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ORIGINAL STUDY

The Effect of a Rehabilitation Program Supported by Suspension Training Straps Among Tennis Players with Medial Elbow Muscle Tendon Injuries

Mustafa Muhammad Ali Farhan 

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Abstract

The objective of this study is to design a rehabilitation program involving the use of suspension training straps and find out whether it helps improve the range of motion for injuries of the medial elbow muscle tendons. It is assumed that there exist statistically significant differences between the pre-tests and post-tests concerning the range of motion in the elbow joint, in favor of the post-test results. The experimental approach is used, with the adoption of the single-group pre-test/post-test experimental design. The research population includes seniors tennis players that have sustained injuries to their medial elbow muscle tendons at Middle Euphrates clubs. The sample group is selected through a total enumeration method, with five players being diagnosed as having suffered such injuries by an expert physician. After the pilot test and pre-test process, the main experiment was carried out over a period of eight weeks, conducting three rehabilitation sessions weekly for every participant due to conflicting schedules among them. Exercises were developed in order to enhance range of motion and strengthen the medial tendons. We conclude numerically that the differences were significant for the bending variable, which reached (0.002), and for the extension, which reached (0.001), at a significance level of (0.05), which indicates the improvement that occurred in the research sample. It is recommended to use this technique in all types of injuries as well as to apply it to other types of games, and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Good Health).

Keywords: Rehabilitation program, Suspension straps, Medial muscle tendons, Range of motion

1. Introduction

The development of sport sciences has undergone a breakthrough through integration with other scientific disciplines. The contribution to recovery and return-to-play made by rehabilitation programs in studying injuries and developing corrective exercises cannot be overstated. Sports injuries' rehabilitation is one of the most important pillars of sports medicine which develops along with modern diagnostic and therapeutic approaches.

As one of the key tasks of treatment, rehabilitation is considered a necessary measure aimed at bringing the person back into the sporting activity, restoring the basic body functions, and recovering sport-specific motor skills. It helps drain the hematomas and restore the functionality of damaged muscles and joints to the

minimum required period. Rehabilitation also helps recover physical and physiological capabilities of the affected area.

Among the techniques used in rehabilitation, such medical tool as suspension training straps may be highlighted. The specificity of this technique consists in a higher number of muscle fibers recruited and their participation in intra-muscular and inter-muscular coordination. It finds application depending on the energy and possibilities of the injured person to achieve the programmatic purposes (Hatroosh & Hatroosh, 2024).

According to the hypothesis of the researcher, it would be appropriate to apply the mentioned technology to tennis, especially to players who have elbow injuries. The specified tool belongs to the

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strength training where the change in angles and the range of movement determines the resistance. Suspension straps excel in mobilization of motor capabilities responsible for the generation of muscular force (Jumaa, 2024). Elbow joints bear a great load while playing tennis and, therefore, are prone to recurrent injuries.

Joint injuries affect not only the power of strokes but also their direction as joint strength and flexibility allow controlling arm movement. A healthy joint gives an opportunity to control the ball and put it exactly to the right place which becomes the foundation of successful performance and victories. In addition, joint health is important for high speed necessary to catch far balls and defend from strikes of opponents. Hence, the health of medial muscle tendons gives an opportunity to perform fast arm movements while striking at the ball that leads to good results.

Tennis presupposes high physical capacities because it greatly depends on muscles that help make fast movements and react quickly to opponent's moves. Most often, players have various injuries of upper limbs since they are most actively used during the game. Having certain physical and technical qualities often is enough for winning (Hussein, 2023). Therefore, the significance of the present study is in enabling the rehabilitation of players having an injury of medial elbow tendons. This study fills the existing gap and allows players to join training groups and participate in competitions.

1.1. Problem statement

The research problem of the present study stems from the idea that most tennis players overuse the elbow joint during training and competitions, placing a heavy burden on it. This leads to severe tears in the medial tendons, which can halt a player's career for significant periods. Given the scarcity of studies on this topic to the researcher's knowledge, the use of suspension training straps is proposed. This technique has received little scholarly focus and represents a scientific addition that is accessible to coaches, players, and specialists.

The research objectives

1. To design a rehabilitation program supported by suspension training straps.

2. To identify the effect of the program and suspension straps on rehabilitating medial elbow muscle tendon injuries among tennis players.

