Finding a predictive value for the degree of pain for partial rupture of the anterior cruciate ligament in terms of some indicators of the functional structure of the knee joint for injured athletes

Encontrar un valor predictivo del grado de dolor por rotura parcial del ligamento cruzado anterior en términos de algunos indicadores de la estructura funcional de la articulación de la rodilla en atletas lesionados

Authors

Ammar Mzial Shnta [1]

[1] Iraqi University - College of Engineering (Iraq)

Corresponding author: Amaar Shanta

ofcbkr@gmail.com

How to cite in APA

Shnta, A. M., & Shanta, A. (2025). Finding a predictive value for the degree of pain for partial rupture of the anterior cruciate ligament in terms of some indicators of the functional structure of the knee joint for injured athletes. *Retos, 67*, 1043–1055. https://doi.org/10.47197/retos.v67.114278

Abstract

Introduction: Understanding the relationship between the functional structure of the knee and pain can contribute to increasing the therapist's knowledge of the degree of pain and improving the quality of rehabilitation programs for injured athletes.
Objective: The research aimed to find predictive equations for the degree of pain among athletes with partial rupture of the anterior cruciate ligament as a function of measuring some indicators of the functional structure of the knee joint during the injury period on a sample of (18) of the injured, conducting the necessary tests and measurements.
Methodology: The study used Arab and foreign sources, experts and specialists, and skill tests. Divided ruler for ten fields containing numbers from (1-10). Telsa Siemens Magnetom Erlangen (MRI) machine made in Germany. The researcher determined the measurements and tests after consultation and approval of the specialist doctors for these tests and measurements. Testing the degree of pain, visual analog scale, in the cases of adduction and abduction.
Results: The results of some statistics (arithmetic mean, standard deviation, lowest two values, and highest measurement) are represented in the functional structure of the knee joint and the degree of pain.
Conclusions: Concluding. Variable (Joint space and erosion of synovial fluid), with the highest percentage of contribution to the degree of pain for the knee joint in injured athletes. Etemad recommended the percentage of contributions shown by the study from sports medicine and physical therapists.

Keywords

Predictive value; degree of pain; partial tear of the anterior cruciate ligament; functional structure.

Resumen

Introducción: Comprender la relación entre la estructura funcional de la rodilla y el dolor puede contribuir a aumentar el conocimiento del terapeuta sobre el grado de dolor y mejorar la calidad de los programas de rehabilitación de los deportistas lesionados.
Objetivo: La investigación tuvo como objetivo encontrar ecuaciones predictivas del grado de dolor en deportistas con rotura parcial del ligamento cruzado anterior en función de la medición de algunos indicadores de la estructura funcional de la articulación de la rodilla durante el período de lesión en una muestra de (18) de los lesionados, realizando las pruebas y mediciones necesarias.
Metodología: El estudio utilizó fuentes árabes y extranjeras, expertos y especialistas, y pruebas de habilidad. Regla dividida para diez campos que contienen números del (1 al 10). Máquina Telsa Siemens Magnetom Erlangen (MRI) fabricada en Alemania. El investigador determinó las medidas y pruebas después de consultar y aprobar a los médicos especialistas en estas pruebas y mediciones. Comprobación del grado de dolor, escala visual analógica, en los casos de aducción y abducción.
Resultados: Muestra los resultados de algunos estadísticos (media aritmética, desviación estándar, dos valores más bajos y medición más alta), representados en la estructura funcional de la articulación de la rodilla y el grado de dolor.
Conclusiones: concluyente. variable (Espacio articular y erosión del líquido sinovial), con el mayor porcentaje de contribución al grado de dolor para la articulación de la rodilla en deportistas lesionados. Etemad recomendó el porcentaje de contribuciones mostradas por el estudio de la medicina deportiva y los fisioterapeutas.

Palabras clave

Valor predictivo; grado de dolor; rotura parcial del ligamento cruzado anterior; estructura funcional.

