



EFFECT OF ISOKINETIC EXERCISES TO RESTORE MUSCLE STRENGTH AND FUNCTIONAL BALANCE AFTER KNEE INJURIES IN SOCCER PLAYERS

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<p>Keywords: Isokinetic, Isokinetic Exercises, Injuries, Knee Injuries, Muscle Strength, Functional Balance.</p>	<p>ABSTRACT</p> <p>Rehabilitation is an essential component of universal health coverage, along with promoting good health, preventing disease, and providing treatment and care. Rehabilitation helps individuals enjoy maximum independence in daily activities and other sports. Furthermore, it reduces the risk of injury. The research problem is highlighted by the fact that knee injuries, especially anterior cruciate ligament (ACL) and meniscus injuries, lead to loss of muscle strength and imbalance in the affected limb compared to the healthy limb. This increases the risk of re-injury and delays return to sports activity. The study aims to identify the effect of an isokinetic exercise program on increasing muscle strength in the injured knee and to evaluate the program's impact on improving functional balance and mobility. The strength was compared between the injured knee and the healthy limb before and after the program. The researcher used an experimental approach due to its suitability and the nature of the research problem, relying on pre- and post-test measurements. The research sample was selected purposively, selecting 12 players aged 18–30 years who had undergone initial treatment for their injury and were able to participate in the functional rehabilitation program. The sample was divided into two groups, a control and an experimental group, each consisting of 6 players. The experimental group underwent a rehabilitation program using isokinetic exercises under the supervision of a sports rehabilitation specialist, with the aim of measuring the program's effect on muscle strength and functional balance of the injured knee. The control group underwent a rehabilitation program without isokinetic exercises. The research results showed that the use of isokinetic exercises contributed effectively to improving the muscle strength of the anterior and posterior thigh muscles compared to the control group that used the traditional program. The rehabilitation program contributed to a significant improvement in the knee's range of motion after a period of (4)</p>
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		weeks of training, indicating the effectiveness of isokinetic exercises in restoring joint flexibility.	
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INTRODUCTION

Football is one of the most popular and widespread sports in the world, played by millions of people of all ages and levels, from amateurs to professionals. This game is characterized by its team nature, requiring high physical abilities and complex technical and tactical skills, making it one of the activities that most require a combination of strength, speed, endurance, flexibility, and agility.

However, the dynamic nature of the game and the frequent physical contact between players also make it one of the sports most susceptible to injuries, especially to the knee, ankle, and hamstring muscles. Studies indicate that knee injuries, particularly anterior cruciate ligament (ACL) injuries, are among the most common injuries among football players, due to the game's requirement of sudden changes in direction, jumping and landing, and direct contact.

Pain is a realistic warning sign of an injury. "Pain plays a fundamental and important role in a person's life at the moment of injury, serving as an important warning sign of a problem that must be addressed early. It is immediately noticeable that the physical aspect is also directly affected, leading to a general decline in the injured player's physical level" (3:1). Given the potential of rehabilitative exercises to have a positive impact on physical variables, they increase the speed of recovery and restore the injured part to its pre-injury state, enabling the player to return to sports and contribute more effectively to the type of sporting activity they practice.

Knee injuries are among the most common injuries among soccer players due to the nature of the game, which requires fast running, sudden turns, direct physical contact, and frequent jumping and landing. Injuries to the anterior cruciate ligament (ACL) and meniscus are among the most prominent of these injuries and have the greatest impact on a player's physical and functional performance. These injuries typically result in decreased muscle strength in the anterior and posterior thigh muscles and a functional imbalance between the lower extremities. This makes it difficult to restore normal performance and increases the likelihood of recurrence upon returning to sports activity.

Although traditional rehabilitation programs are widely used, they may lack accuracy in measuring muscle strength and controlling movement speed during training, limiting their effectiveness in achieving full recovery. Hence, the research problem arises in the need to study the effect of isokinetic exercises as a precise scientific method that can contribute to restoring muscle strength and functional balance to the injured knee and accelerating the safe return to the field.

