis, which states that there are statistical differences between the pre, consecutive and post measurements of the pain level at the site of the injury.

Table (3)
(Ca2) value for finding differences between pre-, post-tracer, and post-measurements of pain level using Friedman's test

Variable	Measure	Average of ranks	Value (Ca2)	Indication level
Pain	Pre	3.00	6.000	0.05
	Traceral	2.00		
	Post	1.00		

It is evident from the previous table that the value of (Ca2) to know the differences between the pre-, follow-up and post-measurements of the pain level using Friedman's equation amounted to (6.00), which is a statistically significant value at the level of 0.05; This indicates that there

are differences between the different measures in the level of pain, and these differences are attributed to the benefit of the post-measurement. Where the average ranks for the post-measurement were less than the pre and tracer measurements, which confirms the effectiveness of using

therapeutic exercises accompanied by shock waves in reducing the pain level of the research sample, and the

following table shows the arithmetic averages of the three measures and the rate of improvement

Table (4)
The arithmetic means, standard deviations, and percentage improvement in pain level

Measure	SMA	standard deviation	Improvement percentage
Pre	8.000	1.000	-100%
Traceral	4.000	0.000	
Post	0.000	0.000	

It is evident from the previous table that the arithmetic mean of the pain score was lower in the telemetry compared to the previous two measurements. Where the mean of the pre-measurement was (9) while the arithmetic average of the tracer measurement was (4.667) and decreased to zero in the post-measurement, and the improvement rate was 100% This indicates the effectiveness of the proposed rehabilitative exercise program in reducing the degree of pain among the research sample. The following chart shows the arithmetic averages of the three measures of pain.

The researcher attributes these differences between the pre, tracer and post measurements and the increase in the percentage of improvement in the level of pain in the limb afflicted with chronic Achilles tendonitis to what the proposed rehabilitation program sought from its initial stages to overcoming the pain resulting from neurological infections of the Achilles tendon and the structural and functional changes it caused to the tendon. The program contained constant and moving exercises of a variety of intensity, size,

and rest periods inside and outside the aqueous environment. This helped reduce the pain level of the research sample.

This is consistent with what Abdul Basit Siddiq (2013) indicated, that exercise is a common method in rehabilitation programs to reduce the level of pain as it maintains the individual's health at all times, because physical activities help control joint pain and swelling. (7: 129)

It also agrees with what Osama Riyadh (2001AD) indicated, that rehabilitative exercises have a positive role, which is reflected in reducing the level of pain in the injured limb. (3: 87)

It also agrees with what Osama Riyadh (1999 AD) indicated that practicing rehabilitative exercises leads to an increase in the muscular strength of the muscles working on the affected part, which leads to relieving the pressure on the muscles and tendons that connect the muscles to the bones and thus leads to a reduction of pain in the affected area. (2:37)

From the above it is evident that the proposed shock wave rehabilitative exercise program has a positive effect

on relieving the pain level of the limb with chronic Achilles tendinitis.

Thus, the first hypothesis of the research is fulfilled, which states that there are statistical differences between the pre, consecutive and post measurements in reducing the pain level of the injured party in favor of the post measurement in the research sample.

Second: Presenting and discussing the results of the second hypothesis, which states that there are statistical differences between the pre, consecutive and post measurements of the muscular strength of the anterior and posterior leg muscles of both the injured and healthy limb

Table (5)

The Ca² value to find the differences between the pre, tracer, and post measures of muscle strength of the affected and intact limb using Friedman's test

Limb	Variable	Measure	Average of ranks	Value (Ca ²)	Indication level
The affected	Stretch the muscle at a speed of 30	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		
	Contract the muscle at a speed of 30	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		
	Stretch the muscle at a speed of 60	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		
	Contract the muscle at a speed of 60	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		
The healthy one	Stretch the ankle joint at speed 30	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		
	Contract the ankle joint at speed 30	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		
	Stretch the ankle joint at speed 60	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		
	Contract the ankle joint at speed 60	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		

It is evident from the previous table that the value of (Ca²) to know the differences between the pre, tracer

and dimensional measurements of muscle strength (extension of the ankle joint at speed 30- grip of the ankle joint

at speed 30- extension of the ankle joint at speed 60- grip of the ankle joint at speed 60) for each side A healthy patient using Friedman's test amounted to (6.00) for all variables, which is a statistically significant value at the level of 0.05; This indicates that there are differences between the different measures of muscle strength, and these differences are due to the benefit of the post-measurement. Where the average

ranks of the post-measurement were higher than the pre and tracer measurements, which confirms the effectiveness of using therapeutic exercises accompanied by shock waves in raising the level of muscle strength in the research sample, and the following table shows the arithmetic averages of the three measures and the rate of improvement.

