

## Efficiency of a Rehabilitative program Using Isokinetic System and Specific Exercises to Rehabilitate Injured Athletes with Iliotibial Band Syndrome

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### **Abstract:**

The current research **aims to** design and validate a strength program using isokinetic device system and specific therapeutic exercises for rehabilitation of soccer players with iliotibial band syndrome and to identify the effectiveness of the recommended rehabilitation program. The researcher used the **experimental approach** (one-group design) with pre- and post-measurements. **The research sample** consisted of 4 soccer players who have been registered with the Egyptian Football Federation (premier league) with iliotibial band syndrome volunteered in this study, Their ages ranged from 18 to 27 years . The researcher used Isokinetic device system (SP3-I37). The following parameters were measured for both the healthy and injured limbs: the Peak Torque at flexion and extension at the 90/180 ° angle, range of motion (ROM) of the knee joint, the balance, the circumference of the thigh muscles and the degree of pain. **Results indicated that:**

1. The isokinetic device System has positive effects on improving muscular Peak Torque of the affected muscles (quadriceps femoris – biceps femoris – glottis medialis – glottis minor – tensor fascia latae) in addition to increasing the knee joint range of motion.
2. The isokinetic device improves muscular balance and stability among soccer players with iliotibial band syndrome
3. Isokinetic device works effectively on restoring functional capacity of affected muscles and helps athlete to return to normal condition quickly and effectively compared with regular rehabilitation programs.
4. Stretches and plyometric exercises increase the range of motion for knee joint and muscle elasticity.

**The researcher recommends** that the importance of using the Isokinetic device in the field of training and rehabilitation, the need to infer the healthy limb of the player in the rehabilitation programs.

**Key Words:** Peak Torque - Iliotibial Band Syndrome – Balance - Range Of Motion (ROM) – Isokinetic.

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**Introduction and Research Problem:**

game and this makes him more vulnerable to injuries.

Rushdy, M. (2003) also indicated that soccer is a physical contact game and injuries may occur due to direct or indirect contact as this depends on movement mechanics.

Riad, O. (2002) indicated that injuries vary according to the nature of game performance. For example, 69% of injuries in soccer are in the lower limb as it is frequently used in performance.

Prentice, W. (2014) indicated that iliotibial band syndrome is a common knee injury that appears as pain in the lateral side of the knee due to inflammation of the lateral side of iliotibial band. Iliotibial band is a thick band that passes through the thigh joint, stretches laterally and finally inserts in the trachea and biceps femoris. Repeated flexion/extension of the knee joint causes inflammation of the iliotibial band and pain spreads along the lateral side of the knee. This causes significant pain and may hinder sports participation.

The iliotibial band is an extension of the Tensor Facia Latae (TFL) and glottis muscles. It is attached to the rough coarse helix line of the femur through muscle membranes to pass the lateral border of the lateral peak of the femur.

It extends outward to insert in the lateral surface of the patella and the lateral side of the trachea as these two points represent the lateral bonding points of the band. It only attaches to the area where it passes the lateral side of the patella and the trachea. The muscle group including Tensor Facia Latae (TFL), Glottis Medialis and Glottis Minor for the short bonding belt between the hippocampus and the anterior iliac fork from the lateral side of iliac cap.

Samuel, S. (2014) indicated that iliotibial band syndrome results from overuse of tissues surrounding the lateral side of the knee. This leads to inflammation of these tissues due to repeated friction between the band and penetrating lower part of the femur bone. This band supports the

Sports medicine, especially sports injuries, has witnessed massive developments recently in safety procedures to decrease injury rates but injuries are increasing constantly due to increased enthusiasm of athletes, high degree of competition and seeking to win higher ranks in various fields of sport. Participation in sport poses significant pressure on joints, ligaments, synovial bags, tendons and spine and this may lead to chronic injuries (Abd El-Hafeez, M. 2013).