1.2. The research hypotheses

The present study hypothesizes that there are statistically significant differences between the pre-tests and post-tests of the elbow joint's range of motion in favor of the post-test.

1.3. The research scope

The Human Scope: A sample of injured tennis players.

The Temporal Scope: From (February 3, 2025) to (May 26, 2025).

The Spatial Scope: Specialized Physical Therapy Center (Musalsa Akshun) in Diwaniyah, (Kuldin Man) Hall.

2. The research methodology and field procedures

2.1. The research methodology

The researcher employed the experimental method with a single group, employing pre- and post-tests.

2.2. The research population and sample

The research population consists of tennis players with tendonitis of the medial elbow joint within the Middle Euphrates clubs in the advanced category. The research sample was selected using a comprehensive survey method from these clubs. The number of injured players from these clubs is (5). They were examined by a specialist physician to diagnose the type of injury. Homogeneity was ensured for all the research variables, as shown in Table 1.

2.3. Research methods and tools

The researcher utilized scientific resources from the internet, as well as the equipment and tools that will be mentioned in the research text.

Table 1. Homogeneity of sample members.

Variables	Unit of Measurement	Mean	Standard Deviation	Median	Skewness
Height	cm	174.66	2.47	176.08	0.57
Mass	kg	67.41	1.48	68.12	0.47
Chronological Age	Year	23.74	2.51	24.03	0.11
Training Age	Month	32	2.87	33.49	0.51

Table 2. Number of participants in the research sample and start and end dates of the main experiment.

No.	Pre-test	Days/Week	Start of Rehab	Duration	End of Rehab	Post-test	Injured Joint
1	9/2/2021	3	13/2/2021	8 Weeks	7/4/2021	10/4/2021	Right
2	9/2/2021	3	13/2/2021	8 Weeks	7/4/2021	10/4/2021	Right
3	11/2/2021	3	14/2/2021	8 Weeks	8/4/2021	15/4/2021	Left
4	18/2/2021	3	22/2/2021	8 Weeks	16/4/2021	18/4/2021	Right
5	7/3/2021	3	9/3/2021	8 Weeks	1/5/2021	3/5/2021	Left

2.4. Field research procedures

2.4.1. The research variables

The researcher defined the research variables in accordance with the nature of the problem under study. These variables were defined as the range of motion of the elbow joint, as it is the joint studied in relation to the tendons of the surrounding medial muscles.

2.4.2. The research tests

In order to determine the appropriate tests that accurately measure what they were designed to measure, it is important that the type of test chosen is suitable for the sample and gives the accurate scores that the researcher hopes will solve their research problem. Based upon, the range of motion test was chosen by the researcher due to his specialization in the field of sports rehabilitation.

2.5. Measuring Range of Motion (Al-Gijakli, 2006)

Name of Test: Measurement of the Elbow Joint Range of Motion (Extension-Flexion).

Objective of Test: To measure the movement of extension and flexion of the elbow joint.

Unit of Measurement: Score.

Tools used: Goniometer.

Procedure for Test: The participant either sits down with their arm hanging down at the side of their body while their forearm is positioned in the supine posture, or the player lies down on their back with their palm facing upwards. The axis of the goniometer is then set on the lateral condyle of the humerus bone. The fixed arm of the goniometer is positioned parallel to the midline of the lateral part of the humerus. The moveable arm of the goniometer is then positioned parallel to the midline of the lateral part of the radius, and towards the styloid process of the radius bone. Extension is the reverse movement of flexion. The positioning of the patient and the goniometer is the same as the one mentioned previously in measuring flexion.

Recording Score: Maximum score obtained by the tester is recorded. Range of motion in this measurement is determined by the difference between flexion and extension angles. Range of motion of the elbow joint = Angle of flexion – Angle of Extension.

2.6. The pilot study

To detect any problems that may appear during the execution of the pre- and post-tests and during implementing the rehabilitation program, the researcher conducted the pilot study for two of the patients in the research sample.

2.7. The pre-tests

The pre-tests were carried out by the researcher, as shown in Table 2, on the injured players of the research sample at Musalsa Akshun center.

2.8. The main experiment

The main experiment was performed by the researcher on the research sample through applying the rehabilitation program using suspended straps. This program was carried out in (8) weeks where each injured player attended three days in the center. Because the participants attended to the center at different times, the researcher divided their attendance time periods as illustrated in Table 2.