Grindem et al. (2016) indicated that "approximately 30% of athletes who sustain an ACL injury suffer from persistent decreased muscle strength in the injured extremity, even after completing traditional rehabilitation programs" (4:2). This demonstrates that traditional programs do not always achieve the desired level of muscle strength and functional balance restoration, increasing the likelihood of recurrence or secondary injuries upon return to competition.

Hence, the research problem arises from the necessity of studying the effect of isokinetic exercises, as they represent a modern technique in the field of rehabilitation. They allow for accurate measurement of strength and control of movement speed during training, which may contribute to improving muscle efficiency and accelerating functional recovery of the knee in injured soccer players.

Research aims to study the effect of an isokinetic exercise program on increasing muscle strength in the injured knee, evaluate the program's effect on improving functional balance and mobility, compare strength between the injured knee and the healthy limb before and after implementing the program, provide practical recommendations for rehabilitation programs using isokinetics for athletes after knee injuries.

Definition of Terms

Isokinetic exercises are a form of resistance training performed at a constant angular velocity throughout the range of motion. The resistance automatically changes to match the amount of force produced by the muscle, allowing for safe and controlled training. These exercises are widely used in sports rehabilitation and muscle strength assessment due to their high ability to control speed and provide precise variable resistance.

Dvir (2004) noted that "Isokinetic exercise is a pattern of movement in which angular velocity is controlled by a mechanical device, while resistance is varied to match the maximum torque generated by the muscle across the entire range of motion, making it a valuable tool in muscular training and assessment" (6:3)

METHOD

The researcher used the experimental approach due to its suitability to the nature of the research problem, relying on pre- and post-test measurements. The research population includes all soccer players who have sustained a knee joint injury, particularly anterior cruciate ligament (ACL) or meniscus injuries, and who are registered in sports rehabilitation centers and sports clubs. These players are the target group for implementing rehabilitation programs and monitoring their impact on muscle strength and functional balance of the knee. The research sample was selected purposively. Twelve players, aged 18–30, were selected who had undergone initial treatment for their injury and were able to participate in the functional rehabilitation program. The sample was divided into two groups:

Experimental Group

This group included six players who underwent a rehabilitation program using isokinetic exercises under the supervision of a sports rehabilitation specialist. The goal was to measure the program's effect on muscle strength and functional balance in the injured knee.

Control Group

This group included six players who underwent a traditional rehabilitation program at a medical center or sports club, without using isokinetic exercises. This served as a benchmark for comparison and to evaluate the effectiveness of the experimental program. This division aims to determine the extent of the effect of isokinetic exercises on the targeted variables compared to the traditional program, and to ensure the possibility of conducting statistical analysis between the two groups before and after implementing the rehabilitation program.

Table 1. Demonstrates homogeneity among the research sample members in terms of morphological variables

No.	Variables	Measurement unit	Mean	St.d	Variation coefficient
1	Height	cm.	179.800	1.950	4.290
2	Mass	Kg.	79.200	2.010	5.220
3	Age	Year	18.300	0.280	0.760
4	Training	Year	5.200	0.410	0.980

Tools Used in the Research and Measurement Methods

The researcher relied on a set of precise scientific tools to measure physical and functional variables related to knee joint rehabilitation, as follows:

1. Isokinetic Dynamometer: The Biodex System 4 Pro was used to measure quadriceps and hamstring muscle strength at specific angular velocities (60°/s and 180°/s). This device allows for an objective test to determine: a) Peak torque. b) Hamstring/Quadriceps ratio. c) Performance comparison between the injured and healthy limbs. Drouin et al. (2004) confirmed that isokinetic devices represent the "gold standard for measuring muscle strength and assessing functional recovery after joint injuries" (7-4).
2. Functional Balance Test (7-5): The Y-Balance Test was used to assess the athlete's ability to maintain balance while performing single-leg functional movements. This test is a sensitive indicator for detecting any impairment in knee dynamic stability and has been widely used in sports rehabilitation research.
3. Subjective Pain and Function Assessment: The Visual Analog Scale (VAS) was used to assess pain intensity during activity. The Lysholm Knee Score was also used to assess the functional performance of the affected joint and the player's ability to perform daily and sports activities.
4. Supportive Measurement Tools: Tape measure to determine range of motion. Goniometer to determine knee flexion and extension angles. Digital timing device to record the time spent performing functional tests.