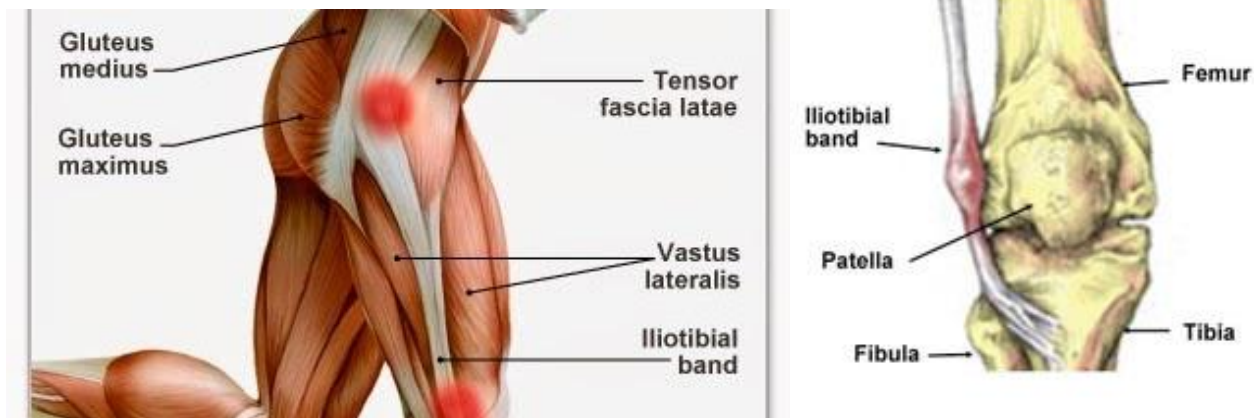
Lamp, D. (2004) indicated that the performance level of soccer witnessed significant improvements and effort exerted during matches doubled during sports seasons. This means that soccer requires high level of physical and physiological efficiency so the player can fulfill his attack/defense tactical duties effectively all along the match. The game is also rough and highly competitive and this requires significant attention during training and preparation.

Motor performance of a soccer player is not merely a set of several skills. Instead, it is the result of various other qualities of the player including physical, functional, physiological, psychological and mental aspects. The lack of these qualities affects the technical/tactical performance of soccer player negatively and prevents him from reaching elite levels (Gaber, A. 2001).

Allawy, M. & Abd El-Fattah, A. (2000), quoting Bargeman, indicated that some sports statistics showed that 7 of every 10 players suffer from different injuries. This leads them to quit training and competitions for a period ranging from 3 weeks to 3 months.

Ghaleb, A. (2003) indicated that soccer is a team sport that requires good physical preparation to improve general and specific physical abilities of players and to enhance functional efficiency of whole body system to its max. This is because soccer player is more vulnerable to physical contact with the opponent than in any other

flexion and extension lateral part of the knee especially during



### Iliotibial Band Syndrome

dealing with iliotibial band syndrome via the isokinetic device not only in functional measurement but also in using it in a post-injury motor rehabilitation program. The device plays a significant role in evaluating and rehabilitating injured athletes. During the last few years, uses of the isokinetic device varied greatly as it can measure the specified muscles without interfering with other muscle groups in addition to its safety and accuracy.

According to the researcher's knowledge, no previous study dealt with this injury in athletes, especially soccer players, in the Arab region while some foreign studies dealt with this injury's rehabilitation through therapeutic exercises and various types of strength exercises like Razib K, & Sharon, H. (2005), Ferber, R. et al (2010), John, M.& Consuelo, T. (2014) and Samuel, S. (2014).

James, R. & Andrews, M. (2010) indicated that the isokinetic device is a recent technology with multiple applications including evaluation, testing and rehabilitation through its functions. This provides us with valuable information like muscular strength, work, Peak Torque and range of motion. Through its function we can develop rehabilitation programs to be more effective. Its tests are related to the concept of applying changing resistances on a constant velocity.

