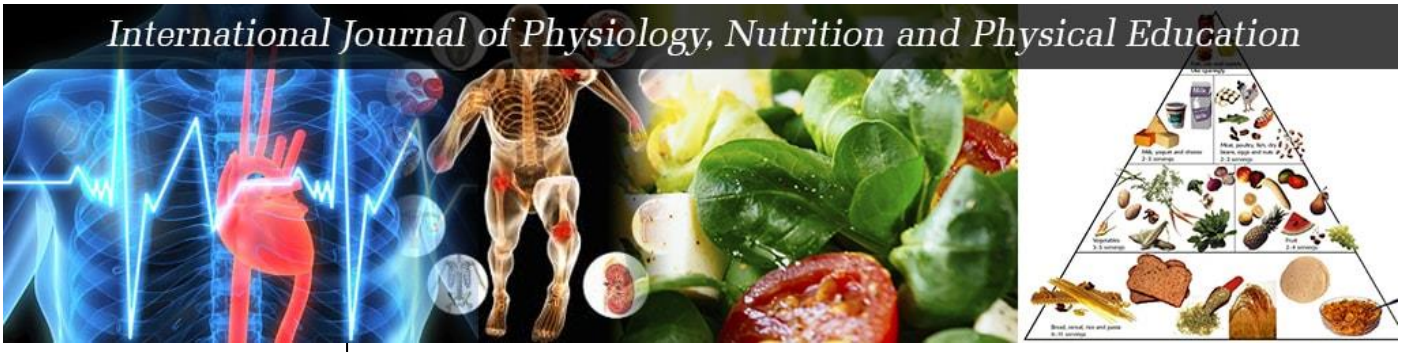

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Physical rehabilitation program accompanied with therapeutic apparatus for rehabilitating: Adductor longus muscle tear and its effect on pain and some physical traits of soccer players

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Abstract
Tendon rupture of the adductor muscle of the thigh is a common injury in football and lead the player to stay away from training for long periods if it is not scientifically rehabilitated. It can also have negative effects. All of these factors contribute to tendons, ligaments, and muscles being stressed. Therefore, the study aims to identify the effectiveness of the physical rehabilitation program for the rupture of the adductor muscle tendon in football players. The program was divided into two groups: basic exercises targeting the adductor muscle and additional exercises targeting the surrounding muscles and other muscles, and a program for the development of physical attributes. Male football players with tendon rupture of the adductor longus of the thigh were subjected to a leg strength test, the balsom agility test, the strength adductor longus dynamometer and squeeze test. The results show a clear improvement in the muscle strength of the adductor muscle (P>0.001), the degree of pain completely disappearing (P>0.0001), and an improvement in some physical characteristics.
The rehabilitation program had a positive impact on the functional efficiency of the hip joint, as indicated by the pre and post-tests. Getting rid of the degree of pain by using rehabilitation exercises and early physiotherapy methods. The rehabilitation program for the adductor longus tendon rupture met the goals of the study.

Keywords: Rehabilitation, tendon rupture, adductor longus, muscular strength, pain

Introduction
The adaptation and cooperation of physiological conditions in the human body among themselves is very important for the development of functional ability in general of elite athletes to achieve high achievement [1], structure, as well as for patients to complete the recovery stages. The total number of tendon ruptures has increased over the last few decades, and unlike other tendon ruptures, they are extremely typically related to sports activity [2, 3]. An increasingly sedentary population has been blamed for the rise in incidence, which has been related to increased engagement in recreational activities [4]. Elite athletes, on the other hand, are at a higher risk of rupture and are likely to have ruptures earlier in life than non-elite athletes due to the increased pressure placed on their tendons [5].
During eccentric stress of the foot, tendon ruptures are common. Athletes who participate in sports such as American football, which require explosive acceleration, sudden changes in direction, or maximum exertion, are more likely to sustain this injury [5]. Furthermore, the processes of acute adductor damage are frequently extrapolated from clinical history. The majority of acute adductor injuries in football are said to occur while kicking or changing directions [6].
Halfmann and colleagues show that most players whose training depends on general endurance and running for long periods are exposed to rupture of the adductor muscle tendon of the thigh and abdominal muscles, and that the percentage of football players injured by this injury reaches 69% of the total players from other sports [7]. In this case, the Meroni study confirms that the adductors of the thigh bear the greatest load in a game such as football, and their use is

doubled in running, shooting, and passing. Thus, the adductor muscles of the thigh are considered one of the basic muscle groups working on the thigh joint for football players, which exposes it to a lot of ruptures and is considered a muscle rupture point for. the knee, which is one of the most common injuries in football [8]. Ruptures are one of the most common causes of dysfunction, and thus will lead to a movement disorder, and such injuries, which are also considered one of the most common injuries in our modern age, especially in the field of sports, and still have a difficult challenge with the health aspect of athletes and their level [9].