Table (6)
The arithmetic means, standard deviations, and rate of improvement in muscular strength for the affected and healthy parties

Limb	Variable	Measure	SMA	standard deviation	Improvement percentage
The affected	Stretch the ankle joint at speed 30	Pre	18.767	3.332	70.7%
		Traceral	23.300	6.264	
		Post	32.033	10.335	
	Contract the ankle joint at speed 30	Pre	18.133	1.436	71.9%
		Traceral	23.200	2.475	
		Post	31.167	4.578	
	Stretch the ankle joint at speed 60	Pre	22.900	9.245	71.8%
		Traceral	26.866	10.400	
		Post	39.333	11.609	
	Contract the ankle joint at speed 60	Pre	21.133	1.537	77.3%
		Traceral	25.367	3.008	
		Post	37.4667	5.220	
The healthy	Stretch the ankle joint at speed 30	Pre	42.9667	2.402	64.4%
		Traceral	52.9000	4.396	
		Post	70.633	6.997	
	Contract the ankle joint at speed 30	Pre	28.133	2.013	71.6%
		Traceral	34.133	3.415	
		Post	48.267	4.235	
	Stretch the ankle joint at speed 60	Pre	37.033	4.602	78.9%
		Traceral	52.867	10.570	
		Post	66.267	12.192	
	Contract the ankle joint at speed 60	Pre	28.233	4.528	67.4%
		Traceral	34.933	5.993	
		Post	47.267	6.607	

The previous table shows that the arithmetic mean of the dimensional measurements is higher than the consecutive and tribal measurements in muscle strength, and the rates of improvement were for each of (Stretching the ankle joint at speed 30 - Gripping the ankle joint at speed 30 - Stretching the ankle joint at Speed 60 - Gripping the ankle joint at Speed 60)) For both affected and intact limbs are elevated; Where it ranged between (70.7% - 77.3%) for the affected limb, and ranged between (64.4% - 78.9%) for the healthy limb, which are high rates. This indicates the effectiveness of the proposed rehabilitative exercise program in improving muscle strength, and the following figure shows the arithmetic averages of the three measures of muscle strength for the injured and healthy parties.

The researcher attributes these differences between the pre, tracer and post measurements and this improvement in muscle strength to the proposed rehabilitative exercise program accompanied by shock waves and the positive effect of the shock wave device in overcoming the tendon calcifications resulting from chronic Achilles tendonitis and its negative effect on tendon flexibility and muscle strength of the front leg muscle group. And the background in addition to the proposed program containing therapeutic exercises based on physiological foundations and their relevance to the nature of muscular work and the muscles working on the ankle joint, starting with static contractions and then moving with tools and devices, fixed, moving and

gradual weights in an attempt to return the injured limb to its normal state before the injury occurred.

This is consistent with what was indicated by Qadri Bakri and Siham Al-Ghamry (2013 AD) that developing muscle strength in its fixed and moving types is one of the most important basic functions that affect the results of the return of the injured limb to the normal state it was in before the injury occurred and the closest thing to a healthy limb. (11:65)

It also agrees with what was indicated by Usama Riyad-Nahid Abdel-Rahim (2001 AD) that the application of static exercises and then the gradual use of exercises with assistance, then positive exercises, then resistance exercises are of great importance in improving the muscular work process of the deficient muscle and gradually increasing it to reach the best level Possible without complications. (3: 113)

It also agrees with what Warner (2013) pointed out that the graduation of strength exercises from static to mobile to the use of different weights in all directions works to develop muscle strength and that rehabilitative exercises rebuild muscle strength. (21: 112)

The researcher believes that the rehabilitation program accompanied by the proposed shock waves and the integration it contained in developing the muscular strength of the front and rear leg muscles group and not focusing on one muscle group without the other with the use of the Leg Press in a gradual manner had a positive effect in developing the muscle

strength of the muscles working on the joint The ankle for both the affected and the intact limb.

