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THE EFFECT OF SPECIAL EXERCISES USING LOW-POWER LASER IN REHABILITATING REFLEX ANKLE SPRAIN INJURIES IN ADVANCED BASKETBALL PLAYERS

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Abstract:
The research aims to prepare special exercises using a low-power laser to rehabilitate a reflex ankle sprain injury for advanced basketball players, and to identify the effect of exercises using a low-power laser to rehabilitate a reflex ankle sprain injury for advanced basketball players.
To achieve the goal, the researcher used the experimental method with pre-test and post-test to suit it with the research problem. The research sample was chosen intentionally from advanced basketball players with reflex ankle sprain for Baghdad clubs for the sports season (2023/2024), numbering (12) players representing the original research community. 100%, after diagnosing the injury, its severity, and medical history from the specialist doctor. The researcher also chose players as a reconnaissance sample and they were excluded from the main sample, The researcher conducted a pre- and post-test for the members of the research sample, and conducted appropriate statistical treatments. The researcher concluded that there was a clear development for the members of the research sample in the variables investigated when using laser rehabilitation exercises with special exercises, and that using the laser approach with special exercises helped better in the rehabilitation process. Relieves reflex sprain injury to the ankle joint by improving the range of motion and muscle strength of the joint.
The researcher recommends adopting modern techniques (laser) in the process of rehabilitating the reflex sprain injury of the ankle joint and the rest of the joints of the body, as well as disseminating the rehabilitation approach used with laser with special exercises to rehabilitation and physical therapy centers in hospitals for the purpose of applying it to the injured, and adopting low-power laser in the process of alleviating and eliminating pain. in the affected area.
Keywords: Low laser power, ankle sprain.

1. Introduction and Importance of Research

Introduction:

Sports injuries are a primary obstacle to athletic progress and performance enhancement. Athletes often sustain injuries due to inadequate adherence to scientific and technical training guidelines, particularly during high-intensity competition or prolonged exertion. Most injuries occur when a body part is subjected to forces beyond its physiological limits (Hazem Al-Nahar et al., 2010, p. 106).
Ankle sprains, especially reflex ankle sprains, are common in basketball, a sport characterized by high physical demands. The injury arises from physical contact, overexertion, weak ankle ligaments, and inadequate physical preparation. Such factors can lead to prolonged recovery periods, sometimes even forcing players to retire temporarily. Effective rehabilitation strategies combining therapeutic exercises and modern technologies are thus essential for restoring optimal performance levels (Mohammed Mutlaq Badr Lazim, 2003, p. 7).

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Hence, the importance of this research lies in the necessity of employing specialized exercises using low-level laser therapy to rehabilitate ankle sprain injuries in advanced basketball players. This approach aims to enable athletes to return to the field in a shorter time and at a performance level comparable to, or close to, their pre-injury state.

2. Research Problem:

Injuries often act as both physical and psychological barriers, preventing athletes from reaching top performance levels. Basketball players, in particular, are frequently exposed to various injuries. Through continuous observation of league matches and training sessions, as well as personal interviews with coaches, the researcher has noted that players suffer from a wide range of sports injuries. Among the most common is the recurrent ankle sprain. Injuries affecting the foot and ankle are highly prevalent in the sports community, with athletes often experiencing repeated injuries in this region of the lower limbs. These injuries vary in terms of their mechanism and the extent of damage they cause. Even minor injuries can sometimes prevent an athlete from engaging in their activity as if the injury were severe (Kumuna team, 2002, p. 223).

Moreover, there is often a misjudgment of the injury's severity by either the coach or the player, coupled with premature returns to the field before full recovery. This is usually driven by the athlete's eagerness to play or the coach's pressing need for their participation. Such practices exacerbate the condition and worsen the injury. Rehabilitation periods tend to be relatively lengthy and less effective due to the lack of modern tools and techniques in the recovery process.

In light of this, the researcher seeks to contribute by employing specialized exercises utilizing low-level laser therapy to rehabilitate recurrent ankle sprains in advanced basketball players.

3. Research Objectives:

- **Develop** specialized exercises utilizing low-level laser therapy to rehabilitate recurrent ankle sprains in advanced basketball players.
- **Identify** the impact of these specialized exercises using low-level laser therapy on the rehabilitation of recurrent ankle sprains in advanced basketball players.

1.4 Research Hypothesis:

- There are statistically significant differences between the pre-test and post-test results in rehabilitating recurrent ankle sprains in advanced basketball players.

1.5 Research Scope:

1. **Human Scope**: A sample of advanced basketball players during the 2023–2024 sports season.
2. **Time Scope**: From February 1, 2024, to May 16, 2024.
3. **Place Scope**: Rehabilitation and Physical Therapy Center in Baghdad.