Materials and Methods

Participants

Male elite players from difference teams were contacted. In total, seven consecutive football players aged 17–25 with rupture of the adductor longus tendon related pain were included in this study. After one week, they diagnosed a rupture of the adductor longus tendon. Before data was collected, all subjects gave written informed consent to participate in the study. The participants were given a thorough overview of all the evaluation and treatment procedures, including the minimally invasive method and the hazards associated with the study. Participants have the option to refuse the minimally invasive surgery and withdraw from the study at any moment without facing any consequences.

Programmes design

Rehabilitation programme

Rehabilitation program begin post 5 days of the injury according to the condition of each participants that was followed by diagnosis. The rehabilitation program was applied individually used Compex stimulating 4 sessions per week/ 12 sessions and Ultra sound device which was performed for 3 sessions per week/ 9 sessions. In contrast, participants also subjected to aqueous medium in 3 sessions per week/ 24 sessions. The rehabilitation program completely 45 sessions.

Exercise training programme

The program was divided into two groups basic exercises (BE) targeting the adductor muscle and additional exercises (AE) targeting the surrounding muscles and other muscles, and a program for the development of physical fitness. The BE group was done in the first day and the AE in the second day, and there were different exercises in the gym hall, with a rate of 5 rehabilitation sessions per week, completely 60 sessions.

After 8 weeks of injury, the physiotherapy devices were excluded after 3 weeks of injury. Participants begin trained in stadium to develop physical fitness for some physical characteristics. 20 sessions were done contributed the agility, strength exercises distinguished by speed and endurance.

Exercise training programme

Exercise A	Exercise B	Running Progression Program
Flexibility / leg Swings - front & back Leg swings - side-to-side	Flexibility/ Leg Swings - front & back Leg swings - side-to-side	1. Jog 4x4minutes 2. Jog 3x7 minutes 3. Jog 3x10 minutes 4. 4 Jog 4x9 minutes 5. Jog 3x12 minutes 6. Jog 3x15 minutes 7. Jog 3x20 minutes 8. Jog 2x30 minutes
Adductors/ Adduction machine Adduction - cable pulley	Abductors/ Hip abduction cable pulley Side-bridge with hip abduction	
Abdominal/ Full range sit-ups on gumball Triple leg lowers Trunk rotation - cable pulley Trunk side flexion	Glutes, Quads/Deadlifts, Squats, Single-leg squat, Hip thrusts	
Hip flexor/Hip flexion - cable pulley - knee strap	Hamstrings/Straight-leg deadlifts Nordic hamstring	
	Calves/ Seated calf raises Standing calf raise	

Muscular strength assessment

Distinctive force as quickly test & Muscular strength test

Subjects did a 15-minute warm-up before testing, which included jogging, lateral displacements, flexibility training, and jumping. As previously stated, the test was carried out [10], briefly, using a jog run up and hopping on the dominant leg from the first cone, the athlete begins 25 meters behind the starting line. It is timed how long it takes to hop between the two cones. After that, the test is performed with the other leg.

On the other hand, muscular strength test was done as the participant stands and the examiner attaché wire of the dynamometer device to the participant's foot pulls inward. Two trails were given and the best trails is taken.

Agility assessment

Balsom Agility Test & T- test Agility

As shown in (Figure.1, A.B) participants stop at the starting point (A) run to the point (B) then make a rotation back to the first point (A) directly crossing to the point (C) till they reach the point (D). Afterward, participants make a turn and return to the cross point (C) and run directly to point (B) before finishing at point (E). Participants are allowed to perform three trails, and the best time trail is taken [11].

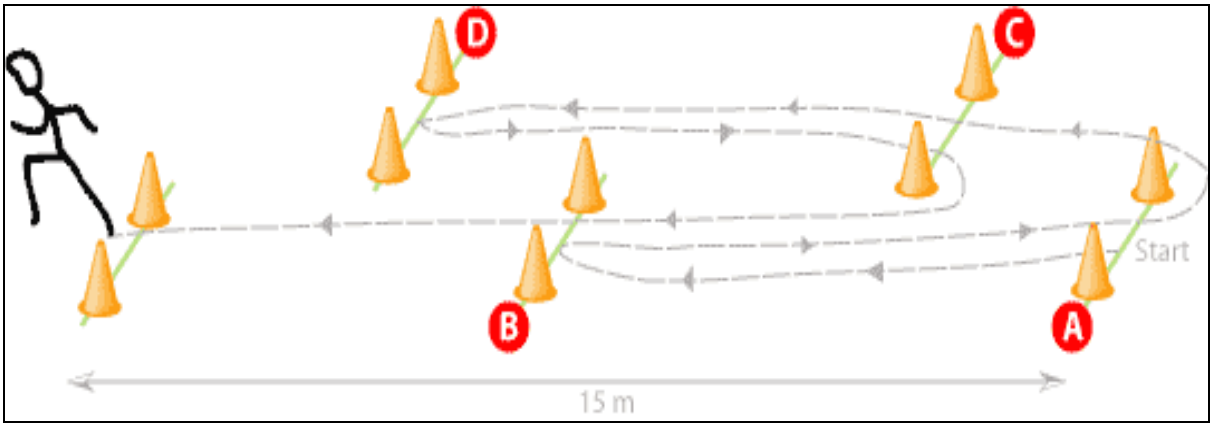

Fig 1A: Demonstrated the agility tests done in this study.