Introduction

Playing sports is always associated with the risk of injury, as no training system can completely prevent injuries. Therefore, it is essential to explore techniques and methods that help reduce the likelihood of injuries on the field or their recurrence (Paterno et al., 2017). The knee joint is one of the most important and complex joints in the human body and is a common site of sports injuries. It plays a vital role in both movement and support. The joint is formed by the intersection of the femur, tibia, and patella, and is reinforced by a group of ligaments and cartilage that provide stability and absorb shocks. Attention should be given to injury prevention measures just as much as to sports training and preparation for competition (Dunn et al., 2010). While it is impossible to completely avoid injuries or prevent their recurrence, physical therapists and trainers can reduce the risk to a minimum through appropriate strategies. A partial tear of the anterior cruciate ligament (ACL) leads to instability of the knee, resulting in pain and significantly impairing the athlete's performance. This pain can be attributed to several factors related to the knee's functional structure (Colombet et al., 2010). Instability in the joint creates uneven pressure, which can intensify the pain and may lead to further damage, such as meniscus injuries, which compromise the knee's shock-absorbing function. Additionally, tears in other ligaments—such as the posterior cruciate ligament (PCL), lateral collateral ligament (LCL), and medial collateral ligament (MCL)—can increase pain and reduce stability (Décary et al., 2018). These ligaments work together to maintain joint stability and prevent abnormal movement. Tissue inflammation surrounding the knee as a result of tearing can also worsen swelling and discomfort. Managing a partial ACL tear requires a comprehensive understanding of the knee's functional structure. This knowledge is crucial in guiding treatment approaches that may include physical therapy, muscle strengthening, and sometimes surgical intervention. The significance of this study lies in its effort to identify the predictive value of pain intensity caused by partial ACL tears, based on specific indicators of knee joint function. Understanding the relationship between pain and functional knee structure can enhance therapists' ability to estimate pain levels and design more effective rehabilitation programs. This helps reduce the risk of re-injury and supports athletes in regaining their competitive performance. This study is important for several reasons. It advances knowledge about the functional structure of the knee and its connection to pain levels in partial ACL injuries among athletes (Kostogiannis et al., 2007). It also provides physical therapists with evidence-based guidance, improving medical care and informing the development of more efficient rehabilitation protocols. This can accelerate recovery and support athletes in returning to play safely and effectively.

Based on the researcher's experience in medical rehabilitation, differences in pain levels among athletes with partial ACL tears have been observed. These differences may stem from variations in injury type and the extent to which the functional structure of the knee is affected during the injury period. This observation led to key research questions:

- What is the relationship between the functional structure of the knee joint during injury and the degree of pain experienced?
- What is the contribution of each functional indicator in determining pain severity?

A deep understanding of these relationships may help determine the predictive value of pain levels in partial ACL injuries. This contributes to the development of targeted treatments and rehabilitation strategies and offers valuable insights for future research focused on therapeutic and preventive innovations in sports injury management.

Research objectives

1- To identify the nature of the relationship between selected indicators of the functional structure of the knee joint measured during the injury period and the level of pain in athletes with a partial rupture of the anterior cruciate ligament.

2- To develop predictive equations for the degree of pain in athletes with a partial rupture of the anterior cruciate ligament based on indicators of the knee joint's functional structure measured during the injury period.

Research hypothesis

There is a statistically significant relationship between the level of pain degree and the functional structure of the knee joint during the injury period for the research group.

Method

Study Design

Due to the nature of the study, the researcher adopted the descriptive analytical approach(Hammood et al., 2024; Khalaf et al., 2025), which focuses on collecting data to test hypotheses or answer questions related to the current conditions of the research sample. This method aims to describe existing situations as they are, without manipulation, and to understand relationships between observed phenomena. According to Samir (1991), descriptive analytical research "seeks to identify and analyze the conditions and relationships that constitute facts and appearances, and to collect data from members of society to determine the current situation regarding specific variables.

Participants

The research population consisted of athletes in Baghdad diagnosed with a partial rupture of the anterior cruciate ligament (ACL). These athletes were identified through medical records maintained by the Sports Medicine Department.

To determine eligibility, the researcher distributed a screening form to potential participants. The form collected detailed information about each athlete's injury history, severity, and medical diagnosis. Based on the responses and official medical documentation, a total of 38 athletes were confirmed to have a partial ACL tear between October 10, 2023, and January 22, 2024. These were categorized as follows:

29 athletes with first-degree partial tears

9 athletes with second-degree partial tears

From this group, a final sample of 18 athletes was selected randomly. The sample included individuals from both injury categories (first- and second-degree partial tears) who were actively receiving treatment or undergoing rehabilitation at the Sports Medicine Hospital during the study period.

Inclusion Criteria

Diagnosed with a partial tear of the anterior cruciate ligament (first or second degree) confirmed by clinical and radiological assessment

Registered with the Sports Medicine Department in Baghdad

Currently undergoing or having completed a rehabilitation program

Aged between 18–35 years

Willing to participate and signed informed consent

Exclusion Criteria

Complete ACL rupture or concurrent tears in other major knee ligaments (e.g., PCL, LCL, MCL)

History of knee surgery or prior ACL reconstruction

Presence of other musculoskeletal disorders or chronic joint diseases

Incomplete medical records or refusal to complete the screening form

This sampling method ensured that the selected group was homogeneous in terms of injury type and rehabilitation context, enhancing the reliability of the data related to knee functional indicators and pain levels.