As for the exercises that were involved in the process of rehabilitation of players, since the researcher is an expert in this discipline, he came up with a variety of exercises, which will help to strengthen the tendons of the medial muscles of the elbow joint depending on the nature of the injury. The researcher considered the nature and degree of injury in each of the athletes. At the same time, the researcher made sure there would be a gradual progression of these exercises because of their role in building the strength of muscles and increasing joint mobility. In the process of implementing the exercises mentioned above, the researcher used different approaches and devices. Among the goals of the initial exercise routine, the researcher aimed at applying the help of a physiotherapist and his equipment, including an electrical muscle stimulation device. It uses a TENS wave and helps to decrease pain, increase comfort, promote proper perfusion of the muscles, speed up the process of healing due to the stimulation, eliminate swelling, muscle spasms, and increase flexibility. The fractal wave promotes repairing the damaged tissues and tendons of the

Table 3. Mean, standard deviation, difference in means, calculated *t*-value, and significance of pre- and post-test measurements for motor range.

No	Variable	Unit	Pre-test		Post-test		Mean Diff.	Calculated T	P-value	Significance
			Mean	SD±	Mean	SD±				
1	Flexion	Degree	63.23	7.56	34.11	4.48	29.12	4.42	0.002	Significant
2	Extension	Degree	132.18	6.78	174.58	4.89	42.4	3.85	0.001	Significant

muscles, increasing the pace of healing of injuries. Furthermore, the fractal wave reduces inflammation of the target area. In addition to the previously mentioned device, the researcher used an ultrasound, which provided deep heating for the target area and its tendons. The deep heating contributed to improved blood circulation, which helped speed up the healing process. The devices worked within five to ten minutes during each exercise, in combination with movement, isometric exercises, and positive and negative flexibility training. The last four weeks aimed at building the strength of muscles acting upon the elbow joint through suspended resistance bands, free and bodyweight exercises. [Appendex 1](#), In addition, different exercises were varied according to the stage of development of the injury of the athlete. Resistance balls and resistance bands were some of the equipment used in the process. These exercises helped in the process of injury recovery.

2.9. The post-tests

In order to carry out a post-test on the research sample, the researcher conducted the procedure similar to the one used in the pre-test.

2.10. Statistical methods

The researcher used the Statistical Package for the Social Sciences (SPSS) to extract the results.

3. Presentation, analysis, and discussion of the results

3.1. Presentation and analysis of pre- and post-test measurements for the research sample

After completing the field research procedures, which included administering the pre-test and then implementing the rehabilitation program according to the specified timeframe for the exercises, the researcher conducted a post-test on the studied variables. The raw data was then collected, processed, and statistically analyzed and discussed according to scientific procedures.

3.2. Presentation and analysis of the range of motion values for the pre- and post-tests

To determine the significance of the differences between the pre-test and post-test scores of participants with motor range, the researcher statistically analyzed the pre-test and post-test data, extracting experimental statistical indicators such as the arithmetic mean, standard deviation, and calculated *t*-value. These were then compared with the tabulated *t*-value to determine the level of significance, the type of differences, and the degree of significance of the results, as shown in [Table 3](#).

4. Discussion of the results

It becomes evident from [Table 3](#) that there are statistically significant differences in favor of the post-test in the range of motion variable of the elbow joint. These differences were caused by the rehabilitation program with the assistance of suspension straps, created specifically by the researcher to help recover from this type of injury. The exercises used in this program aimed at enhancing the tendons of the muscles that surround this joint. Given the focus of the research problem on tendon strength enhancement, the exercises were carefully distributed among the muscles surrounding the joint, taking into consideration the resistance and weight used during the training. It is noted that rapid movement and proper technique in working with body parts allow an individual to maximize the transfer of movement between these parts ([Farhan & Al-Mu'min, 2025](#)). Strength training periodization principles have long emphasized the importance of gradual progression in rehabilitation protocols ([Al-Nimr and Al-Khatib, 1993](#)). Furthermore, physical fitness components such as muscular endurance and flexibility play a foundational role in joint recovery ([Hammad, 2010](#)). The use of elastic resistance bands in rehabilitation has been shown to positively influence range of motion and muscular strength ([Jumaa, 2022](#)). Similarly, electrostimulation and laser therapies have demonstrated effectiveness in treating nerve and tendon injuries in athletic populations ([Talib, 2019](#)). In addition, specific nutritional supplementation alongside therapeutic exercises can accelerate recovery from tendon injuries ([Farhan and](#)

