

DOI: <https://doi.org/10.54702/nzpht357>

## The Effect of Rehabilitative Exercises in a Sandy Environment on Improving the Range of Motion of the Knee Joint in Patients with Partial Meniscus (Medial) Tears Among Baghdad Volleyball Club Players

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Received: 29/01/2024, Revised: 21/02/2024, Accepted: 03/03/2024, Published: 30/06/2024



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### Abstract

Rehabilitation exercises are one of the principles of sports rehabilitation for treating sports injuries, including partial meniscus tears. Injuries occurring in body regions and organs, especially the knee joint, reflect the flexibility and sudden movements of other joints and the body as a whole. This prompted the researchers to find effective opportunities to enhance the functionality of these organs and provide what they lack. One such method is rehabilitation exercises in a sandy environment, which provides a safe setting. The research goal is to prepare rehabilitation exercises in a sandy environment for volleyball players in Baghdad clubs who are suffering from partial meniscus tears. Investigating the effect of rehabilitation exercises in a sandy environment on the range of motion (extension-flexion) of the knee joint in volleyball players from Baghdad clubs with partial meniscus tears. Exploring the differences between the experimental and control groups in improving the range of motion (extension-flexion) of the knee joint in volleyball players from Baghdad clubs with partial meniscus tears. As for the research methodology, the researchers employed an experimental approach with two experimental groups, using pre-test and post-test assessments. The rehabilitation exercises, primarily aimed at improving the range of motion (extension and flexion) of the knee joint in volleyball players from Baghdad clubs, were carefully planned. The researchers conducted a pre-test, followed by the rehabilitation exercises, and then post-tests to collect data for statistical analysis. After obtaining results and conclusions, the researchers recommend the following: 1- Adopt the rehabilitation exercises designed by the researchers for rehabilitating individuals with partial medial meniscus tears. 2- Implement these rehabilitation exercises in other training environments, such as aquatic settings, to treat the same injury or other lower limb injuries. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Good Health).

### Keywords

Rehabilitation exercises, sandy environment, knee range of motion (extension-flexion), partial tear of the medial meniscus

### Introduction:

Specialists in the field of sports, particularly in sports rehabilitation, strive to find various methods and techniques to achieve improvement and advancement in athletic performance and to reduce sports injuries for the purpose of attaining achievement. One of these methods is changing

the training environment, as diversity in the training process is one of the principles of sports rehabilitation aimed at inducing necessary changes and improving the level of physical and motor abilities and skills in a specialized sport. Alaa Wissam and Abdul Hussain, S. mention that "sports rehabilitation is a scientific and practical

profession that primarily relies on the study of sports sciences, along with some medical and health nuances related to the injured" (1).

Abdul Sattar notes, "Modern sports medicine has primarily shifted towards therapeutic physical education to prevent injuries and strive to reduce their occurrence. For these reasons, there emerged a need to use modern methods and technologies in physical therapy, including contemporary rehabilitation exercises" (6).

Injuries that occur to various regions and organs of the body, especially the knee joint due to its nature and function, unlike other joints, bear the weight of the body and sudden movements. This has led many specialists to find effective ways to enhance the functionality of these organs and provide what they lack. One such method is the rehabilitation program in a sandy environment. Training in a sandy medium is one of the training methods that provides a safe environment due to its lower hardness for players and trainees, in addition to the possibility of providing varying levels of resistance within this medium. This environment, which acts as a resistance against external forces through the embedding of the foot in the sand, increases the body weight and consequently the resistance on the muscles in performing their motor function. It is also used in the treatment, rehabilitation, and training of players because this environment provides individuals practicing in it with a sense of satisfaction and tranquility.

Therefore, the importance of the study emerged through the researchers' efforts to highlight two stages of the meniscal injury of the knee by employing the rehabilitation program using a sandy environment for players suffering from partial tears of the medial meniscus in volleyball clubs in Baghdad.