Procedures

Means of collecting information and data

- Arab and foreign sources.
- Experts and specialists
- Skill tests

Devices and tools used in the research

1. Divided ruler For ten fields containing numbers from (1-10).
2. Telsa Siemens Magnetom Erlangen (MRI) machine made in Germany.

Determine the measurements and testing for the research

The measurements and tests were determined by the researcher after consultation and approval of the specialist doctors for these tests and measurements>

Testing the degree of pain, visual analog scale, in the cases of adduction and abduction(Wikstrom EA & Chmielewski TL et al, 2007)

Test name: Pain Score Measurement (V.A.S).

The objective of the test:-

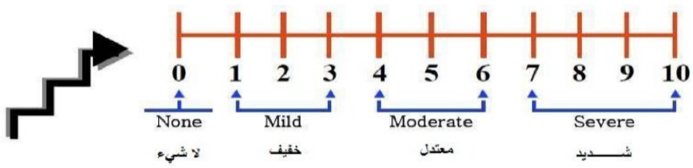
- Measure the degree of pain from the adduction position.

Figure 1. Pain score measurement (V.A.S)

Measure the degree of pain from the abduction position.

Tools: - Paper or divided ruler For ten fields containing numbers from (1-10) squares, as shown in the figure

Figure 2. Pain score measurement (V.A.S)



Procedures and conditions

When performing the position that is determined for the tester, he is asked to determine the degree of pain that he feels when the injured player is sitting, and then he is asked to extend the knee joint to the greatest possible range of motion. Once the pain is felt, the degree stops being recorded while the leg is extended. Then the degree of pain is determined by his feelings and by the specialist doctor who asks to determine the degree and degree of pain.

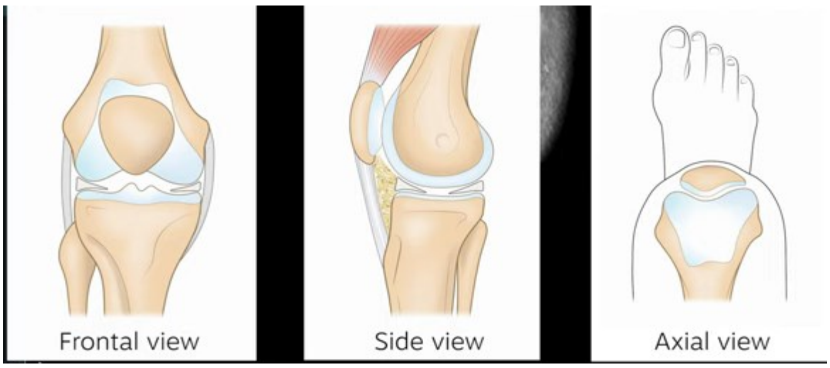
Registration: The degree of pain felt by the experimenter while moving the leg is recorded, and the score (10) expresses the maximum degree of pain that the experimenter cannot bear.

Unit of measurement: Degree

1- Specific measurements of the functional structure of the knee joint:

The researcher worked to find measurements of the functional structure of the knee joint in order to study the specific functional variables. After consultation with specialists, the subjects were examined on an MRI scanner at the Medical City in Baghdad (3 Telsa Siemens Magnetom Erlangen), German-made, to determine the degree of the functional structure of the knee joint in order to Study the functions of this condition by analyzing the images generated by the magnetic resonance imaging device (MRI) to detect these changes and determine the extent of their impact on the joint. The possibility of MRI from three directions (frontal, lateral, and vertical), is shown in Figure (1). The study used a protocol, which is a three-dimensional sagittal pulse DESS with a slice thickness of 0.7 mm, 16.3 MS TR, 140 mm field of view (FOV), and 384× matrix. 307, with a resolution of 0.37 mm x 0.46 mm. Signs that can be detected using MRI include the following: (The joint space, the distance between the patella and the ligament, the height of the patella, and the size of the cruciate ligament) are as follows:

Figure 3. Explain shooting directions (front, side, and vertical)