Prentice, W. (2014) indicated that this injury is very common among soccer players, long-distance runners, cyclists, weight lifters, long jumpers and other athletes who are required to squat repetitively. Inflammation of the iliotibial band leads to difficulty in knee joint movement and decreases its range of motion. Symptoms include pain during walking or climbing the stairs, numbing in the knee joint, click sound during knee flexion/extension and subcutaneous implants with high temperature due to inflammation.

Through the researcher's work in the field of training and rehabilitation, she noticed that this injury is common and in most cases, it is misdiagnosed. Therefore, it is important to solve this problem so as to avoid any complications that may occur in this important area due to its negative effects on major thigh muscles which in turn lead to more injuries in the knee joint. In addition to therapeutic exercises, the researcher will use strength exercises on the isokinetic device that is commonly used in functional measurements of joints, especially the knee joint as its software calibrates itself according to the state and abilities of muscles in the injured area. According to the researcher's knowledge, this study is one of pioneer studies in

**Aims:****The current research aims to:**

1. Design and validate a strength program using isokinetic device system and specific therapeutic exercises to rehabilitate soccer players with iliotibial band syndrome.
2. Identify the effectiveness of the recommended rehabilitation program through identifying:
  - Pain degree
  - Peak Torque of affected muscles working on the knee joint at 90°/180° angle in flexion/extension
  - Knee range of motion
  - Thigh circumference
  - Balance (Front/Back with one foot – Lateral – Front/Back feet together)

**Hypotheses:**

1. The recommended rehabilitation program leads to elimination of pain in the injured limb.
2. Using Specific therapeutic exercises and isokinetic device exercise lead to improvements in the post-measurements, compared to pre-measurements, of the following variables:
  - Peak Torque of affected muscles working on the knee joint at angle 90°/180°.
  - Knee range of motion
  - Thigh circumference
  - Balance (Front/Back with one foot – Lateral – Front/Back feet together).
3. There are no statistically significant differences between the injured limb and the healthy limb on all physical variables under investigation.

**Methods:**

**Approach:** The researcher used the experimental approach (one-group design) with pre- and post-measurements.

**Participants:** The research sample consisted of 4 soccer players who have been registered with the Egyptian Football Federation (premier league) with iliotibial band syndrome volunteered in this study. They were chosen according to the following criteria:

- All players were diagnosed as having iliotibial band syndrome
- They are all between 18-27 years
- They are all volunteers
- They did not undergo any previous knee surgery
- They are not under any other rehabilitation program during the main study
- Injury is in one leg
- The injured limb is free of any other injuries

**Table (1): Descriptive data of anthropometric and age variables of participants (n=4)**

Variables	Measurement unit	Mean	SD	Squewness
Age	Year	24.12	2.53	0.327
Height	Cm	174.43	3.41	0.015
Weight	Kg	73.93	5.05	0.715

**Devices and tests:**

- Isokinetic device (SP3-I37) for measuring muscular strength of knee working muscles and knee joint range of motion in flexion/extension at 80°/190° angle. (Attachment 1).
- Biodex Balance System for measuring muscular balance (front, lateral and both feet). (Attachment 2).

- A restameter for measuring heights and a medical balance for measuring weights
- Visual Analog Scale (VAS) for measuring pain degree. (Attachment 3).
- Data recording form for each participant

#### Assistants tools for the rehabilitative program:

Sand bags – cones – training plates – hoops – matrixes – swiss balls – trampoline – alternative balls – soccer ball – stop watch

The researcher chose to perform procedures of testing and rehabilitation at the kinesiology lab of Faculty of Physical Education for Men – Helwan University and Ahly Club for the following reasons:

- Isokinetic device (SP3-I37) and Biodex Balance system is available at the Faculty of Physical Education for Men – Helwan University
- Other instruments are available at the Ahly club.