The results of that study are consistent with the results of the Qadri Bakri-Ashraf Al-Abbas study (2016 AD) and its findings on the positive effects of rehabilitative therapeutic exercises directed at the Achilles tendon on increasing the muscle strength of the muscles attached to the tendon and working on the ankle joint. (9)

It also agrees with the results of the Killer study (2013) and its findings regarding an improvement in the mechanical functioning of the leg muscles after Achilles tendon injuries, and this was reflected in an increase in

muscle strength by 10% for the study sample. (18)

In this way, the second hypothesis of the research is achieved, which states that there are statistical differences between the pre, consecutive and post measurements of the muscular strength of the anterior and posterior leg muscles for both the injured and the healthy limb.

Third: Presenting and discussing the results of the third hypothesis of the research, which states that there are statistical differences between the tribal, consecutive and post measurements of the leg circumference around the twin muscle of both the affected and healthy limb.

Table (7)

The (Ca2) value to find the differences between the pre, tracer and posterior measurements of the leg circumference around the gastronomies muscle of both affected and intact limbs using Friedman's test

Variable	Measure	Average of ranks	Value (Ca2)	Indication level
Calf circumference of the affected limb	Pre	1.00	6.000	0.05
	Traceral	2.00		
	Post	3.00		
Calf circumference of the healthy limb	Pre	1.00	6.000	0.05
	Traceral	2.00		
	Post	3.00		

It is evident from the previous table that the value of (Ca2) to know the differences between the tribal, follow-up, and dimensional measurements of the circumference of the calf calf of the injured and intact man using Friedman's test reached (6.00) in each of them, which is a statistically significant value at the level of 0.05; Which indicates that

there are differences between the different measurements in the circumference of the calf, and these differences are due in favor of the post measurement. Where the average ranks of the post-measurement were higher than the pre and tracer measurements, which confirms the effectiveness of the proposed program in increasing the circumference of the calf (twin muscle)

of the affected and healthy parties in the research sample, and the following table shows the arithmetic averages of

the three measurements and the rate of improvement.

Table (8)
The arithmetic means, standard deviations, and rate of improvement of the leg circumference around the gastronomies muscle for both affected and healthy limbs

Variable	Measure	SMA	standard deviation	Improvement percentage
Calf circumference of the affected limb	Pre	37.667	1.527	17.69%
	Traceral	39.667	1.502	
	Post	44.333	1.154	
Calf circumference of the healthy limb	Pre	39.667	1.534	17.64%
	Traceral	40.667	1.428	
	Post	46.667	1.456	

It is evident from the previous table that the arithmetic mean of the dimensional measurements is higher than the consecutive and tribal measurements in the circumference of the calf around the twin muscles of both the injured and the healthy sides, and the rates of improvement were for both the injured and the healthy parties, respectively (17.69% - 17.64%). This indicates the effectiveness of the proposed rehabilitation program in increasing the circumference of the calf around the gastronomies muscle for both the affected and healthy limbs.

The researcher attributes those differences between the pre, tracer and post measurements, and this improvement in the circumference of the leg around the twin muscle of both the injured and healthy limb to what the proposed rehabilitation program sought from its initial stages to overcoming the muscular atrophy

caused by the lack of movement for the member afflicted with chronic Achilles tendonitis and diversity In exercises directed at the calf muscles and the ankle joint working on it.

This is consistent with what Cove and Naylor (2013) indicated that regular, targeted training builds a large number of myofibrils, which leads to an increase in the size of working muscle cells. It also has positive effects on the growth of muscle ligaments and tendons. (16:63)

The results of that study are consistent with the results of Walid Muhammad Al-Demerdash's study (2016 AD) and its findings that the inclusion of the treatment program on regular and gradual muscle strength exercises leads to various changes in the muscles such as an increase in the cross-section of the muscle, an increase in the size of the fibers and an increase in the density of capillaries. (15th)

The results of that study are also consistent with the results of the study of Muhammad Hassan Mahfouz (2017) and its findings of the positive effects of rehabilitative exercise on the circumference of the leg muscles around the gastronomies muscle in children with Achilles tendon insufficiency.

Thus, the third hypothesis of the research is fulfilled, which states that

there are statistical differences between the pre, consecutive and post measurements of the leg circumference around the twin muscle of both the affected and healthy limb.

Fourth: Presentation and discussion of the fourth hypothesis of the research, which states that there are statistical differences between the tribal, consecutive and post measurements in the degree of total body equilibrium.