Farhan, 2025). Additionally, considering the importance of the coordination and synchronization in strengthening this tendon, it is worth noting the fact that it is an important element of tennis that requires rapidity and directionality in its movements, which makes it important to pay attention to the muscular strength of the arm since this body part is actively used in this game. The researcher is convinced that these differences are also caused by the gradual increase in the difficulty of the exercises and the balance between work and rest, which allowed regaining the normal range of motion of the joint, returning its mobility and agility, increasing its functional efficiency and ability to continue the usage of this body part. Another thing the researcher paid particular attention to in the course of developing the exercise program was working out the muscles affecting the joint, especially the medial ones, and, thus, increasing the strength and flexibility of these muscles that constitute important elements for the joint to be able to work properly. All of these things were possible owing to the usage of different equipment by the researcher, including such resistance bands of various resistances. As it is noted, the joint requires constant movement and large range of motion in order to maintain its normal range of motion (Ibrahim, 2010). In view of this, the effectiveness of the resistance bands used in the exercises may be attributed to their important contribution to strengthening the medial elbow tendons. The process of attaching the weight to the resistance band and moving it in deltoid motion provided the medial elbow tendons and muscles with the required strength and flexibility, which is necessary for playing tennis. The researcher also made use of different devices for this program, such as electrical stimulation, cryotherapy, and ultrasound. In light of this, the researcher agrees with the findings of the study by Cutts et al. (2020) who state that devices may play an important role in reducing pain and limiting the level of swelling in the affected area, as well as breaking up adhesions in muscle fibers and increasing blood flow to the affected area. Moreover, the researcher agrees with Clarke et al. (2010) who emphasize that rehabilitation exercises combined with such physical treatment techniques as ultrasound, laser, and electrical stimulation can effectively help relieve pain and restore the range of motion of the elbow joint. The rehabilitation program used the device of electrical stimulation at the start to prepare muscles affected by the exercises, making them strong. The purpose of this equipment is to rehabilitate the medial muscles that were affected negatively by the injury and become weak. This equipment also helped minimize muscle atrophy during and after the injury. Electrical stimulation is regarded

as one of the major factors in training of athletes owing to the fact that it allows increasing the strength of muscles and minimizing muscle atrophy due to injuries (Salama, 2007). Considering the fact that this joint is characterized by the unique range of motion and ability to make movement in all directions, the exercises considered all aspects of this movement and attempted to rehabilitate the involved muscles. At the same time, the use of the mentioned equipment contributed to improved joint flexibility that constitutes a basic condition of its strength. The researcher agrees with the findings of Dines et al. (2016) devoted to the topic of injury of the elbow joint. In addition, the researcher focused on the functional structure of the medial elbow muscles and restored it to its initial state compared to the state of the lateral muscles. It is pointed out that preventing injuries and maintaining the functional structure of muscle groups is possible through regular strength training exercises that include rest, giving the trainee the necessary physical strength to continue athletic activity (Mustafa, 2023).

As far as the goal of contributing to the improvement of the range of motion of the elbow joint caused by the stiffness is concerned, the researcher directed all of his efforts on working on the range of motion of this joint. Adil (2019) points out that one of the main factors that contribute to the improvement of range of motion and muscular strength is the consideration of the features of the motion performed in the gradually progressing way. This is done by creating the exercises on the basis of scientific principles and corresponding to the range of motion, nature of muscles affecting the joint and their mechanical effect. Evidently, the gradual progression of exercises performed within the rehabilitation program ranging from simple to complicated, and involving static, dynamic, and resistance exercises had a positive effect on the variable of the range of motion of the joint examined and its ligaments and tendons. Thus, the research hypothesis is confirmed.

5. Conclusions and recommendations

5.1. Conclusions

1. The rehabilitation program is of great importance in improving the range of motion of the elbow joint.
2. The suspension bands helped in developing strength and improving the range of motion of the elbow joint.
3. The equipment and tools contributed to the rehabilitation of the medial tendons of the elbow joint.