The T-test was used to determine speed when changing directions. The participants began by placing both feet behind the starting line A. (Fig.2). Each subject rushed ahead to cone B and touched the base with his right hand at his own choice. They shuffled to the left to cone C and touched its base with their left hand, facing ahead and without crossing their feet. The subjects then shifted to the right to cone D and placed their right hand on its base. They shuffled back to the left to touch the base of cone B. Finally, the subjects dashed backwards as swiftly as they could to line A. Any person who put one foot in front of the other, didn't touch the cone's base, or didn't face forward the entire time had to repeat the test [12]. This test yielded the higher score of the two previous trials.

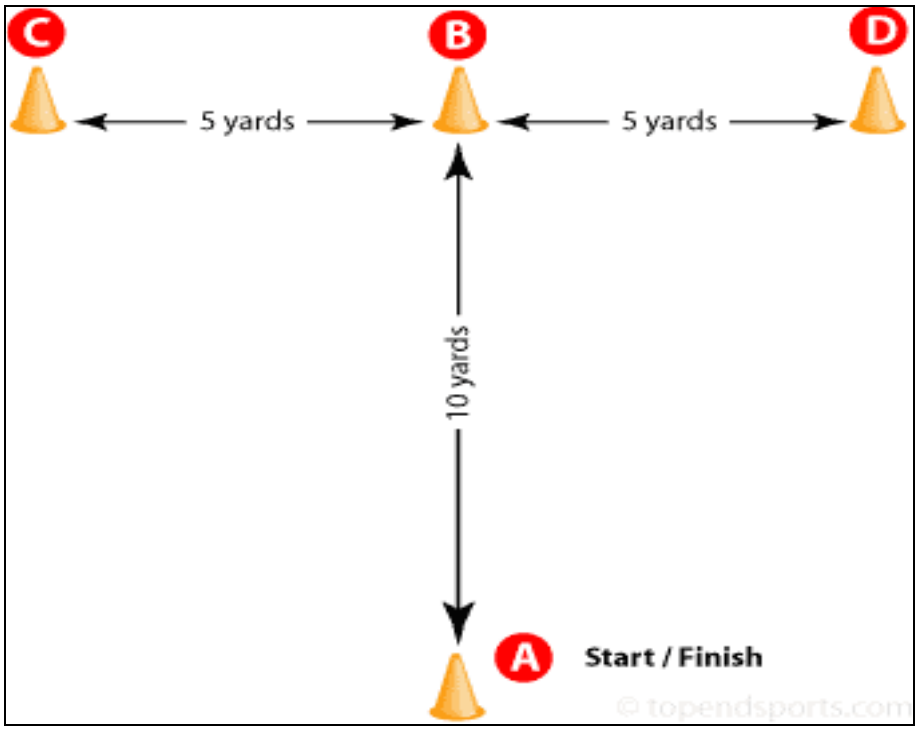

Fig 1B: demonstrated the agility tests done in this study.

Muscles pain assessment

Squeeze 45^0 & Squeeze 0^0.

As previously described [13], the patient lies supine. One leg is flexed until the medical malleolus is positioned at the level of the contralateral medical knee joint line (fig.). The other leg is then flexed similarly, so both medical malleoli are next to each other and the feet are flat on the bed. The hips will then be approximately 45 degrees flexed and the knees approximately 90 degrees flexed. The examiner then positions a clenched fist between the patient's knee and the patient's asked to squeeze the knees together with maximal force. While Squeeze 0^0 was done, the patient lied supine with hips and knees in a neutral position. The examiner stands at the end of the examination bed with his lower arm in between the patient's ankles to hold them apart. The patient's feet point straight up and the patient squeezes the ankle together with maximal force without lifting the legs or pelvis (Figure. 2. A. B).

Fig 2: A.B. Showed the muscles pain assessment.

Statistical analysis
SPSS v.22.0 was used to analyse the data. Comparisons of the original and cross validation demographic and pain characteristics data were analysed using a t-test followed by an arithmetic mean, standard deviation, and percentage. Significance was established as (0.05).

Results
Pains outcomes
Table 1 shows the performance of pains. Significant differences were found in squared 45^0 between prior tests (P>0.01) compared to post-tests (P>0.00). However, significant differences were also shown in squared 0^0 between prior tests (P>0.01) compared to post-tests (P>0.00).