3. Research Methodology and Field Procedures:

3.1 Research Methodology:

The researcher employed the experimental method using a pre-test and post-test design, as it aligns with the nature of the research problem.

3.2 Research Population and Sample:

The sample was purposively selected from advanced basketball players in Baghdad clubs who suffered from recurrent ankle sprains during the 2023–2024 sports season. The total sample size was 12 players, representing 100% of the original research population. Injuries were diagnosed, and their severity and medical history were confirmed by a specialist physician. Two players were selected for a pilot study and excluded from the primary sample.

The researcher ensured the sample met the following criteria:

- Injury severity.
- Timing of the injury occurrence.

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3.3 Methods, Tools, and Equipment for Data Collection:

3.3.1 Data Collection Methods:

- Arabic and foreign references and sources.
- Personal interviews.
- Examination forms.
- Internet resources.
- Tests and measurements.
- Pilot experiments.

3.3.2 Tools and Equipment Used:

- Multi-weight loads.
- Towel.
- Green elastic band.
- Square-shaped glass plate.
- Electronic stopwatch.
- UAE-manufactured low-level laser device.
- Goniometer for measuring joint movement and muscle activity.
- Fabric shoe with loops at the front and back, worn by the injured individual.

4. Field Research Procedures:

3.4.1 Tests Used in the Research:

1. Measuring the Plantar Flexion Angle of the Ankle Joint (PEGGY AHOUGLUM, 2012, p. 361):

- **Test Name**: Measuring the plantar flexion angle of the ankle joint.
- **Purpose**: To measure the range of motion of the ankle joint during toe movement in the maximum plantar flexion direction.
- **Equipment Used**: Goniometer, flat chair, and a cotton cushion placed under the knee to ensure the proper alignment of the leg.
- **Performance Description**: The injured person sits on a flat chair, placing the injured leg on a level surface. A cotton cushion is placed under the knee to maintain proper alignment of the leg. The foot is positioned at a 90-degree angle. Upon receiving the therapist's cue, the injured person performs plantar flexion. The researcher uses the goniometer to determine the range of motion achieved during the test.
- **Recording**: The value is recorded by reading the angle indicated by the goniometer's pointer. Two attempts are given, and the best value is recorded.

2. Measuring the Dorsiflexion Angle of the Ankle Joint (PEGGY AHOUGLUM, 2012, p. 361):

- **Test Name**: Measuring the dorsiflexion angle of the ankle joint.
- **Purpose**: To measure the range of motion of the ankle joint by reducing the angle between the dorsum of the foot and the leg.
- **Equipment Used**: Goniometer.
- **Performance Description**: The injured person stands with their back against a wall, extending the injured foot slightly forward compared to the other foot. The injured foot is positioned at a 90-degree angle. Upon the therapist's cue, the person performs dorsiflexion while maintaining the ankle joint's fixed point of reference. The range of motion is measured using the goniometer.

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- **Recording**: The value is recorded by reading the angle indicated by the goniometer's pointer. Two attempts are given, and the best value is recorded.

3. Measuring the External Inversion Angle of the Ankle Joint (PEGGY AHOUGLUM, 2012, p. 356):

- **Test Name**: Measuring the external inversion angle of the ankle joint.
- **Purpose**: To measure the range of motion of the ankle joint during external inversion.
- **Equipment Used**: Goniometer, recording pen, white paper placed under the heel, and a square glass plate (40 × 30 cm).
- **Performance Description**: The injured person adopts a long-sitting position on the floor, aligning the injured foot toward the glass plate. The foot is positioned at a 90-degree angle between the leg and foot bones at the ankle joint. Upon the therapist's cue, the injured person performs external inversion by pushing the glass plate. The researcher records the angle using the goniometer and the white paper placed under the foot.
- **Recording**: The value is recorded by reading the angle indicated by the goniometer's pointer. Two attempts are given, and the best value is recorded.

4. Measuring the Internal Inversion Angle of the Ankle Joint (PEGGY AHOUGLUM, 2012, p. 356):

- **Test Name**: Measuring the internal inversion angle of the ankle joint.
- **Purpose**: To measure the range of motion of the ankle joint during internal inversion.
- **Equipment Used**: Goniometer, recording pen, white paper placed under the heel, and a square glass plate (40 × 30 cm).
- **Performance Description**: The injured person adopts a long-sitting position on the floor, aligning the injured foot toward the glass plate. The foot is positioned at a 90-degree angle between the leg and foot bones at the ankle joint. Upon the therapist's cue, the injured person performs internal inversion by pushing the glass plate. The researcher records the angle using the goniometer and the white paper placed under the foot.
- **Recording**: The value is recorded by reading the angle indicated by the goniometer's pointer. Two attempts are given, and the best value is recorded

3.4.2 Pain Levels:

The range of motion and resistance for each test were divided into three levels to assess pain intensity. Pain was measured as follows:

- For the **first level** with a score of (3), if pain was observed, a score of (3) was recorded in the first box, and (0) was recorded for the other two boxes of the same test. If no pain was observed, a score of (0) was recorded, and the test moved to the second level.
- For the **second level** with a score of (2), if pain was observed, a score of (2) was recorded, and a score of (0) was given for the third level. If no pain was observed at both the first and second levels, the test proceeded to the third level.
- For the **third level** with a score of (1), if pain was observed, a score of (1) was recorded. If no pain was observed, it indicated a normal range of motion.