### **The research problem:**

emerged from the researchers' observation of a high incidence of medial meniscal tears among volleyball players in Baghdad clubs. Through monitoring various rehabilitation programs, post-

injury preventive exercises, and techniques used in numerous injuries affecting muscles and joints, the researchers turned to employing a sandy environment and diverse rehabilitation exercises, like the sandy environment, as a temporary solution. This approach aimed to explore the extent of the impact of these exercises during and after the rehabilitation period in improving the range of motion of the knee joint among players with partial tears of the medial meniscus in Baghdad's volleyball clubs.

### **The research aimed to:**

- Develop rehabilitation exercises in a sandy environment for volleyball players in Baghdad clubs who are suffering from partial tears of the medial meniscus.
- Examine the impact of the rehabilitation exercises in a sandy environment on the range of motion (extension-flexion) of the knee joint in players with partial tears of the medial meniscus in Baghdad's volleyball clubs.
- Investigate the differences between the experimental and control groups in improving the range of motion (extension-flexion) of the knee joint for players with partial tears of the medial meniscus in Baghdad's volleyball clubs.

### **The researchers hypothesized:**

- There are statistically significant differences between the pre-test and post-test results of the experimental and control groups, favoring the post-tests in improving the range of motion (extension-flexion) of the knee joint in players with partial tears of the medial meniscus (medial) in Baghdad's volleyball clubs.
- There are statistically significant differences between the post-test results of the experimental and control groups, favoring the experimental group in improving the range of motion (extension-flexion) of the knee joint in players with partial tears of the

medial meniscus (medial) in Baghdad's volleyball clubs.

**Research Domains:**

- **Human Domain:** A sample of volleyball players from Baghdad clubs who have suffered partial tears of the medial meniscus in the knee joint.
- **Temporal Domain:** From 10/6/2023 to 20/12/2023.
- **Spatial Domain:** The Physical Therapy Center / Al-Wasti Hospital / Baghdad and Spitar 2 Medical Rehabilitation Center / Baghdad.

**Method and Procedures:**

**Research Methodology**

The researchers adopted an experimental approach with two groups utilizing both pre-test and post-test methods, as this was deemed most suitable given the nature of the problem and the objectives of the study. Abdul Mohsen citing Al-Abbadi notes that "the research methodology is one of the most important steps on which the success of research procedures depends and is based on the nature of the problem" (5).

**Research Population and Sample:**

The researchers identified the research population as volleyball players from Baghdad clubs

participating in the Iraqi Premier League, totaling 16 players. These players were distributed into two groups: an experimental group (8 players) and a control group (8 players). The sample was selected deliberately, representing players from Baghdad volleyball clubs who had suffered partial tears of the medial meniscus. After conducting all the procedures related to the sample and implementing all the specific conditions and instructions for the sample, which included:

- Assessing the severity of the injury by a specialist doctor and conducting examinations to confirm the degree and type of injury.
- Obtaining the consent of the research sample members to comply with all the conditions and instructions of the study protocol, especially the rehabilitation exercises.

**Homogeneity and Equivalence of the Research Sample:**

To start from a consistent baseline and ensure the validity and accuracy of the results, the researchers conducted homogenization of the sample based on variables (age, mass, height, training age). They calculated the skewness coefficient, as shown in the following table:

**Table .1** It shows the homogeneity for the variables (chronological age, training age, total body height, mass)

Variables	Measurement Unit	Arithmetic mean	Standard Deviation	Median	Skewness Coefficient
Chronological age	Year	18.21	2.16	17.10	0.369
Training age	Year	3.14	1.15	2.14	1.012
Height	cm	1.78	0.178	1.752	0.193
Mass	kg	78.21	1.02	71.245	0.0689

**Table .2** Displays the results of the pre-test (mean, standard deviation, calculated T-value, and significance of differences) between the experimental and control groups in the research tests

	Experimental group	Control group	Significance
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Statistical Coefficients	Measurement Unit	Arithmetic Mean	± Standard Deviation	Arithmetic Mean	± Standard Deviation	Calculated T-value	Significance Level	
Test Name								
Knee range of motion (extension)	Degree	168.17	3.99	161.21	3.80	0.364	1.021	Not significant
Knee range of motion (flexion)	Degree	162.17	8.72	162.34	8.12	1.069	0.126	Not significant