#### Pilot study:

Pilot study was performed on (one) soccer player with iliotibial band syndrome for nine weeks from May 2014 to July 2014. Results indicated that:

1. The rehabilitative program using isokinetic device was validated
2. Specific therapeutic exercises were identified (stretches – strength exercises for thigh abductors/adductors)
3. A fourth stage (2 weeks) was added including functional exercises

#### Main study:

The recommended rehabilitative program with isokinetic device was applied to (4) participants individually for (11) weeks from August 2014 to July 2015.

#### Pre-measurements:

Pre-measurements for the injured and healthy limbs of each participants were taken before applying the recommended program for each of the following variables:

- Pain degree (point)
- Peak Torque of thigh muscle (Flexion/Extension) working on the knee joint 80°/190° angle (N.M)
- Knee joint range of motion (ROM) at 80°/190° angle (degree)
- Thigh circumference (cm)
- Balance (degree) Front/Back with one foot – Lateral - Front/Back feet together.

**Table (2): descriptive statistics for pre-measurements of the healthy and injured limbs and difference significance between them using mann whiteny (u) test**

(n=4)

Variables	Healthy limb			Injured limb			Difference significance		
	Mean	SD	Squewness	Mean	SD	Squewness	U	P	
<b>Pain degree</b>	-----	-----	-----	8.75	0.5	2.0	-----	-----	
<b>Peak Torque</b>	<b>Flexion</b>	56.25	0.957	0.855	11.5	3.51	0.00	0.00*	0.020
	<b>Extension</b>	117.5	2.08	0.00	8	2.94	0.00	0.00*	0.021
<b>ROM</b>	105.5	0.577	0.00	101.75	0.957	0.855	0.00*	0.019	
<b>Thigh circumference</b>	43.62	0.478	0.855	43.25	0.493	0.00	4.00	0.240	
<b>balance</b>	<b>Front</b>	2.90	0.583	-0.989	4.7	0.294	0.00	0.00*	0.020
	<b>Lateral</b>	2.90	0.141	-1.41	3.77	0.263	0.124	0.00*	0.019
	<b>Together</b>	3.00	0.382	0.655	4.52	0.221	0.323	0.00*	0.014

P<0.05

Table (2) showed statistically significant differences between the pre- and post-measurements of the experimental group on all research variables in favor of the healthy limb. Except for the circumference of the thigh, there were no significant differences between the two extremities.



**The recommended rehabilitation program:**

The program lasts for (11) weeks (3 sessions per week). It is divided into four stages (first stage = 3 weeks – second stage = 3 weeks – third stage = 3 weeks – fourth stage = 2 weeks). Total number of rehabilitation sessions was (33). Each session starts with applying ice then respiratory and warm-up exercises for (5) minutes. This is followed by static strengths using isokinetic device as a main part then the concluding part includes specific exercises (stretches – strengths) and ice. (Attachment 4).

**Stages of the recommended program:**

**First Stage : Inflammation Control**

**Duration:** 3 Weeks . **Number of Sessions:** 9 sessions . **Average of session time:** 45 – 55 min.

**Objectives:**

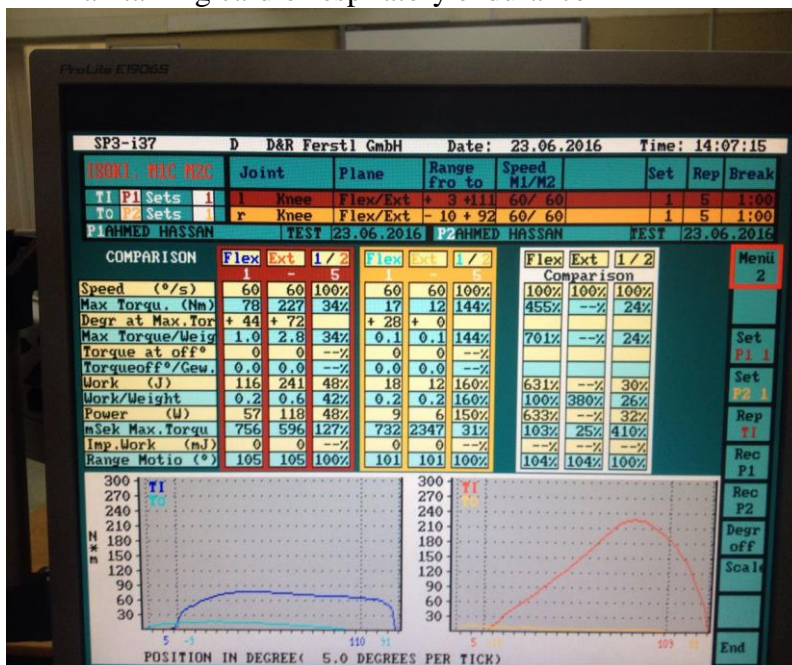
- Inflammation control
- Protection of joint and limiting activity to avoid over exertion of inflamed tissues of Iliotibial Band
- Maintaining joint range of motion and flexibility
- Maintaining muscular strength and endurance