Table 1: Showed the comparison between squared 45^0 and squared 0^0.

Prior test			Post test					
Variables	**Arithmetic mean**	**standard deviation**	**Arithmetic mean**	**standard deviation**	**Median difference**	**Value T**	**evolution rate**	**Sig**
Pain Test 45°	6.714	0.559	1.714	0.487	5.000	13.229	%95.28	0.000
Pain Test 0°	8.714	1.112	2.142	0.690	6.571	15.333	%97.85	0.000

Agility outcomes
Performance scores at agility tests for athletics are given in Table 2. Significant differences were found in T- test agility between prior tests (P>0.01) compared to post-tests (P>0.00). However, significant results were also shown in the balsom agility test between prior tests (P>0.01) compared to post-tests (P>0.00). A comparison between T- test agility to balsom agility demonstrated that the T- test agility was significantly greater than the balsom agility test (P>0.00).

Table 2: Showed the comparison between t- test agility and balsom agility.

Prior test			Post test					
Variables	**Arithmetic mean**	**standard deviation**	**Arithmetic mean**	**standard deviation**	**Median difference**	**Value T**	**evolution rate**	**Sig**
T- test Agility	11.403	0.556	12.430	0.32[1]	5.164	7.976	%37.57	0.00
Balsom Agility	16.575	1.473	12.439	0.353	4.145	5.794	%87.57	0.01

Leg Strength Test & Muscular strength test outcomes
Significant differences were found in adductor thigh strength (P>0.01) compared to post-tests (P>0.000). However, significant was also shown in the speed test of the injured leg between prior tests (P> 0.001) compared to post-tests (P>0.00). Table 3.

Table 3: Showed the comparison between Speed test of injured leg and adductor thigh strength.

Prior test			Post test					
Variables	**Arithmetic mean**	**standard deviation**	**Arithmetic mean**	**standard deviation**	**Median difference**	**Value T**	**evolution rate**	**Sig**
Speed test of injured 1egisec	15.134	1.124	11.572	1.053	3.561	6.819	%42T88	0.000
Adductor thigh strength test/kg	10.000	2.160	23.000	3.958	13.000	7.172		0.001

Discussion
The purpose of the current study was to investigate the effect of the rehabilitation program by compass stimulating device, used for 8 weeks, including 3 sessions per week. The results determined that the rehabilitation exercise protocols used in this study along with therapy devices had a positive effect on the adductor longus tendon rupture. A development in the rupture of the adductor muscle tendon may have accrued to the regularity of the participants during rehabilitation sessions or may have been because of the different methods and rehabilitation protocols used as an effective treatment.

However, this is the first study to examine the adductor longus tendon rupture, but the funding of the study is in line with the previous study [14, 15]. Found that athletes with groin pain had lower adductor squeeze test results when assessed at 0 and 30 degrees of hip flexion, but not at 45 degrees of hip flexion.

In terms of agility, the findings revealed that the rehabilitation exercise protocols used in this study, in conjunction with therapy devices, had a positive effect on the post-agility outcome when compared to the prior agility outcome. Our findings are consistent with those of Bompa and Carrera [16]

When demonstrating that agility training is neuromuscular training, as it depends on the work and ability of the nervous system to send fast, strong, and high-frequency impulses to the fast-contracting muscle fibres involved in performing agility exercises, as agility does not exist independently, and it is not a program in itself, but rather a skill A task to be completed by a training program based on the development of a range of other abilities, such as: ability, strength, transitional speed, motor speed, response speed, and reaction speed. Moreover, the improvement may have accrued due to the use of SAQ training, which is a complex training sentence that includes three elements: transitional speed, agility, and kinetic speed, and it is one of the modern methods used for multiple training purposes, and among the exercises in this type of training [17]. In contrast, the importance of this type of training lies in the fact that the best players in the world in football, who have the quality of speed and can overcome competitors, whether with or without the ball. This is because they possess a high level of technical skills in physical SAQ and skills SAQ related to speed of response, thinking or decision making based on mental processes [18].

On the other hand, static muscle training strengthens muscles, tendons, and ligaments without putting undue strain on the joints engaged in performance [19]. Therefore, our results showed the positive effect of strength rehabilitation on tendon rupture of adductor longus that may happen because the transition from static muscle training to dynamic training in the thigh leads to the development of strength for the adductor long muscle of the thigh. Thus, muscular strength training, whether static or dynamic exercises, helps to increase the size of the muscle fiber according to the longitudinal division of the muscle [20].

Conclusion

The rehabilitation program used in this study had a positive impact on the functional efficiency of the hip joint, as indicated by the mechanism of the pre and post-tests, by getting rid of the degree of pain by using rehabilitation exercises and early physiotherapy methods.

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