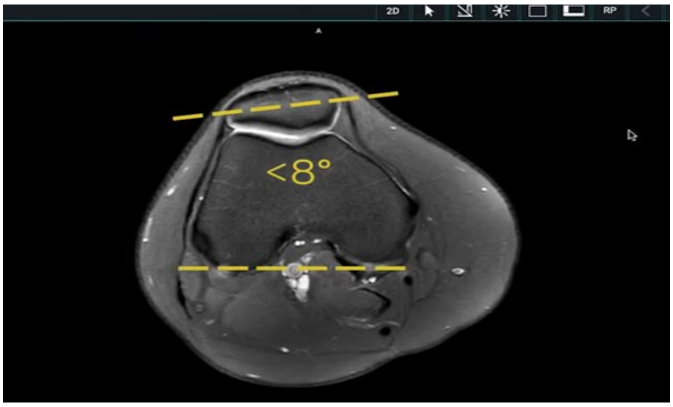


2- Joint space erosion of synovial fluid: The size of the joint space was measured from a magnetic resonance imaging device (MRI) by lateral imaging to detect the narrowing of the space as a result of cartilage erosion. Or the erosion of synovial fluid. The amount of synovial fluid inside the joint can be measured. This method determined the total volume of cartilage (V), and the cartilage volume was normalized to the surface area as a measure of thickness (Th). And measuring the shape of the cartilage with magnetic resonance imaging. Specifically,

Figure 4. Explain how to measure Distance and the size of the joint space Using a magnetic resonance imaging machine (MRI).)

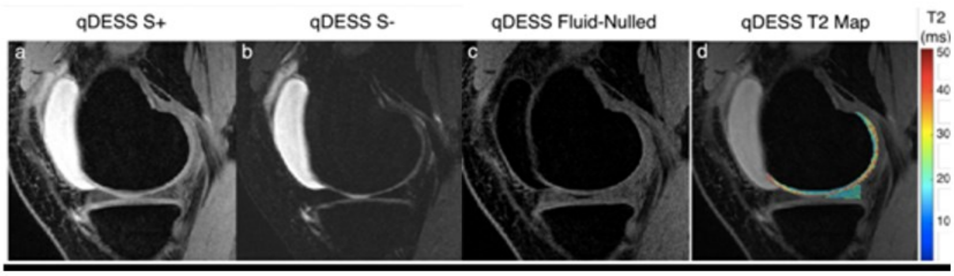
3-Angle of inclination of the patella bone: It means the angle of inclination of the patella bone from its horizontal axis from the magnetic resonance imaging (MRI) device in vertical imaging, as the image techniques obtained from the MRI device show the direction of the patella bone. The angle of inclination of the patella upon injury can be measured with the horizontal line. (Abbas, 2021)

Figure 5. Explains how to measure The angle of inclination of the patella bone Using a magnetic resonance imaging machine (MRI).)



4- The size of the cruciate ligament: Using images generated by the magnetic resonance imaging device (MRI) by imaging from three directions (front, side, and head), it is possible to determine the size of the cruciate ligament, its width, height, and the distance between it and neighbouring parts of the body. It was calculated from the widths, as straight lines were connected between the identified points to display digital results measured in millimetres. (Abbas, 2021)

Figure 6. Explains how to measure Cruciate ligament size Using a magnetic resonance imaging machine (MRI).)



5- Patella height: Using images generated by a lateral magnetic resonance imaging (MRI) device, the distance between the patella and the cruciate ligament in adjacent parts of the body can be determined, measured in millimetres.

Figure 7. Explains how to measure the distance between the kneecap and the cruciate ligament using a magnetic resonance imaging (MRI) device.

6- The distance between the patella and the cruciate ligament: Using images generated from the magnetic resonance imaging device (MRI) and lateral imaging, the distance between the patella and adjacent parts of the body can be determined. Measured in millimetres (Abbas, 2021) As Figure (7) shows

Field research procedures

The main experiment

The researcher organized a schedule to examine the research sample, and the researcher conducted tests for the research sample from Monday, 2/22/2024, until 3/29/2024, where the researcher took the research sample according to the schedule of visits for (4) infected people every week to a city hospital. Medicine to perform an MRI on the injured knee under the care of specialized doctors in order to obtain variables of the functional structure of the knee joint (articular space and angle of inclination). The patella, the distance between the patella and the ligament, the height of the patella, and the size of the cruciate ligament) using magnetic resonance imaging at the Medical City in Baghdad (3 Telsa Siemens Magnetom Erlangen), then a pain test was performed.

Data analysis

The researcher used statistical questions through the statistical package (SPSS), statistical packages for social systems, and the relevant statistical laws(Ali et al., 2022; Mohammed Hammood et al., 2025; Omar et al., 2025). Statistical laws:

1. Arithmetic mean

2. Standard deviation and standard error

3. Kolmogorov-Smirnov test

4. Nonparametric (U) test for two independent groups

5. Singularity analysis Multilinear R –

Results

Description Functional structure of the knee joint and the degree of pain

Table 1. Shows the results of some statistics, represented by (arithmetic mean, standard deviation, two lowest values, and the highest measurement), represented by the functional structure of the knee joint and the degree of pain.