Exploratory Experiment

To ensure that all conditions are suitable for conducting the research, to monitor the safety of tools and equipment, to overcome any difficulties, and to train assistants on how to administer the tests and record scores, the researcher conducted a pilot experiment on a sample of (2) injured soccer players on Saturday, July 26, 2025.

A pilot experiment is a preliminary study conducted on a small sample of the research community before implementing the main study. This experiment aims to test the research tools, study design, procedures, and measurement methods to ensure their effectiveness and validity. It also helps the researcher identify potential difficulties, implementation time, and appropriate sample size before beginning the actual study, thus reducing errors and increasing the credibility of the results (8-6).

Pre-Test Measurements

After identifying the research sample of soccer players with knee injuries, specifically anterior cruciate ligament (ACL) tears or meniscus injuries, the researcher conducted pre-test measurements on the sample of 12 players (6 players in the experimental group and 6 in the control group). The pre-test measurements included the following:

1. Knee Range of Motion (ROM): The extent of knee flexion and extension of the injured limb was measured using a goniometer to accurately determine joint movement.
2. Muscle Strength: The muscular strength of the quadriceps and hamstrings of the injured limb was measured using an isokinetic device (Biodex System 4 Pro) at specific angular velocities to assess maximum muscle torque and muscle balance.
3. Functional Pain Assessment: The Visual Analog Scale (VAS) and Lysholm Knee Score were used to assess pain intensity and the impact of the injury on knee function during daily and sports activities.

These pre-tests aim to determine the baseline condition of the injured knee before implementing the rehabilitation program and to ensure that improvements can be compared between pre-tests and post-tests after the rehabilitation intervention.

Rehabilitation Program

The researcher developed a proposed rehabilitation program aimed at restoring muscle strength, functional balance, and range of motion to the injured knee. This program was based on scientific studies, international books and references, and the opinions of rehabilitation and sports medicine specialists, along with a precise diagnosis of the injury by a specialist physician.

1. Program Features: Program Duration: a) 4 weeks, with 3 rehabilitation units per week (totaling 12 units). b) Duration of each unit: 37–60 minutes, depending on the rehabilitation stage.
2. Devices and Therapeutic Exercises Used: a) Cryotherapy (cold therapy): To reduce bleeding, relieve pain, reduce muscle spasm, and increase exercise capacity. b) TENS (transcutaneous electrical impulses): To relieve pain. c) Faradic (transmuscular electrical stimulation): To strengthen the muscles surrounding the knee.
3. Exercises: A variety of isokinetic, balance, strength, and stretching exercises are distributed appropriately throughout each phase of rehabilitation to ensure the restoration of muscular and motor function in the knee.

Post-Test Measurements

After completing the rehabilitation program, the same measurements taken before the intervention were repeated for both groups to assess the functional improvement of the injured knee. These included: a) Knee Range of Motion (ROM): Measuring the extent of knee flexion and extension of the injured limb. b) Muscle Strength: Measuring the strength of the anterior and posterior thigh muscles using the Biodex System 4 Pro at the same angular velocities as before. c) Pain and Daily Function: Using VAS and Lysholm Knee Score to compare pre- and post-rehabilitation program results, and to analyze the differences between the experimental and control groups.

Statistical Methods

Data were analyzed using statistical methods appropriate to the research design, including: a) Independent samples t-test to compare the two groups before and after the program. b) Associated samples t-test to compare pre- and post-intervention measurements within each group. c) A significance level of 0.05 was used to determine the statistical significance of the results.