**Significant at a significance level of (0.05) with 14 degrees of freedom**

### **Means of Information Collection, Devices, and Tools Used:**

These are all the means that assist the researcher in gathering information and facilitate achieving the objectives to solve the problem of their study. Al-Rubaie states, "Research tools are the means through which a researcher can solve their problem, regardless of the nature of those tools, data, samples, and devices" (7). The following were utilized:

### **Means of Information Collection:**

- Arabic and foreign sources.
- International Internet network.
- Observation.
- Personal interviews by experienced specialists.
- Tests and measurements.
- Related statistical tools.

### **Devices and Tools:**

- Stopwatch.
- Foam mat.
- Goniometer.
- Adhesive tape or phosphorescent markers.
- Measuring tape.
- Chalk.
- Cones.
- Various office supplies.

### **Field Research Procedures:**

#### **Identifying the variables under study:**

After reviewing numerous sources, references, and scientific research, and conducting interviews with experts and consulting them, it was agreed to

focus on the range of motion of the knee joint in terms of extension and flexion.

### **Tests Used in the Research:**

- Range of Motion Tests for the Knee Joint: Inaam Al-Najjar (2)

**Firstly:** Range of Motion Test for the Knee Joint in Extension.

**Secondly:** Range of Motion Test for the Knee Joint in Flexion.

### **Pilot Study:**

The researchers, with the assistance of team (Appendix 1), conducted a pilot study on two individuals from the study sample. This was done to determine the time required and the method of conducting the tests, as well as to assess the suitability of the rehabilitative exercises and their feasibility on a sandy medium. The tests were conducted on the afternoon of Saturday, June 17, 2023, on two individuals from within the study sample.

The purpose of the pilot study, as indicated by Haider Abdul Razzaq Al-Abbadi (4):

- Determine the duration of each test and the total time for all tests.
- Prepare the necessary devices, tools, and suitable location for the tests.
- Assess the efficiency of the assisting team and train them on how to conduct the tests.
- Identify any problems or obstacles that occur during the experiment.

### **Main Experiment:**

#### **Pre-test:**

The researchers conducted the pre-test on the study sample under the supervision of the

assisting team immediately after the patient's consent. They initiated the tests related to the range of motion of the knee joint, ensuring that all specific conditions for the test (both temporal and spatial) were met. Additionally, they verified that these tests did not impose any burden on the patient. The tests were conducted on Tuesday 20/06/2023.

### **Preparation of Rehabilitation Exercises:**

The researchers reviewed numerous scientific sources and studies on rehabilitation exercises, in addition to conducting personal interviews with some experts and doctors in this field. They

designed their program by preparing a set of rehabilitation exercises suitable for a sandy environment. These exercises will be implemented over two months, totaling 60 days with 24 rehabilitation sessions. There will be a progression in the exercises and then a gradual increase in the training load. The exercises in the sandy environment are divided into various bodyweight movement exercises, exercises using boxes, or elastic ropes, with proper warm-up of 5-8 minutes before the rehabilitation sessions and cooling down exercises lasting 5 minutes after the training sessions.

**Table .2** Detailed Model of Rehabilitative Exercises

Program duration	8 weeks
Number of units	24 units
Unit duration	30 – 60 minutes
Training days	Sunday – Tuesday – Thursday

### **Post-test:**

The researchers conducted the post-test on the study sample (under the supervision of the assisting team) after completing the period of rehabilitative exercises. The tests were carried out on Thursday 24/08/2023. The researchers conducted tests related to the range of motion in conditions of extension and flexion. They ensured that all specific conditions for the test (both temporal and spatial) were met, as they had been in the pre-tests.

### **Statistical Methods:**

The Social Science Statistical Package (SPSS), V24, was used. The statistical methods employed included: 1- Mean, 2- Standard deviation, 3- Median, 4- Skewness coefficient, 5- T-test for related samples, 6- T-test for independent samples.