The division of motion ranges for each test was as follows:

1. Measuring the Plantar Flexion Angle of the Ankle Joint:

- Pain at 90° angle → 3 points.
- Pain at 120° angle → 2 points.
- Pain at 135° angle → 1 point.

2. Measuring the Dorsiflexion Angle of the Ankle Joint:

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- Pain at 90° angle → 3 points.
- Pain at 80° angle → 2 points.
- Pain at 70° angle → 1 point.

3. Measuring the External Inversion Angle of the Ankle Joint:

- Pain at 20° angle → 3 points.
- Pain at 15° angle → 2 points.
- Pain at 10° angle → 1 point.

4. Measuring the Internal Inversion Angle of the Ankle Joint:

- Pain at 30° angle → 3 points.
- Pain at 20° angle → 2 points.
- Pain at 10° angle → 1 point.

3.4.3 Pilot Study:

The researcher conducted a pilot study on two players from the same research population on **Sunday, February 11, 2024, at 10:00 AM**. The purposes of the pilot study were:

- To prepare equipment and materials for the main experiment.
- To determine the time required to complete all tests.
- To ensure the functionality of the devices used.
- To identify obstacles and errors to avoid during the main experiment.

3.4.4 Pre-Tests:

The pre-tests were conducted on the research sample on **Thursday, February 15, 2024**, with all necessary equipment and preparations in place.

3.4.5 Main Experiment:

The researcher implemented special exercises using low-power laser therapy for rehabilitating the research sample suffering from reflective ankle sprains. The specifications of the rehabilitation units were as follows:

- Conducted over three weeks, with three units per week.
- The laser therapy dose duration was **3 minutes**.
- The red laser used had a wavelength of **660 nm**.
- Each rehabilitation session lasted between **30–45 minutes per patient**.
- Exercises utilized body weight and auxiliary tools such as weights, elastic bands, and towels.
- The exercises followed a gradual progression to improve joint flexibility and strength.
- Movement ranges of the ankle joint were carefully considered when designing the exercises.
- The exercises were structured into weekly units:
    - **Week 1**: Four exercises referred to as "passive exercises."
    - **Week 2**: Seven exercises referred to as "active exercises."
    - **Week 3**: Seven exercises referred to as "resistance exercises."
- A total of **nine rehabilitation units** were completed per injured player.
- The main rehabilitation sessions began on **Sunday, February 18, 2024**, and concluded on **Thursday, March 7, 2024**.

3.4.6 Post-Tests:

After completing the pre-tests and rehabilitation program, the researcher conducted the post-tests with the assistance of the supporting team on **Sunday, March 10, 2024**. The tests were supervised by the researcher and her team.

3.6 Statistical Tools:

The following statistical tools were used in the study:

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- **IBM SPSS Ver. 20** to calculate:
  - Arithmetic mean.
  - Standard deviation.
  - Skewness coefficient.
  - Paired samples t-test.

4. Results Presentation, Analysis, and Discussion

4.1 Presentation and Analysis of Test Results:

Further details on the results and discussion would follow in this section.

Variable	Pre-Test Mean	Post-Test Mean	T-Value	Significance
Plantar Flexion (°)	103 ± 6.26	133.5 ± 4.2	30.63	Significant (p<0.05)
Dorsiflexion (°)	83.72 ± 1.7	73.75 ± 0.96	10.93	Significant (p<0.05)
External Rotation (°)	10.5 ± 2.81	19.20 ± 1.71	15	Significant (p<0.05)
Internal Rotation (°)	17.75 ± 0.97	28.35 ± 1.5	21	Significant (p<0.05)
Pain Score (1-10)	15.5 ± 0.58	2.5 ± 0.5	31.48	Significant (p<0.05)

The post-test means indicated significant improvements in range of motion and strength, alongside a notable reduction in pain levels.