**Second Stage : Motion Restoration**

**Duration:** 3 Weeks . **Number of Sessions :** 9 sessions . **Average of session time:** 55 - 65 min.

**Objectives:**

- Restoring 70 - 80% of injured limb range of motion
- Restoring flexibility of injured knee joint compared to healthy one
- Starting Proprioception stimulation
- Starting isometric and isokinetic device exercises to strengthen thigh muscle (anterior/posterior), posterior leg muscles and glottis muscles for the injured limb inside pain limit
- Starting functional (soccer specific) exercises without resistance and without pain
- Maintaining cardio-respiratory endurance



Model of the Session of training on the device isokinetic

**Third Stage: Developing Muscular Strength and Endurance**

**Duration:** 3 Weeks . **Number of Sessions:** 9 sessions . **Average of session time:** 65 - 75 min.

**Objectives:**

- Full recovery of range of motion and kinesthetic reception of injured limb
- Full recovery of muscular strength and endurance of muscles working on the knee joint using isokinetic device progressively
- Maintaining cardio-respiratory endurance
- Moving from mild to moderate resistance in soccer functional exercises

#### **fourth Stage (functional): Return to Sports Activity**

**Duration:** 2 Weeks . **Number of Sessions:** 6 sessions . **Average of session time:** 75 - 90 min.

Objectives:

- Analyzing technical performance and correcting movement mechanics
  - Improving muscular strength and endurance
  - Restoring muscular coordination and balance
- Increasing types of soccer functional exercises and return to sports activity

#### Conditions for applying the recommended rehabilitation program:

- Exercising healthy limb during rest
- Exercising upper and lower extremities
- Good warm-up before exercises
- Considering specific conditions including pain degree
- Decreasing passive (forced) stretches by the rehab specialist so that the muscle can produce the highest possible power while fibers are elongated
- Variation of work angles to improve all muscle fibers so that the muscle can work with full capacity
- Variation of muscle contraction type to improve all muscle fibers. First stage should start with isometric contraction to avoid complications like knee pain and effusion
- Progression of loads during the three stages should be considered. Low loads (50% of 1RM) can be used in stage one the repeated for 10 repetitions at the beginning of stage two. It can be increased to (75%) at the beginning of stage three and to (90%) at its end before return to sport.
- Transfer from one stage to another should be based on results of post-measurements at the end of each stage. To pass from stage one to stage two the player needs to restore at least 60% of joint functionality compared to the healthy limb. This percentage is increased to 80% to pass to stage three and then should reach 90% before return to sport.
- Ice should be applied for 5-10 minutes at the end of each training day to cool down the knee joint
- While using the trampoline for balance, the player stands in the middle of the device with both feet at the beginning then with the injured one only. Directions should be changed to increase joint balance.
- Physical fitness exercises including flexibility, agility, neuro-muscular coordination and cardio-respiratory endurance should be considered by the beginning of third stage
- Inclusive and balanced strength exercises for all working muscles of knee joint should be considered with specific attention paid to anterior/posterior thigh muscles and glottis.
- In case of complications that hinder the program progression, a physician should be consulted
- Considering individual differences among players and applying the program individually
- Return to sport decision should be taken by rehab specialist and specialized physician
- The player is required to continue physical fitness exercises and thigh muscle strength exercises during being in court

#### **Post-measurement:**

Post- measurement for the injured and healthy limbs of each participants were taken separately after the end of the rehabilitative program with the same equipment and tests and under the same conditions.