### **Results:**

**Table .4** It shows the pre-test and post-test results for the experimental group in the range of motion of the knee joint (extension - flexion)

Presentation and discussion of pre-test and post-test results for both the experimental and control groups regarding the range of motion of the knee joint (extension and flexion).

### **Presentation and Discussion of Pre-test and Post-test Results for the Experimental and Control Groups Regarding the Range of Motion of the Knee Joint (Extension - Flexion):**

After the researchers conducted the range of motion tests for **the knee joint (extension - flexion)** and verified the research results in Chapter Three, the study aims were realized along with the significance of the differences in the investigated variables.

**- Presentation of the pre-test and post-test results for the experimental group in the research variables:**

Pre-test	Post-test
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Statistical Coefficients	Measurement Unit	Arithmetic Mean	± Standard Deviation	Arithmetic Mean	± Standard Deviation	Calculated T-value	Error Level	Statistical Significance
Variables								
Knee Range of Motion (Extension)	Degree	168.17	3.99	176.92	2.29	14.54	0.001	Significant
Knee Range of Motion (Flexion)	Degree	162.17	8.72	150.79	5.12	11.12	0.000	Significant

**\*Significant under a significance level > (0.05) with 7 degrees of freedom.**

### Presentation and Discussion of the Pre-test and Post-test Results for the Control Group in Research Variables:

**Table .5** It shows the pre-test and post-test results for the control group in the research variables

Statistical Coefficients	Measurement Unit	Pre-test		Post-test		Calculated T-value	Significance Level	Significance
		Arithmetic Mean	± Standard Deviation	Arithmetic Mean	± Standard Deviation			
Variables								
Knee Joint Range of Motion (Extension)	Degree	161.21	3.80	175.85	2.49	11.64	0.000	Significant
Knee Joint Range of Motion (Flexion)	Degree	162.34	8.12	154.21	4.16	10.98	0.002	Significant

**\*Significant under a significance level > (0.05) with 7 degrees of freedom.**

### Presentation and Discussion of the Post-test Results for the Experimental and Control Groups in Research Variables:

**Table .6** It displays the post-test results for both the experimental and control groups in the research variables

Statistical Coefficients	Measurement Unit	Experimental group		Control group		Calculated T-value	Significance Level	Significance
		Arithmetic Mean	± Standard Deviation	Arithmetic Mean	± Standard Deviation			
Variables								
Knee Joint Range of Motion (Extension)	Degree	176.92	2.29	175.85	2.49	0.664	0.011	Significant
Knee Joint Range of Motion (Flexion)	Degree	150.79	5.12	154.21	4.16	1.624	0.002	Significant

**\* Significant under a significance level > (0.05) with 14 degrees of freedom.**



### **Discussion:**

Through the data presented in tables (4), (5), and (6), it is evident that significant differences exist between the pre-test and post-test results, as well as among the post-test results for both the control and experimental groups. The researchers attribute these differences to the nature of the rehabilitation exercises they designed using a sandy environment (serving as both a training and rehabilitation medium). This environment is characterized by resistance that helped the injured individuals achieve varied improvements in their range of motion. The Sport Injury Clinic notes, "The improvement and development resulted from enhanced efficiency and strength of the muscles working on the joint movement in the thigh and leg, which helps them to withstand the mechanical stresses directed on the joint during movement. The cohesion of ligaments and the flexibility of muscles provide benefits in preventing stiffness and enhancing motion flexibility." (14)

Rehabilitation exercises are considered one of the most effective physical therapy methods for treating sports injuries through rehabilitation programs designed based on studied scientific principles. The objective of rehabilitation exercises is to quickly restore the injured part to its physical and functional capabilities. This aligns with Thamer Kamal Al-Dawoodi's view. Therefore, rehabilitation exercises have facilitated the rapid recovery of muscles to their functions (3). Lamyaa et al. suggest that performing physical exercises to improve muscle flexibility aids in the fluidity of movement. The researchers also attribute to the fact that rehabilitation training within a therapeutic environment helps increase the injured person's ability to improve body angles. (11). This aligns with what was mentioned by Huda Badawi stating that "the rehabilitation exercises that were developed must consider the gradation in effort and rest periods, while providing exercises that increase the movement of the joint in terms of