Variables	loneliness Measurement	Average Arithmetic	deviation Standard	less value	Highest value
Articular space	mm	0.275-	0.059	0.18-	0.37-
The angle of inclination of the patella bone	degree	7.611	1.334	5	10
Cruciate ligament size	mm	271.5	6.214	261	284
Patella height	mm	8.333	1.644	5	11

The distance between the kneecap and the cruciate ligament	mm	16.444	1.688	14	19
Degree of pain	degree	8.0	1.283	6	10

Multiple linear regression analysis

Testing the goodness of fit of the normal model

Testing the goodness of fit of the normal model for the variables with the aim of demonstrating the validity of the assumption of a normal distribution of variables in measuring the degree of pain as a function of the prediction model in question, as well as with regard to the validity of the assumption of a normal distribution of the results of the variables for the basic stages explaining the results of the aforementioned function, which is represented by the functional structure of the knee joint (joint space, The angle of inclination of the patella bone، cruciate ligament size, Patella height, and The distance between the kneecap and the cruciate ligamentTable No. (2) includes the results of examining the goodness of fit of the natural model for those variables.

Table 2. Kolmogorov-Smirnov test to examine the goodness of fit of the natural model for the variables combined by transformation with relative calibration scores.

Compatibility check indicator	first X1	second X2	Third X3	Rabaa X4	Fifth X5	AND	decision
Number of sample members (N)	18	18	18	18	18	18	Accept the hypothesis
(K-S) to test Z statistics -	0.662	0.722	0.616	0.838	1.019	0.725	
Error level	0.774	0.674	0.842	0.484	0.251	0.669	
Connotation	not spiritual	not spiritual	not spiritual	not spiritual	not spiritual	not spiritual	

NS: Not significant with a significance greater than 0.05. Decision: The distribution function follows a normal distribution

View and analyze the results of the prediction model

Table 3. Results of analysis of variance for multiple linear regression with estimates of variables

Analysis of variance for multiple linear regression with weighted estimates						Connotation
Sources of variation	Sum of squares	Degree of freedom	Mean squares	F value F	Connotation	
Regression	58.800	5	11.760	24.758	0.000	spiritual
The rest	5.70	12	0.475			

The explanatory variables are represented by the Functional structure of the knee joint.
Y is the dependent variable represented by the degree of pain.

Estimates of some coefficients of multiple linear regression analysis

Table 4. Some multiple linear regression model estimates for variables The total correlation coefficient, the coefficient of determination, the corrected and the standard error of the estimate

Model summary			
Total correlation coefficient R	Determination coefficient	Corrected coefficient of determination	Standard error of the estimate
0.955	0.912	0.875	0.689

The explanatory variables are represented by the Functional structure of the knee joint.
X1, X2, X3, X4 . X5

Show the results of the multiple linear regression analysis of the prediction model

Table 5. Estimates of multiple linear regression model coefficients for combined variables by transformation in degrees

Transactions	Unstandardized coefficients		Standard transactions Oh	T-test t-test	Significance level	Moral comparisons
	Transactions B	Random error	Transactions			
The fixed limit	1.019	0.462		2.205	0,044	HS

X1	6.624-	1.447	1.150	4.577	0.000	HS
X2	0.104	0.084	0.104-	2.428	0.030	HS
X3	0.012-	0.022	0.058	0.524	0.610	NS
X4	0.243	0.086	0.058	2.825	0.016	HS
X5	0.583	0.235	0.767-	2.487	0.029	HS

Significant with a significance greater than 0.05,

Discussion

It is clear from the results of Table No. (2) that the assumption of a normal distribution of the results of the variables in measuring the functional structure of the knee joint, represented by (joint space, The angle of inclination of the patella bone□, cruciate ligament size, Patella height, and The distance between the kneecap and the cruciate ligament This confirms the validity of applying point estimates to estimate the parameters of the assumed natural model, represented by the mean measurement, the standard deviation, and the standard error of the population mean, in addition to the validity of testing the hypothesis of analysis of variance for multiple linear regression and other estimates associated with it, represented by the total correlation coefficient, the coefficient of determination, and the estimation coefficients. For a predictive model. Testing the quality of the natural model fit constitutes the cornerstone for conducting all approved statistical steps and operations, which inevitably fail when this quality is not achieved.