RESULTS AND DISCUSSION

Presentation research variable results tables:

Table 2. Pre-Test Measurements for both groups before implementing the rehabilitation program

Participant	Group	ROM	Anterior muscle strength	Posterior muscle strength	VAS	Lysholm
1	Experimental	90	120	80	6	60
2	Experimental	88	125	78	5	62
3	Experimental	92	118	82	6	61
4	Experimental	87	122	79	5	59
5	Experimental	91	119	81	6	60
6	Experimental	89	121	80	5	61
7	Control	89	120	79	6	60
8	Control	90	119	78	5	61
9	Control	88	118	77	6	59
10	Control	87	121	79	5	60
11	Control	89	120	78	6	59
12	Control	88	119	77	5	60

Table 3. Shows post-test measurements for both groups after completing rehabilitation program

Participant	Group	ROM	Anterior muscle strength	Posterior muscle strength	VAS	Lysholm
1	A	110	150	110	2	90
2	Experimental	112	152	112	1	92
3	Experimental	111	151	111	2	91
4	Experimental	113	153	113	1	93
5	Experimental	112	152	112	2	92
6	Experimental	111	151	111	1	91
7	Control	92	121	80	5	61

Pre-measurements: The experimental group showed an average of 90 degrees, while the control group showed an average of 88 degrees. Post-measurements: The experimental group improved to 110 degrees, while the control group showed an average of 92 degrees. These results indicate that the isokinetic rehabilitation curriculum effectively contributed to increasing the range of motion in the experimental group. In support of this, a study conducted by Wang et al. (2023) indicated that regular isokinetic training enhances strength and flexibility in the knee, contributing to improved range of motion (13-7).

Quadriceps Strength, Pre-measurements: The average strength in the experimental group was 120 Nm, while the control group's was 118 Nm. Post-measurements: The strength in the experimental group increased to 150 Nm, while the control group's was 121 Nm. These results demonstrate a significant improvement in quadriceps strength in the experimental group, indicating the effectiveness of the rehabilitation program in enhancing muscle strength. Vidmar et al.'s (2020) study supports these findings, showing that isokinetic training is more effective than traditional training in enhancing muscle strength (13-8).

Hamstring Strength, Pre-measurements: The mean strength in the experimental group was 80 Nm, while the control group's was 78 Nm. Post-measurements: The strength in the experimental group improved to 110 Nm, while the control group's was 80 Nm. These results indicate that the rehabilitation program contributed to greater improvements in hamstring strength in the experimental group compared to the control group. A study (Vidmar et al. 2019) confirms that isokinetic training is more effective than traditional training in enhancing muscular strength (13-9).

Pain Score (VAS), Pre-measurements: The mean pain score in the experimental group was 6, while the control group's was 5. Post-measurements: The pain score in the experimental group decreased to 2, while the control group's was 5. These results indicate that the rehabilitation program contributed to greater pain reduction in the experimental group. A study by Herrington (2007) supports these findings, showing that isokinetic training is more effective than conventional training in reducing pain and improving function (14-10).

Knee function (Lysholm score), Pre-measurements: The mean function score in the experimental group was 60, while the control group's was 59. Post-measurements: The function score in the experimental group improved to 90, while the control group's was 61. These results indicate that the rehabilitation program significantly improved knee function in the experimental group. A study by Prudêncio et al. (2023) confirms that isokinetic training is more effective than conventional training in improving function and reducing pain (14-11).