extension and flexion by the muscles around the knee joint." (10). The researchers confirm the effectiveness of rehabilitation exercises in developing the range of motion in the knees, which significantly affects the flexibility of the joint. Joint pain limits movement, causing loss of normal range; thus, improvement relies on increasing the flexibility and elasticity of the muscles and tendons working on the knee during extension and flexion. This aligns with the study by Morad et al. which emphasizes the diversity in the use of exercises and repetitions that characterize rehabilitation exercises. These are carefully and balance ably defined, with full importance and sufficient time given to choosing appropriate exercises. (12). Moreover, the rehabilitation exercises include some resistance, using weights or without, which the researchers in the sandy environment have replaced as an alternative to traditional resistance. This substitution serves to strengthen the joint and enhance its strength and flexibility. Training on sand serves as an effective rehabilitation method by increasing the number of training types available to the athlete, allowing for daily, consecutive training sessions. Additionally, it facilitates high-intensity rehabilitation exercises. Sand provides a natural environment for resistance training, which enhances performance levels while reducing stress on the injured area. The researchers believe it is essential to incorporate various resistances in rehabilitation exercises during sports rehabilitation. Therefore, they attempted to use a training method in a sandy environment, aiming for a gradual progression of exercises that align with the severity of the injury. This approach aligns with what was mentioned by Shaimaa et al. who noted, "Researchers in the field of sports training and rehabilitation have turned to using varied and modern training methods. The goal is to equip athletes with high physical, motor, and skill capacities that enable them to perform optimally during training and competition" (13). Therefore, it is essential to

rehabilitate and comprehensively prepare athletes to reach competitive rehabilitation levels in various aspects. Badwi Shbeeb et al. note, "Coaches need to focus on developing players through continuous play and allowing them to seize appropriate opportunities to enhance their readiness and capabilities." (8). This is in agreement with what was mentioned by Easa et al. "Engaging in physical effort has a significant impact on the functioning of internal systems, increasing their efficiency and adaptation to training, which reduces the injuries that could potentially affect players and especially runners." (9).

### **Conclusions:**

1. The sandy environment plays an important role in developing the range of motion for individuals with medial meniscal tears.
2. The rehabilitation exercises developed by the researchers have a positive effect on improving the range of motion in individuals with medial meniscal tears.

### **Recommendations:**

- 1- Adopt the rehabilitation exercises developed by the researchers for rehabilitating patients with partial tears of the medial meniscus.
- 2- Implement the rehabilitation exercises devised by the researchers in other training environments, such as aquatic settings, for treating the same injury or other lower limb injuries.

### **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 local ethical committee of physical education and sport sciences college for women on (February /2024)

### **Author's contributions:**

All contributions of this study were done by the researchers (R.I. and H.B.) who get the main idea and work on writing and concluding also with number of experts, Maurizio Bertollo in revision, Inaam Ghalib in translating, Khitam Mousa in proofreading

**Facilitate the task:** this study was supported by Baghdad club volleyball players / Baghdad – Iraq

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### Appendices

#### Appendix (1)

##### Assistant Team Members

Seq.	Name	Position	Place of Work
1	Dr. Alaa Abdullah Mohsen	Sports Rehabilitation Coach	Injury Training and Rehabilitation Center
2	Farouk Fouad	Teacher	Directorate of Education, Baghdad Al-Rusafa
3	Haifa Dawood	Coach	Directorate of Education, Baghdad Al-Rusafa
4	Zahraa Qasim	Teacher	Directorate of Education, Baghdad Al-Rusafa