In light of what was stated in the initial presentation of the application of the multiple linear regression model, Table No. (3) includes a presentation of the results of the analysis of variance for the multiple linear regression with the aim of determining the level of reliability of the results of the weighted estimates of the coefficients of the model subject of prediction, represented by testing the goodness of fit of the aforementioned model through identification On the effects of the explanatory variables on the function variable measuring the degree of pain as a function of the prediction model and expressed by the covariance test hypothesis, where the results of the analysis indicate the success of the model's reliability. This was achieved through the significance of the shared variance between the model function (measuring the measurement and degree of pain) and the explanatory variables (represented by the functional structure of the knee joint (represented by (joint space, The angle of inclination of the patella bone □cruciate ligament size, Patella height, and The distance between the kneecap and the cruciate ligament) On the other hand, which reflects the high level of reliability in building the prediction model in question.

Based on the above, Table No. (4) includes estimates of some coefficients of multiple linear regression analysis, represented by the multiple correlation coefficient between the model function variable degree of pain the explanatory variables, the coefficient of determination, the corrected coefficient of determination, and the standard error of the coefficient mentioned by, represented by the functional structure of the knee joint (joint space, The angle of inclination of the patella bone □cruciate ligament size, The height of the patella bone, and the distance between the patella and the cruciate ligament)

The degree of relationship between the effect of the explanatory variables, represented by (andArticular space □The angle of inclination of the patella bone □cruciate ligament size, The height of the patella bone, and the distance between the patella and the cruciate ligament) with the model function variable represented by a variable with Degree of pain The total correlation (0.955) and the coefficient of determination (0.912(which indicates the percentage value to explain the effect of the explanatory variables on the changes induced by the values of the model function variable and the corrected coefficient of determination)0.875) which explains the percentage of changes caused by the values of the model function variable after removing the effect of lack of fit from the sources of the residual term in the aforementioned model. A test appeared Burn Weston (2.509) Which means adopting the model.

Table 5 shows the significance of the differences at the significant level of significance (0.05) for the coefficients of the linear regression model for the variables of the functional structure of the knee joint (joint space, The angle of inclination of the patella bone □ □The height of the patella bone, the distance between the patella and the cruciate ligament) and the randomness of the differences for (cruciate ligament size) from the approved level of significance, which reflects the importance of these Variables in explaining what the degree of pain will lead to, which reflects the importance of those variables in explaining what the results will lead to, and the model below represents the final version of the prediction model subject to construction.

$$CapCapOen\widehat{and}_i = 1.019 - 6.624X_{1i} + 0.104X_{2i} - 0.012X_{3i} + 0.243X4 + 0.583X5$$

Where it indicates:

CapX_{1i}: To the results of the aggregate values Articular space cape cappeX_{2i}: To the results of the aggregate values The angle of inclination of the patella boneX_{3i}: to the results of the values Cruciate ligament size

X_{4i} To the results of the values Patella height

X_{5i}To the results of the values The distance between the kneecap and the cruciate ligament openligament$\widehat{and}_i$: To the results of the aggregate values of a variable Degree of pain

Discuss the results of the prediction equation

It appears from the interpretation represented by (Articular space The angle of inclination of the patella bone   The height of the patella bone, and the distance between the kneecap and the cruciate ligament) with the model function variable, representing the degree of pain. The changes occurring in the degree of pain are explained by the model function variable. The percentage value of changes appeared (0.875) from the level and according to the equation, and this model measures the occurrence of levels of impact on the functional structure of the knee joint, and the pain degree index is a common measure to evaluate the change in the functional structure as a result of the injury. It must be noted that the statistical relationships are overlapping and are important and complementary to the other. It is one of the most important factors shaping the pain degree index, and it showed that the largest percentage of influence was for the measurement of Articular space Erosion of the synovial fluid. The researcher believes that the degree of pain is often related to the extent of the erosion of the synovial fluid and the contraction of the joint space. When synovial fluid decreases, the joint becomes more susceptible to damage and inflammation, leading to increased pain. It can provide the shape and composition of synovial fluid. An indicator of joint health during injury. Synovial fluid plays an important role in facilitating movement and reducing friction between bones. Synovial fluid erosion is one of the main indicators through which the condition of the joints can be assessed and the degree of pain associated with them can be determined. This viscous substance works within the joint space to facilitate joint movement and prevent direct friction between the bones. As synovial fluid erodes, its ability to protect the joint decreases, leading to increased friction, inflammation, and cartilage damage, which in turn causes pain.