**Statistical Methods:**

- Descriptive statistics: Mean – SD – Squewness
- Mann Whitney (U) test for difference significance between injured and healthy limps
- Wilcoxon (Z) test for difference significance between pre- and post-measurements
- Improvement percentage (%)
- $P \leq 0.05$

**Results:****Table (3): Difference significance between pre- and post-measurement of injured limp of the experimental group using Wilcoxon test (Z) (n=4)**

Variable	Pre- measurement			Post- measurement			Difference Significance		Improvement ratio (%)	
	Mean	SD	Squewness	Mean	SD	Squewness	Z	P		
<b>Pain degree</b>	8.75	0.5	2.0	1	0.00	-	2.89*	0.00	88.5	
<b>Peak Torque</b>	<b>Flexion</b>	11.5	3.51	0.00	75	0.816	0.00	2.88*	0.00	552
	<b>Extension</b>	8	2.94	0.00	144.25	1.7	0.735	2.0*	0.046	190.3
<b>ROM</b>	101.75	0.957	0.855	106	1.15	0.00	2.88*	0.00	4.1	
<b>Thigh circumference</b>	43.25	0.493	0.00	44.9	0.668	1.0	2.88*	0.00	3.8	
<b>balance</b>	<b>Front</b>	4.7	0.294	0.00	2.25	0.238	0.00	2.0*	0.046	52.1
	<b>Lateral</b>	3.77	0.263	0.124	2.77	0.263	0.124	2.0*	0.046	26.5
	<b>Together</b>	4..52	0.221	0.323	2.37	0.275	0.323	2.0*	0.046	47.5

$p \leq 0.05$

Table (3) shows statistically significant differences between the pre- and post-measurements of the injured limp in favor of post-measurements. Improvement percentages ranged from 552% as the highest value for Peak Torque (Flexion) at angle  $90^\circ/180^\circ$  to 3.8% as the least value for thigh muscles circumference. This indicates the effectiveness of the recommended rehabilitation program using isokinetic device and specific therapeutic exercises.

**Table (4) Difference significance between post-measurements of the healthy and injured limps using Mann Whitney test (U) (n=4)**

Variables	Healthy limp			Injured limp			Difference Significance		
	Mean	SD	Squewness	Mean	SD	Squewness	U	P	
<b>Peak Torque</b>	<b>Flexion</b>	67.25	3.20	0.48	75	0.816	0.00	0.00*	0.019
	<b>Extension</b>	131.0	15.01	0.00	144.25	1.70	0.735	3.0	0.137
<b>ROM</b>	106.0	1.15	0.00	106	1.15	0.00	8.0	1.0	
<b>Thigh circumference</b>	44.77	0.644	0.411	44.9	0.668	1	6.5	0.663	
<b>balance</b>	<b>Front</b>	2.27	0.230	0.229	2.25	0.238	0.00	7.0	0.770
	<b>Lateral</b>	2.75	0.288	0.00	2.77	0.263	0.124	7.0	0.752
	<b>Together</b>	2.22	0.221	0.482	2.37	0.275	0.323	5.0	0.381

$P \leq 0.05$

Table (4) showed no statistically significant differences between post-measurements of injured and healthy limps on all research variables. This indicates the effectiveness of the recommended rehabilitation program as the injured limp improved to normal condition. Except for the variable peak torque at flexion there is significant difference between the Tow extremities in favor of the injured limp.