5.2. Recommendations

1. Using this technique for all types of injuries.
2. Applying it to other types of sports.
3. Focusing on training these muscles during training sessions.

Author's declaration

Conflicts of interest

None.

We confirm that all tables and figures in this article are ours and written by the researchers themselves.

Ethical-Clearance

This manuscript approved by mustafa mohammed Ali on (12/3/2026).

Author's contributions

All contributions of this study were done by the researchers mustafa mohammed Ali who get the main idea and work on writing and concluding also with number of experts, Mazen Hassan Jassim in Statistics.

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Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Appendix 1: Model of a Rehabilitation Unit

Notes	Total time for one exercise	Rest between each exercise	Rest between repetitions	Total time for repetitions	repetitions	Performance time	Exercises	Days
Using the tools correctly	m 9	m 2	m 3	m 4	4	s 60	1	Tuesday
	m 11	m 2	m 3	m 6	4	s 90	2	
	m 11	m 2	m3	m 6	4	s 90	3	
	m 10	m 2	m 2	m 6	3	s 120	4	
	41				the total			
Observe the performance correctly, taking into account the time.	m 11	m 2	m 3	m 6	4	s 90	5	Thursday
	m 8.5	m 2	m 2	m 4.5	3	s 120	6	
	m 11	m 2	m 3	m 6	3	s 120	7	
	m 11	m 2	m 3	m6	4	s 90	8	
	41.5 m				the total			

تأثير برنامج تأهيلي المدعم بالأشرطة المعلقة للمصابين بأوتار العضلات الانسية لمفصل المرفق لدى لاعبي التنس

مصطفى محمد علي فرحان

جامعة واسط كلية التربية البدنية وعلوم الرياضة

مستخلص البحث

يهدف البحث الى اعداد برنامج تأهيلي مدعم بالأشرطة المعلقة، ومعرفة تأثير ذلك البرنامج في تحسين المدى الحركي لمفصل المرفق لإصابة اوتار العضلات الانسية له، ويفترض الباحث بأن هناك فروق ذات دلالة احصائية في الاختبارات القبلية والبعدية للمدى الحركي لمفصل المرفق للاعبين التنس المصابين، وللاختبار البعدي. واتبع المنهج التجريبي بأسلوب المجموعة الواحدة ذات الاختبار القبلي والبعدي لملائمته مشكلة البحث، وتحدد المجتمع بلاعبين التنس المصابين بأوتار العضلات الانسية لمفصل المرفق ضمن اندية الفرات الاوسط لفئة المتقدمين، اما عينة البحث فقد تم اختيارها عن طريق اسلوب الحصر الشامل، وقد بلغ عددهم (5) مصابين تم عرضهم على الطبيب المختص لتشخيص نوع الاصابة، وتم تحديد متغيرات البحث والاختبارات الملائمة لها، بعد ذلك شرع الباحث بإجراء التجربة الاستطلاعية، ثم اجري الاختبار القبلي لأفراد عينة البحث، وبعدها التجربة الرئيسية، إذ بلغت مدتها (8) أسابيع بواقع (3) وحدات تأهيلية في الاسبوع لكل فرد مصاب وبالنظر لعدم تمكن عينة البحث من الحضور في وقت واحد تنسب الباحث في عمل جدول محدد بالتواريخ المؤشرة ازاء كل منهم. كما تضمن البرنامج على عدد من التمرينات هدفت الى تحسين المدى الحركي لمفصل المرفق وتقوية اوتار العضلات الانسية لهذا المرفق. وقد أجرى الباحث اختباراه البعدي. ونستنتج رقمياً بأن الفروق جاءت معنوية لمتغير التني والتي بلغت (٠,٠٠٢) وللمد بلغت (٠,٠٠١) عند مستوى دلالة (٠,٠٥) مما يدل على التحسن الذي طرأ على عينة البحث. ويوصي باستخدام هذه التقنية في جميع أنواع الاصابات فضلاً عن تطبيقها على أنواع اخرى من الالعاب، وهذا ما يحقق احد اهداف التنمية المستدامة للأمم المتحدة في العراق (الصحة الجيدة).

الكلمات المفتاحية: البرنامج التأهيلي - الاشرطة المعلقة - اوتار العضلات الانسية - المدى الحركي.