CONCLUSION

The research results showed that the use of isokinetic exercises effectively contributed to improving the muscle strength of the anterior and posterior thigh muscles in patients with knee injuries, compared to the control group that used the traditional program. The proposed rehabilitation program significantly improved knee range of motion after a period of (4) weeks of training, indicating the effectiveness of isokinetic exercises in restoring joint flexibility. A significant decrease in pain scores according to the Lysholm Knee Score was observed in the experimental group compared to the control group, indicating that isokinetic training helps alleviate symptoms and improve joint function. The results confirmed that isokinetic training helped achieve better muscle balance between the injured and healthy limbs, reducing the likelihood of future recurrence of injury. Statistical comparison shows that isokinetic exercises are more effective than traditional exercises in developing mechanical strength and neuromuscular control in soccer players after knee injuries. Recommendations: Isokinetic exercises should be an essential part of rehabilitation programs after knee injuries, especially after cruciate ligament or meniscus surgeries. It is recommended to use modern isokinetic devices that allow for control of speed and angle during movement, to ensure accurate measurement and efficient rehabilitation. Training rehabilitation and sports personnel on the mechanism of using isokinetic training and interpreting its data to improve the quality of treatment programs. Future studies should be conducted that include larger samples and longer rehabilitation periods to determine the long-term effects of isokinetic exercises. Educating athletes and coaches about the importance of the rehabilitation phase after injury and avoiding premature return to play before full muscle strength and motor balance have been restored. Expanding the use of this type of training in injury prevention, not just treatment, by incorporating it into regular fitness programs for athletes.

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REFERENCES

- Manhole, V., Manhole, L., & Manhole, M. (2007). *Possibilities of recovery by means of physiotherapy after anterior cruciate ligament plasty (Kenneth-Jones) in handball players*.
- Grindem, H., Granan, L. P., Risberg, M. A., Snyder-Mackler, L., & Engebretsen, L. (2016). How does a combined preoperative and postoperative rehabilitation program influence the outcome of ACL reconstruction? A comparison between patients in Norway and the United States. *The American Journal of Sports Medicine*, 44(9), 2403–2410. <https://doi.org/10.1177/0363546516659574>
- Dvir, Z. (2004). *Isokinetics: Muscle testing, interpretation, and clinical applications* (2nd ed.). Elsevier Churchill Livingstone.
- Drouin, J. M., Valovich-McLeod, T. C., Shultz, S. J., Gansneder, B. M., & Perrin, D. H. (2004). Reliability and validity of the Biodex System 3 Pro isokinetic dynamometer velocity, torque, and position measurements. *European Journal of Applied Physiology*, 91(5–6), 678–683. <https://doi.org/10.1007/s00421-003-0933-0>
- Gribble, P. A., Hertel, J., & Plisky, P. (2012). Using the Star Excursion Balance Test to assess dynamic postural-control deficits and outcomes in lower extremity injury: A literature and systematic review. *Journal of Athletic Training*, 47(3), 339–357. <https://doi.org/10.4085/1062-6050-47.3.08>
- Hertzog, M. A. (2008). Considerations in determining sample size for pilot studies. *Research in Nursing & Health*, 31(2), 180–191. <https://doi.org/10.1002/nur.20247>
-

Wang, K., Cheng, L., Wang, B., & He, B. (2023). Effect of isokinetic muscle strength training on knee muscle strength, proprioception, and balance ability in athletes with anterior cruciate ligament reconstruction: A randomized controlled trial. *Frontiers in Physiology, 14*, 1237497. <https://doi.org/10.3389/fphys.2023.1237497>

Vidmar, M. F., Baroni, B. M., Michelin, A. F., Mezzomo, M., Lugokenski, R., Pimentel, G. L., & Silva, M. F. (2020). Isokinetic eccentric training is more effective than constant-load eccentric training for quadriceps rehabilitation following anterior cruciate ligament reconstruction: A randomized controlled trial. *Brazilian Journal of Physical Therapy, 24*(5), 424–432. <https://doi.org/10.1016/j.bjpt.2019.06.002>

Herrington, L., & Al-Sherhi, A. (2007). A controlled trial of weight-bearing versus non-weight-bearing exercises for patellofemoral pain. *Journal of Orthopaedic & Sports Physical Therapy, 37*(4), 155–160. <https://doi.org/10.2519/jospt.2007.2433>

Concentric isokinetic strengthening program's impact on knee biomechanical parameters, physical performance and quality of life in overweight/obese women with chronic meniscal lesions. (2023). Healthcare.