Table (9)

The (Ca2) value to find the differences between the pre-, post-lateral, and dimensional measurements of the degree of equilibrium, using Friedman's test

Variable	Measure	Average of ranks	Value (Ca2)	Indication level
Balance	Pre	1.00	6.000	0.05
	Traceral	2.00		
	Post	3.00		

It is evident from the previous table that the value of (Ca2) to know the differences between the tribal, consecutive and dimensional measurements in the degree of equilibrium using Friedman's test amounted to (6.00), which is a statistically significant value at the level of 0.05; This indicates that there are differences between the different measures in the degree of equilibrium, and these differences are due to the

benefit of the post-measurement. Where the average ranks of the post-measurement were higher than the pre and tracer measurements, which confirms the effectiveness of the proposed program in raising the level of the overall body balance of the research sample, and the following table shows the arithmetic averages of the three measures and the rate of improvement.

Table (10)

The arithmetic means, standard deviations, and the rate of improvement in the level of equilibrium

Variable	Measure	SMA	standard deviation	Improvement percentage
Balance	Pre	4.6667	.57735	85.7%
	Traceral	6.0000	1.00000	
	Post	8.6667	.57735	

It is evident from the previous table that the arithmetic mean of the post-measurement is higher than the consecutive and pre-standard measures in the level of equilibrium, and the rates of improvement were (85.7%). This indicates the effectiveness of the proposed program in improving the degree of balance of the research sample.

The researcher attributes those differences between the pre, consecutive and post measurements, and this improvement in the degree of total body balance to what the proposed rehabilitation program sought during the first period of the functional rehabilitation phase and what it included in moving exercises with different rhythms of the muscles of the lower extremity in addition to free exercises of the ankle joint in all directions. .

The researcher believes that exercises directed at the Achilles tendon and the leg muscles attached to it (the twin muscle) stimulate the muscle sensory receptors, which contributes to increasing the overall balance of the body.

This is in agreement with what Jean (2014 m) stated on the presence of mechanical sensory receptors, mechanoreceptors, which are found in the muscles and tendons surrounding the joint, and these receptors are activated and excited by stimuli that the joint is exposed to, such as force or mechanical stresses (contraction - relaxation - vibration - lengthening) and thus Information is sent to the brain about these stimuli so that it can deal with them, and that injury to these

receptors leads to a failure in self-reception after injury, which leads to a decrease in the balance. (17: 213(

It also agrees with what Abu Al-Ela Abdel-Fattah (2003 AD) said, that the term muscle-sensory receptor training has become used with interest in the field of physical rehabilitation, as muscle and joint receptors are among the most important receptors in joint stability, which play an important role in the joint's sense of place, as they are located in the joint capsule and ligaments. And some articulated components such as cartilage. Muscle receptors are also found in muscles and tendons and are important for both muscle and tendon perception and muscular control of muscles. (1: 320)

The results of that study are consistent with the results of the study of Muhammad Mahmoud Ibrahim (2015 CE) and its findings of the positive effects of rehabilitation programs directed at Achilles tendon on increasing the degree of overall balance of the body. (13(

The results of the Qadri Bakri-Ashraf Al-Abbas (2016) study are in agreement with the findings that therapeutic exercise programs after Achilles tendon injury showed a significant improvement in the basic functions of the affected limb with an increase in the overall balance of the body. (9)

Thus, the fourth hypothesis of the research is fulfilled, which states that there are statistical differences between the tribal, consecutive and dimensional measurements in the degree of total body equilibrium.

Fifthly, presenting and discussing the results of the fifth hypothesis of the research, which states that there are statistical differences

between the pre, tracer and post measurements of the motor range of the ankle joint to which the affected tendon is attached.

Table (11)

The (Ca2) value to find the differences between the pre, tracer, and posterior measurements of the range of motion of the foot joint for both affected and healthy limbs using Friedman's test

Variable		Measure	Average of ranks	Value (Ca2)	Indication level
The range of motion of the ankle joint of the affected limb	Stretch	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		
	Contract	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		
The range of motion of the ankle joint of the healthy limb	Stretch	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		
	Contract	Pre	1.00	6.000	0.05
		Traceral	2.00		
		Post	3.00		

It is evident from the previous table that the value of (Ca2) to know the differences between the pre, tracer and post measurements of the range of motion of the ankle joint for both the healthy and the injured limb using Friedman's test reached (6.00) in each of them, which is a statistically significant value at the level of 0.05; Which indicates that there are differences between the different measurements in the range of motion of the foot joint, and these differences

are attributed to the benefit of the post measurement; Where the average ranks of the post-measurement were higher than the pre and tracer measurements, which confirms the effectiveness of the proposed program in increasing the range of motion of the injured and healthy parties in the research sample, and the following table shows the arithmetic averages of the three measurements and the rate of improvement.