**Table (5): Difference significance between pre- and post-measurements of the health limp using Wilcoxon test (Z) (n=4)**

Variables	Pre-measurements			Post -measurements			Difference significance		Improvement ratio (%)	
	Mean	SD	Squewness	Mean	SD	Squewness	Z	P		
<b>Peak Torque</b>	<b>Flexion</b>	56.52	95.7	0.855	67.52	3.2	0.84	1.84	0.066	19.5%
	<b>Extension</b>	117.5	2.08	0.00	131.0	15.01	0.00	1.82	0.068	11.5%
<b>ROM</b>	105.5	57.7	0.00	103.0	1.15	0.00	1.41	0.157	0.50%	
<b>Thigh circumference</b>	43.26	47.8	0.855	44.77	0.644	0.411	1.84	0.066	0.71%	



balance	Front	2.90	0.583	-0.989	2.27	0.330	0.229	1.84	0.066	21.72%
	Lateral	2.90	0.141	-1.41	2.75	0.288	0.00	1.82	0.068	5.17%
	Together	3.00	0.382	0.655	2.22	0.221	0.481	1.82	0.068	26.0%

$P \leq 0.05$

Table (5) showed that there were no significant differences between the pre- and post-measurements of the healthy limb in all research variables, the highest improvement percentage was 26.0% for balance (front/back) feet together, while the lowest value was 0.5% for thigh muscles circumference. This indicates that the recommended rehabilitation program had positive effects on the healthy limb as well, In spite of the differences are not significant.

#### Discussion:

Table (3) indicated statistically significant differences between pre- and post-measurements of the injured limb in favor of post-measurements on all research variables (pain degree, Peak torque and range of motion of knee joint, thigh muscles circumference, balance) The highest improvement percentage was 522% for Peak Torque (Flexion). Table (4) indicated that there were no statistically significant differences between post-measurements of injured and healthy limbs in all research variables. This means that the injured limb improved to a level comparable with healthy limb in all research variables, Except for the variable peak torque at flexion there is significant difference between the Two extremities in favor of the injured limb.

The researcher thinks that improvements in pain degree is due to the use of isokinetic device as it decreases pain to minimum during exercise, in addition to benefits of ice at the end of every session to prevent inflammation and decrease pain. This is consistent with Razib, K. & Sharon, F.H. (2005), John, F. (2006), Michael, F. & Brian, D. (2010) and Hendrickson, M. (2012) who indicated that knee joint pain decreases to minimum after using therapeutic and strength exercises for knee joint working muscles. It is also consistent with Perlman, A. (2011) who referred to the effectiveness of exercises in decreasing Symptoms Associated With Inflammation such as pain.

Improvements in Peak Torque (Flexion/Extension) is due to the use of strength exercises on the isokinetic device as the device works effectively on loading muscles with max strength along the full range of motion for the joint. It also concentrates on specific muscle groups without interfering other groups (muscle isolation). This had positive effects on the working muscles of knee joint and this improved the muscular power of injured limb. The researcher explains these differences between pre- and post-measurements and the increase in muscular strength of the knee joint working muscles are due to using different types of exercises. For example, exercises used in stage one was static and evolved to include exercises with or without help then came isokinetic exercises with different resistances according to each stage. In addition, using Swiss balls, Rubber cords and tools similar to technical performance in Soccer helped in achieving balance among muscle groups working on knee joint. This decreases the period of rehabilitation and helped players to return to sport soon.

This is consistent with Al-Hashemy, M. (2013), Yousef, K. (2010), Eyd, A. (2006), who indicated positive effects in muscular power (Flexion/Extension) of the knee joint working muscles due to the use of strength exercises as isokinetic device is very effective in improving muscular power of the injured limb.

The researcher thinks that improvements in range of motion are due to the effects of exercises with isokinetic device as it is the best way to load muscles to max along the whole joint range of motion. Resistance of isokinetic device is based on biomechanical principles and changes in muscles (tension and length of muscle) and this helps to restore the injured joint's range of motion to normal. Static exercises performed before, inside and after the rehabilitation session had positive effects on restoring range of motion to normal. This is consistent with Jodi, A. & Quinette, AL. (2004), Ferber, R. et al (2010) and Romero, R. et al (2011).