Table (1) illustrates the statistical indicators of the test results for the pre- and post-measurements of the research variables applied to the study sample. The results indicate that the mean values for all variables were higher in the post-test compared to the pre-test, with a significant difference between the two tests favoring the post-test. This suggests that higher mean values correlate with improved levels, except for the pain scale. For the pain scale, the mean values were lower in the post-test compared to the pre-test, indicating a significant improvement in favor of the post-test. This is because the values for such variables are inverse—lower mean values indicate better levels, as they reflect reduced pain levels. The significance levels for all research variables were below the threshold of 0.05, indicating significant differences between the pre- and post-tests. The researcher attributes the improvement in the post-test results compared to the pre-test to the implementation of the rehabilitation program designed by the researcher for rehabilitating the inverted ankle joint injury. This program led to improvements in the joint's range of motion and muscular strength. The use of laser therapy alongside specific exercises had a significant positive effect on rehabilitating the ankle joint, maintaining its strength, and enhancing its range of motion. Recent research published in reputable scientific journals worldwide has consistently demonstrated the effectiveness of laser therapy compared to other treatment methods, particularly in the field of injury rehabilitation.

Experts emphasize that laser therapy offers superior healing and effective pain relief compared to ultrasound therapy. Over 2,000 scientific experiments conducted in recent years on this device have unequivocally demonstrated its exceptional success in medical treatments. These studies highlight the significant therapeutic capabilities of low-power laser radiation.

One of the key reasons for this progress is the consideration of the joint's range of motion and strength in a manner that simulates and gradually adapts to natural movements. The rehabilitation exercises were based on scientific principles tailored to the joint's range of motion, strength, and the mechanical impact of the muscles acting on the joint. This aligns with what (Sareeh Al-Fadhli, 2004) emphasized: that body tissues generally have a unique ability for maximum extension and contraction and are thus influenced by rehabilitation programs when athletes are exposed to gradual increases in physical loads.

Exercises are structured and purposeful movements aimed at developing motor skills in daily life and sports contexts (Bastawisi Ahmed and Abbas Al-Samarrai, 1984, p. 235). Moreover, the gradual progression in implementing these exercises had a positive impact on enhancing the flexibility and strength of the ankle joint.

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This is consistent with what (Mohammed Al-Ajam, 2013, p. 107) emphasized, stating that the principle of gradual progression acts as a safeguard against internal joint and muscular tendon disorders, effectively reducing muscle spasms—an essential aspect of the rehabilitation process.

Strength exercises also played an active role in improving the flexibility and strength of the ankle joint. This aligns with the findings of (Yasser Al-Shafei, 1993, p. 97), who highlighted that the range of motion (flexibility) of a joint is determined by the strength of the muscle groups responsible for movement and the elasticity of the opposing muscles. To enhance the range of motion in a joint, it is necessary to develop the strength of the active muscle groups and improve the strength of the opposing muscle groups, alongside exercises targeting the range of motion.

The use of rehabilitative exercises resulted in increased blood flow to the injury site, thereby aiding in the removal of waste and injury byproducts, which reduced pressure and consequently alleviated pain. It is worth noting that the exercises were performed slowly to avoid any strain that might exacerbate pain at this stage. This aligns with (Mackenzie, 1989, p. 339), who emphasized that exercises should be performed carefully to avoid pain, particularly during the initial stage of execution.

The optimal application of the prescribed exercises at regular intervals significantly contributed to the marked improvement in post-test results for the research sample.

5-1 Conclusions:

Based on the results, analysis, and discussion presented, the researcher concluded the following:

• A clear improvement was observed in the research sample's variables when using rehabilitative exercises with laser therapy alongside specific exercises.

• The use of laser therapy combined with specific exercises proved to be more effective in the rehabilitation of ankle sprain injuries, leading to improvements in joint range of motion and muscle strength.

5-2 Recommendations:

• The use of modern techniques (laser) should be adopted in the rehabilitation of sprained joints, including the ankle and other body joints.

• The rehabilitative approach using laser therapy with specific exercises should be implemented in rehabilitation and physical therapy centers within hospitals for treating injured individuals.

• The application of low-level laser therapy should be adopted to alleviate and eliminate pain in the injured area.

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• **PEGGY AHOUGLUM**, *Examination of Musculoskeletal Injury*, New York, 2012.
• **Mackenzie R.**, *Treat Your Own Back*, Orthopedic Physical Therapy Products, 1989.

Appendix (1)
Pain Degree Determination Form

Pain Degree for Each Player	Test Name and Ideal Range												Player's Name
	Eversion of the ankle joint (0° - 60°) degrees			Inversion of the ankle joint (0° - 30°) degrees			Dorsiflexion of Ankle Joint (90° - 70°)			Plantar Flexion of Ankle Joint (90° - 135°)			
	Pain during movement at the angle			Pain during movement at the angle			Pain during movement at the angle			Pain during movement at the angle			
	10	20	30	10	15	20	70	80	90	135	120	90	
	1	2	3	1	2	3	1	2	3	1	2	3	