"People with arthritis often have a narrow joint space and eroded synovial fluid, which leads to increased pain." (Madry H & multiple researchers, 2020) Therefore, measurement of the joint space can be used as a means to evaluate the condition of the joint and predict the degree of pain that the patient may experience. Liu L, Sun Y, (Liu L, Sun Y,) stresses that "synovial inflammation that provoked intraosseous pressure and mechanical stresses on the ligaments and tendons within the joint and around the joint are possible contributors." In the chronic pain you experience (Liu L et al., 2021)Ligaments and tendons also contribute to stabilizing the joint and absorbing shocks. The focus must be on factors that reduce the chances of injury. It must be noted that the patellar movement is effective(Strong et al., 2021).

As a result of ligament injuries Such as tearing of the ligaments that hold the kneecap in place. It is an important factor in evaluating the health of the knee and the degree of pain that the athlete may suffer. "The patella is the small bone at the front of the knee, which plays a vital role in joint movement and support. When any disturbance occurs in the movement of this bone, this can result in severe pain and functional problems. The movement of the patella is represented by its vertical and horizontal movement within the femoral groove(Ali et al., 2024; Bonci, 1999). This movement must be smooth and balanced to ensure that forces are properly distributed across the knee joint. When a disturbance in this movement occurs, such as a deviation or partial dislocation, it can lead to abnormal friction between the kneecap and the femur bones, which can lead to abnormal friction between the kneecap and the femur.

"It causes pain and inflammation." (Graeme, 2009) This was reflected in the results of the predictive equation, and the relationships were logical.

Conclusions

1. The relationship between measuring the functional structure of the knee joint and the degree of pain is an important topic for understanding joint health and developing effective strategies in medical rehabilitation procedures.
2. The relationship between joint space measurement, synovial fluid erosion, and knee joint pain score is an important topic for understanding joint health and developing effective treatment strategies in medical rehabilitation procedures.
3. shares variable (Joint space and synovial fluid erosion), with the highest contribution to the degree of pain in the knee joint in injured athletes
4. shares variable (The distance between the kneecap and the cruciate ligament), the second highest contribution to the degree of pain in the knee joint among injured athletes
5. shares variable (Height of the patella), with the third highest contribution to the degree of pain in the knee joint among injured athletes
6. shares variable (angle of inclination of the patella bone), with the fourth highest contribution to the degree of pain in the knee joint among injured athletes
7. shares variable (cruciate ligament size), with the least contribution to the degree of pain in the knee joint in injured athletes
8. The value of the contribution percentage has been reached
9. Degree of pain $=\widehat{and}_i = 1.019 - 6.624X_{1i} + 0.104X_{2i} - \ 0.012X_{3i} + 0.243X4 + 0.583X5$

Recommendations

1. Paying attention to the percentage of contributions shown by the study to the degree of pain in the knee joint among injured athletes.
2. Approval of the contributions shown by the study from sports medicine and physical therapists.
3. Adopting the prediction value reached in evaluating the medical rehabilitation process.
4. It was suggested that a magnetic resonance imaging (MRI) machine be provided at the Sports Medicine Hospital.
5. Increasing cooperation between magnetic resonance imaging (MRI) diagnosticians in the Medical City with athletes.
6. Conduct similar studies in the shoulder or hip joint.

Acknowledgements

This work has been greatly influenced by the valuable intellectual and cognitive contributions of all those involved in the completion of the article. I am grateful for their assistance.

Financing

This article received no funding.

References

Abbas, F. H. (2021). The effect of exercises accompanied by an innovative device to rehabilitate partial tears of the anterior cruciate ligament on the range of motion and functional performance of the knee joint for athletes. Al-Mustansiriya University.

Ali, O. A., Ahmed, W. H., Saeed Abd, A. Q., & Hummadi, J. N. (2022). Effect of a proposal of exercises on the development of basic motor abilities in men's artistic gymnastics. Sport TK, 11. https://doi.org/10.6018/sportk.539131

Ali, O. A., Mushref, A. J., Hummadi, J. N., & Awad, A. (2024). The effect of a proposed training curriculum to develop some special physical abilities and the accuracy of the movement scoring skill for the Ramadi football club players | El efecto de un plan de estudios de entrenamiento propuesto para desarrollar algu. Retos, 61, 193–200. https://doi.org/10.47197/retos.v61.107271

Bonci, C. M. (1999). Assessment and evaluation of predisposing factors to anterior cruciate ligament injury. Journal of Athletic Training, 34(2), 155.

Colombet, P., Dejour, D., Panisset, J.-C., Siebold, R., & Society, F. A. (2010). Current concept of partial anterior cruciate ligament ruptures. Orthopaedics & Traumatology: Surgery & Research, 96(8), S109–S118.