Table (12)
The arithmetic means, standard deviations, and the rate of improvement of the range of motion of the foot joint for both affected and healthy limbs

Variable		Measure	SMA	standard deviation	Improvement percentage
The range of motion of the ankle joint of the affected limb	Stretch	Pre	75.000	5.000	61.8%
		Traceral	87.333	2.516	
		Post	121.333	1.527	
	Contract	Pre	77.333	2.516	75%
		Traceral	102.333	2.081	
		Post	135.333	4.509	
The range of motion of the ankle joint of the healthy limb	Stretch	Pre	97.00	3.000	64.4%
		Traceral	126.00	4.000	
		Post	159.333	4.725	
	Contract	Pre	95.000	2.000	57.5%
		Traceral	107.667	1.527	
		Post	149.667	2.516	

It is evident from the previous table that the arithmetic mean of the dimensional measurements is higher than the consecutive and tribal measurements in the range of motion of the ankle joint for both the injured and the healthy parties, and the improvement rates for both the injured and the healthy parties were high. This indicates the effectiveness of the proposed program in increasing the range of motion of the ankle joint for both the injured and the healthy limbs.

The researcher attributes those differences between the pre and tracer measurements and the dimensional measurements and this improvement in the range of motion of the ankle joint to what the proposed rehabilitation program contained in terms of targeted exercises that increase muscle strength and continue to perform stretching and

flexibility exercises for the ankle joint and the muscles working on it with the use of the stationary bike Argometer and push device Leg Press and the positive role of the functional rehabilitation phase in its two periods, as it gradually increased the range of motion in conjunction with overcoming tendon calcifications in the Achilles tendon and increasing the elasticity and elasticity of the tendon.

This is consistent with what Abd al-Basit Siddiq (2013 CE) indicated that rehabilitative therapeutic exercises are one of the best safe methods of treatment and physical rehabilitation because of their positive effect on increasing the range of motion of the joint. (7: 130)

It also agrees with what Samia Khalil Muhammad indicated (2010 AD) that flexibility and elastic

exercises work on joint flexibility, especially in cases of muscle adhesions or muscle shortening, and that stretching exercises are a manual method for lengthening the skeletal system such as muscles, ligaments, tendons, with the aim of increasing the range of motion of the joint (179: 5)

It also agrees with what Talha Husam al-Din - Wafa Salah (1997 AD) indicated, that flexibility exercises work to develop the muscle stretching component and increase the elasticity property of muscles and ligaments, which leads to an increase in the range of motion of the joint. (6:246)

Where Muhammad Qadri Bakri (2000 AD) indicates that targeted movement therapy (physical, kinesthetic therapy) is one of the basic natural methods in the field of integrated injury treatment, and that sports therapy is of special importance in the field of rehabilitation, especially in its final stages when implementing treatment with work in preparation for preparing The injured player to practice his specialized sports activity and return to the stadiums after restoring the basic functions of the injured part. (8: 88)

The results of this study are in agreement with the results of the Qadri Bakri-Ashraf Al-Abbas study (2016) and the positive effects of therapeutic exercise on restoring the basic functions of the limb affected by Achilles tendon rupture and increasing

the range of motion of the ankle joint. (9)

It also agrees with the results of the Killer study (2013) and its findings of an improvement in the mechanical functioning of the leg muscles after Achilles tendon rupture with an increase in the range of motion of the ankle joint by 17% in the study sample with no need for surgical interventions in some Achilles tendon injuries. (18) Thus, the fifth hypothesis is fulfilled, which states that there are statistical differences between the pre, consecutive and post measurements of the motor range of the foot joint to which the affected tendon is attached.

Conclusions:

In light of the objectives and assumptions of the research, and within the limits of the research sample and the measurements used, and within the framework of the statistical analysis of the data that have been reached, we conclude the following:

- 1- The rehabilitation program, accompanied by shock waves, showed a significant improvement in pain relief in the limb with chronic Achilles tendon infections.
- 2- The rehabilitative exercises directed using graduated resistors showed a significant improvement in the level of muscle strength of the front and rear leg muscles working on the ankle joint.
- 3- Balance exercises have shown high efficiency in the apparent

improvement in the degree of overall body balance.