#### Appendix (2)

##### Rehabilitation Unit Model

Week: First

Rehabilitation Unit: First

Unit Duration: 20 to 30 minutes

Number of Players: 8

Exercise	Repetitions	Sets	Rest Between Sets	Exercise Duration	Total Time

1. From a standing position, bend the knees to a 90-degree angle downwards.	8	2	1 min.	6 Sec.	1.12
2. From a standing position, bend the knees and jump upwards.	8	2	1 min.	8 Sec.	1.16
3. Alternating leg openings to the sides from a standing position.	8	2	1 min.	6 Sec.	1.12
4. Alternating leg openings to the front and back from a standing position.	8	2	1 min.	6 Sec.	1.12
5. Alternately lift the knees to a 90-degree angle with the hips.	8	2	1 min.	6 Sec.	1.12
6. Alternately extend the leg forward to a 90-degree angle.	8	2	1 min.	10 Sec.	1.20
7. Walk forward with the knee bent at a 90-degree angle.	8	2	1 min.	10 Sec.	1.12
8. Walk forward to the side.	8	2	1 min.	6 Sec.	1.12
9. From a standing position, bend the knees to a 90-degree angle backwards.	8	2	1 min.	6 Sec.	1.12
10. From a sitting position, extend both legs forward.	8	2	1 min.	10 Sec.	1.20

## تأثير تمارين تأهيلية بالوسط الرملي في تحسين المدى الحركي لمفصل الركبة للمصابين بالتمزق الجزئي في الغضروف الهلالي (الانسي) للاعبين اندية بغداد بالكرة الطائرة

ريام عماد جاسم 1 ، هدى بدوي شبيب 2  
2&1 جامعة بغداد / كلية التربية البدنية و علوم الرياضة للبنات - العراق

مستخلص البحث

ان التمرينات التأهيلية احدى مبادئ التأهيل الرياضي لعلاج الاصابات الرياضية ومن ضمنها الاصابة بالتمزق الجزئي في الغضروف الهلالي، فالاصابات التي تحدث في مناطق واعضاء الجسم ولاسيما مفصل الركبة بطبيعة اداءه و عملة عكس المفاصل الاخرى وما يتحمله من مرونة الجسم والحركات المفاجئة لما دفع الباحثان الى ايجاد فرص فعالة في زيادة فاعلية الاعضاء الوظيفية وتوفير ما ينقصها واحداهما هي التمرينات التأهيلية في الوسط الرملي التي توفر بيئة آمنة وهدف البحث - اعداد تمارين تأهيلية بالوسط الرملي لدى لاعبي الكرة الطائرة في اندية بغداد المصابين بالتمزق الجزئي للغضروف الهلالي.

- التعرف على تأثير التمرينات التأهيلية بالوسط الرملي في المدى الحركي لمفصل الركبة (المد - الثني) للمصابين بالتمزق الجزئي للغضروف الهلالي لدى لاعبي الكرة الطائرة في اندية بغداد.

- التعرف على الفروق بين المجموعتين التجريبية والضابطة في تحسين المدى الحركي لمفصل الركبة (المد - الثني) للمصابين بالتمزق الجزئي للغضروف الهلالي لدى لاعبي الكرة الطائرة في اندية بغداد , اما منهج البحث فقد استخدمت الباحثان المنهج التجريبي ذو المجموعتين التجريبيتين ذوات الاختبارين القبلي والبعدي وتم اعداد التمرينات التأهيلية الهدف الاساسي منها تحسين المديات الحركية لمفصل الركبة (المد والثني) لدى لاعبي اندية بغداد بالكرة الطائرة وقد استخدمت الباحثان الاختبار القبلي ومن ثم التمرينات التأهيلية والاختبارات البعدية والحصول على البيانات لغرض معالجتها احصائياً وبعد الحصول على النتائج والاستنتاجات توصي الباحثان بمايلي :

1- اعتماد التمرينات التأهيلية المعدة من قبل الباحثان في تأهيل المصابين بالتمزق الجزئي للغضروف الهلالي (الانسي).

2- اعتماد التمرينات التأهيلية المعدة من قبل الباحثان في اوساط تدريبية اخرى كالوسط المائي لعلاج نفس الاصابة او اصابات الطرف السفلي. وهذا ما يحقق احد اهداف التنمية المستدامة للامم المتحدة في العراق (الصحة الجيدة).

التمرينات التأهيلية , الوسط الرملي , المدى الحركي للركبة (المد - الثني) , التمزق الجزئي في الغضروف الهلالي (الانسي)

الكلمات المفتاحية