Décary, S., Fallaha, M., Belzile, S., Martel-Pelletier, J., Pelletier, J.-P., Feldman, D., Sylvestre, M.-P., Vendittoli, P.-A., & Desmeules, F. (2018). Clinical diagnosis of partial or complete anterior cruciate ligament tears using patients' history elements and physical examination tests. PLoS One, 13(6), e0198797.

Dunn, W. R., Spindler, K. P., Amendola, A., Andrish, J. T., Kaeding, C. C., Marx, R. G., McCarty, E. C., Parker, R. D., Harrell Jr, F. E., & An, A. Q. (2010). Which preoperative factors, including bone bruise, are associated with knee pain/symptoms at index anterior cruciate ligament reconstruction (ACLR)? A Multicenter Orthopaedic Outcomes Network (MOON) ACLR Cohort Study. The American Journal of Sports Medicine, 38(9), 1778–1787.

Graeme, J. (2009). he associations between indices of patellofemoral geometry and knee pain and patella cartilage volume: a cross-sectional study. BMC Musculoskeletal Disorders, 1–8.

Hammood, Y. M., Awad, A. K., Ali, O. A., Mushref, A. J., & Hummadi, J. N. (2024). Measuring the aggressive behavior of the teams in the Iraqi Premier League in football and its relation to the results and ranking of the league for the 2022-2023 season. Sportske Nauke i Zdravlje, 14(2), 127–134. https://doi.org/10.7251/SSH2402127H

Khalaf, Y. A., AbdulJabbar, M. A., & Ali, O. A. (2025). The effect of sports job burnout on the performance of workers in student activities departments in Iraqi universities | El efecto del agotamiento laboral deportivo en el rendimiento de los trabajadores de los departamentos de actividades estudiantiles de. Retos, 66, 86–95. https://doi.org/10.47197/retos.v66.113271

Kostogiannis, I., Ageberg, E., Neuman, P., Dahlberg, L., Fridén, T., & Roos, H. (2007). Activity level and subjective knee function 15 years after anterior cruciate ligament injury: a prospective, longitudinal study of nonreconstructed patients. The American Journal of Sports Medicine, 35(7), 1135–1143.

Liu L, Sun Y, Li Q, Zhang Y, & Yang Y. (2021). Elevated Synovial Fluid Neuropeptide Y Levels Are Correlated with Pain in Osteoarthritis . The Journal of Pain Research, 1221–1230.

Madry H, & multiple researcher. (2020). The relationship between synovial inflammation, structural pathology, and pain in post-traumatic osteoarthritis. differential effect of stem cell and hyaluronan treatmen, Arthritis Research & Therapy.

Mohammed Hammood, Y., Hussein Rashid, A., & Adham Ali, O. (2025). The effect of a proposed training method using play exercises to develop specific agility and skill performance in football | El efecto de un método de entrenamiento propuesto que utiliza ejercicios de juego para desarrollar la agilidad específica y el re. Retos, 63, 719–728. https://doi.org/10.47197/retos.v63.111095

Omar, A. F., Hammadi, W. K., Moseekh, L. Z., Muhammad, K. M., Saleh, M. M., & Ali, O. A. (2025). The impact of cognitive training on field intelligence growth and some composite skills of advanced football players | El impacto del entrenamiento cognitivo en el crecimiento de la inteligencia de campo y algunas habilidades compuestas de los jugadores d. Retos, 66, 46–58. https://doi.org/10.47197/retos.v66.113234

Paterno, M. V, Huang, B., Thomas, S., Hewett, T. E., & Schmitt, L. C. (2017). Clinical factors that predict a second ACL injury after ACL reconstruction and return to sport: preliminary development of a clinical decision algorithm. Orthopaedic Journal of Sports Medicine, 5(12), 2325967117745279.

Strong, A., Arumugam, A., Tengman, E., Röijezon, U., & Häger, C. K. (2021). Properties of knee joint position sense tests for anterior cruciate ligament injury: A systematic review and meta-analysis. Orthopaedic Journal of Sports Medicine, 9(8), 23259671211007880.

Wikstrom EA, T. M., & Chmielewski TL et al. (2007). Dynamic Postural Stability Deficits in Subjects with Self-Reported Ankle Instability (Vol. 39). Med Sci Sport Exerc.

Authors and translators' details:

Ammar Mzial Shnta	ammaralhatem@aliraqia.edu.iq	Author
Amaar Shanta	ofcbkr@gmail.com	Translator