4- The improvement in the degree of balance and range of movement coincided with an increase and improvement in the level of muscle strength of the ankle muscles of the ankle and posterior leg muscles.

5- The combination of rehabilitative exercises and shock waves using a shock wave device had a positive effect in overcoming the structural changes of the Achilles tendon resulting from chronic inflammation without the need for surgical interventions and their complications, especially for people with diseases (weak immunity-recurrent lower extremity infection-blood and circulation diseases) Hematological- heart and lung disease).

Recommendations:

1- Inference of the proposed rehabilitation program accompanied by shock waves when dealing with Achilles tendonitis.

2- The study leads to chronic Achilles tendonitis without the need for surgical interventions.

3- Emphasizing on the players the need to focus on (polymetric) exercises, which are a type of rapid exercises that work to strengthen the muscles and nerves of the lower extremity, and these exercises include (jumping - jumping rope - jumping on one foot) as a preventive factor from recurring injury.

4- Chronic Achilles tendonitis started as severe infections that were not properly treated or diagnosed.

5- Emphasis on conducting the physical and skill tests of the player before returning to the competition, noting that the player's participation decision is through the doctor and the physical rehabilitation specialist.

6- Conducting more research in the field of treatment and rehabilitation of chronic Achilles tendon infections in basketball players.

References

1- **Abu El-Ela Abdel Fattah (2003 AD):** Physiology of Training and Sports, First Edition - Arab Thought House, Cairo.

2- **Osama Riad (1999 AD):** Physical Therapy and Rehabilitation of Athletes, First Edition - Arab Thought House.

3- **Usama Riyad- Nahid Abdel-Rahim (2001 AD)** Measurement and Kinetic Rehabilitation for the Disabled, Dar Al Fikr Al Arabi, Cairo.

4- **Zakaria Abdel-Hamid (2010)** Hestology, Part 1, Faculty of Medicine, Mansoura University.

5- **Samia Muhammad Khalil (2010 AD):** Physical Therapy, Means and Techniques, First Edition, Sports Academy, Iraq.

6- **Talha Hossam El-Din, Wafa Salah El-Din, Saad Abdel-Rashid (1997 AD):** The Scientific Encyclopedia of Training (Strength - Endurance - Endurance - Flexibility) Part One - The Book Center for Publishing, Cairo.

- 7- Abd al-Basit Siddiq Abd al-Gawad (2013 CE):** Modern Readings in Sports Injuries - Rehabilitation and Treatment Programs, Mahe House for Publishing and Distribution - Alexandria.
- 8- Muhammad Qadri Bakri (2000 AD)** Sports Injuries and Modern Rehabilitation - Al Kitab Center for Publishing, Cairo.
- 9- Muhammad Qadri Bakri - Ashraf Al-Abbasi (2016 AD)** The effect of therapeutic exercises on handball players with first-degree Achilles tendon rupture, The Seventh International Scientific Conference of the Faculty of Physical Education for Girls in Gezira - Cairo.
- 10- Muhammad Qadri Bakri - Thuraya Nafeh (1999 AD)** Your Guide to Sports Medicine, authored by Gap Merketh, First Edition, Al-Kitab Center for Publishing.
- 11- Muhammad Qadri Bakri-Siham Al-Ghamry (2013)** Sports Injuries and Physical Rehabilitation, Dar Al-Manar Printing Press, Cairo.
- 12- Muhammad Muhammad Hassan Mahfouz (2017 AD)** The Effect of a Physical Rehabilitation Program to Restore the Walking Movement of Children with Achilles Tendon Insufficiency, Unpublished Master Thesis, College of Physical Education for Boys, Helwan University.
- 13- Muhammad Mahmoud Ibrahim (2015 AD)** The effectiveness of a physical rehabilitation program on the range of movement and balance to reduce Achilles tendon injury for young athletes, College of Physical Education for Boys, Helwan University.
- 14- Walid Muhammad Al-Demerdash (2006 AD)** The effect of a proposed dynamic rehabilitation program on basketball players 'knee cartilage rupture, published master's thesis, College of Physical Education for Boys in Al-Haram, Helwan University.
- 15- Walid Muhammad Al-Demerdash (2016 AD)** The Effect of Rehabilitation Therapeutic Exercises on the Reflexology of Basketball Players Affected by Four-Head Femoral Tendon Rupture, Journal of Comprehensive Education Research, College of Physical Education for Girls, Zagazig University.