This is also consistent with Ahmed, G. (2009) who indicated that rehabilitation programs of this type have significant effects on improving the range of motion for the injured knee joint in both Flexion and Extension, compared with the healthy joint.

Improvements in thigh muscles circumference are due to resistance exercises using isokinetic device as they had positive effects on muscle volume for knee joint working muscles. Slow performance on the isokinetic device increases blood fusion to the working muscles of the injured limb. In addition to the static exercises in the first stage of the program and consequently increases its circumference. This is consistent with Khalil, O. (2008) and Al-Anany, N. (2006).

Static exercises in the rehabilitation session and use of trampoline and other balance exercises led to significant improvements in balance due to the increase of muscle power and strength of the knee joint working muscles. This is consistent with Mohamed, M. (2007).

Table (4) indicated that there were no statistically significant differences between the post-measurements of the healthy and injured limbs on all research variables. This clearly shows that the injured limb restored normal condition and reached the performance level of the healthy limb. But there was significant difference between two limbs in peak torque at flexion in favor of injured limb, it means that the injured extremity exceeded the healthy limb in this variable. And Table (5) showed that there were no significant differences between the pre- and post-measurements of the healthy limb in all research variables, This indicates that the recommended rehabilitation program had positive effects on the healthy limb as well, In spite of the differences are not significant.

The researcher thinks that this is due to the effectiveness of using isokinetic device and therapeutic exercises in addition to training both limbs and the variation of methods used in rehabilitation. These factors helped decreasing the period of rehabilitation and restoring functionality of injured limb to normal. They also improved the physical fitness of players and helped them to return quickly to training. Plyometric exercises for improving speed strength and functional exercises at the end of the rehabilitation program helped the injured limb to restore functionality to normal very quickly.

This is consistent with Al-Ghamry, S. (2001), and Ahmed, G. (2009) who indicated that rehabilitation exercises helped the injured knee joint to be restored to normal condition before injury. This is also consistent with the results of Gregory, C. & Fanelli, M. (2004), Michelle, R. & Deven, T. (2004), Jidi, A. & Qunette, AL. (2004), Prentice (2014), and Thomas, A. et al (2015).

**Thus, the researcher has achieved the objectives of the research and verified the validity of its hypotheses.**

### **Conclusions:**

According to this research aims, methods and results, the researcher concluded the following:

1. Static exercise, muscle Stretching and cooling reduce pain and inflammations in the first stage of rehabilitation.
2. The isokinetic device has positive effects on improving muscular Peak Torque of the affected muscles (quadriceps femoris – biceps femoris – glottis medialis – glottis minor – tensor facia latae) in addition to increasing the knee joint range of motion.
3. Training with the isokinetic device in addition to the specific therapeutic exercises leads to increase and improve balance and stability among soccer players with iliotibial band syndrome.
4. Isokinetic device system and functional exercise works effectively on restoring functional capacity of affected muscles and helps athlete to return to normal condition quickly and effectively compared with regular rehabilitation programs.
5. Stretches and plyometric exercises increase the range of motion for knee joint and muscle elasticity

## Recommendations:

According to these results and conclusions, the researcher recommends the following:

- Using the recommended motor rehabilitation program with isokinetic device in rehabilitation of knee injuries, especially iliotibial band syndrome, in other sports activities
- Using functional tests as a standard procedure for deciding the athlete's return to sports activity
- Using the healthy limb of the same athlete as a reference for the injured limb's progress
- Using cooling methods at the beginning, middle and end of each rehabilitation unit to decrease pain and reduce inflammations
- Concentrating on strength, power and stretch exercises for muscles affected by iliotibial band syndrome
- Performing more studies on motor rehabilitation using isokinetic device

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