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TOKAT GAZİOSMANPAŞA UNIVERSITY

GRADUATE EDUCATION INSTITUTE

THE RELATIONSHIP OF THE CHARACTERISTICS OF THE FORCE-TIME CURVE WITH SOME BIO-KINEMATIC VARIABLES DURING THE TAKEOFF PHASE OF BASKETBALL LAYUP

QAISAR MUSTAFA ISMAEL

PHYSICAL EDUCATION AND SPORTS

MASTER THESIS

ADVISOR

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TO THE DIRECTORATE OF GRADUATE EDUCATION INSTITUTE

With this document, I declare that all the information in this thesis has been collected and presented in accordance with academic rules and ethical principles, and as required by these rules and principles, I refer to all data, thoughts and results that do not belong to me in the study and indicate its source.

(6.12.2021)

The Student Who Prepared the

Thesis

QAISAR MUSTAFA ISMAEL

Signature

…….

DEDICATION

To my parents..... whose constant love, support and guidance have been my source of strength all these years.

To my siblings..... who taught me that life without interdependence, love and cooperation is not worth anything.

To everyone……..... who learned me a letter.

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Abstract

The Relationship ıof The Characteristics of The Force-Time Curve With Some Bio-Kinematic Variables During The Takeoff Phase Of Basketball Layup

Supervisor — Researcher

Asos. Prof. Mehmmet Kargün — Qaisar Mustafa Ismael

The aim of this study lies in focusing on the biomechanical variables affecting the layup shooting. The research aims to identify the values of the force-time function in the layup shooting of basketball and the values of some biomechanical variables in the layup shooting of basketball and to reach the relationship of the force-time function in some bio-kinematic variables in the stage of the advancement of the layup shooting. The researcher used the descriptive approach for its relevance to the nature of the research. The research sample consists of (5) advanced players representing Iraq's basketball team. The researcher used two Japanese-made SONY digital cameras, and a Japanese-made Lenovo laptop computer for the platform and Foot Scan. The researcher used a questionnaire and measuring height and corresponding body mass as means of data collection, and the bio-kinematic variables in the research were divided into two groups. The first group is concerned with the measured variables, which were measured by means of movement analysis software in the computer. The second group extracted variables that were extracted based on the variables measured by physical laws and the variants of the Foot Scan device. The reconnaissance experiment was conducted on Friday 9/4/2021 at eleven o'clock in the indoor basketball hall of the Duhok Sports Club in Dohuk Governorate in order to obtain the best video image of the player (Resolution) according to the dimensions of the two cameras. The side camera was placed to the right of the player at a horizontal distance of (8) meters, and at a height from the ground from the center of the focus of the camera (1,50) meters, and as for the front camera, it was far from the finish line from the player's side (8) meters, and at a height of measured from the center of the camera focus (1,50) meters, as well as the installation of a Foot Scan, which placed the place where the player stands. The main experiment was conducted on Saturday 10/4/2021 at 6:00 pm in the indoor basketball hall of Duhok Sports Club. The cameras and the Foot Scan were placed in the same place and at the same heights that were measured in the previous exploratory experiment. The values were treated statistically by relying on the statistical package (SPSS) to extract (arithmetic mean, standard deviation, coefficient of variation, and simple correlation coefficient of (Pearson), and the researcher concluded that there is a significant negative correlation between the maximum force on the ground and the fulcrum angle in the starting position of the collision. There is a significant positive correlation between the maximum force on the ground and the length and speed of the resulting three-dimensional displacement in the thrust phase. Also, there is a positive significant correlation between the maximum force on ground, the time of the rise phase, the length of the displacement resulting in three dimensions, X, Y, Z, the amount of the angular difference to rise, and the value of the trajectory of the center of mass of the body in the rising phase. Moreover, there is the absence of significant correlations between the maximum force on ground and the rest of the study variables in all its stages.

Keywords: Basketball, layup shooting, Kinematic, Force-Time Curve, Variables.

ÖZET

Basketbol Dizilişinin Kalkış Aşamasında Kuvvet-Zaman Eğrisinin Özelliklerinin Bazı Biyo-Kinematik Değişkenlerle İlişkisi

Danışman
Doç. Dr. Mehmmet Kargün

Araştırmacı
Qaisar Mustafa Ismael

Araştırmanın problemi, turnike atışlarını etkileyen biyomekanik değişkenlere odaklanmaktır. Araştırma, basketbolda turnike şutunda kuvvet-zaman fonksiyonunun değerleri ile turnike şutunda bazı biyomekanik değişkenlerin değerlerini tespit etmeyi ve bazı biyo-kinematik değişkenlerde kuvvet-zaman fonksiyonunun ilişkisine ulaşmayı amaçlamaktadır. turnike çekiminin ilerleme aşaması. Araştırmacı, araştırmanın doğasına uygunluğu nedeniyle betimsel yaklaşımı kullanmıştır. Araştırma örneklemi, Irak basketbol takımını temsil eden (5) ileri düzey oyuncudan oluşmaktadır. Araştırmacı, platform ve Foot Scan için Japon yapımı iki SONY dijital kamera ve Japon yapımı bir Lenovo dizüstü bilgisayar kullandı. Araştırmacı, veri toplama aracı olarak bir anket ve boy ve buna karşılık gelen vücut kütlesini ölçtü ve araştırmadaki biyo-kinematik değişkenler iki gruba ayrıldı. Birinci grup, bilgisayarda hareket analizi yazılımı aracılığıyla ölçülen ölçülen değişkenlerle ilgilidir. İkinci grup, fiziksel yasalarla ölçülen değişkenlere ve Foot Scan cihazının varyantlarına dayalı olarak çıkarılan değişkenleri çıkardı. Keşif deneyi, 9/4/2021 Cuma günü saat on birde Dohuk Valiliği'ndeki Duhok Spor Kulübü'nün kapalı basketbol salonunda, oyuncunun (Resolution) boyutlarına göre en iyi video görüntüsünü elde etmek amacıyla yapılmıştır. iki kamera. Yan kamera oyuncunun sağına yatay (8) metre uzaklıkta ve kamera odak merkezinden yerden (1,50) metre yükseklikte, ön kamera ise , oyuncunun yanından bitiş çizgisinden (8) metre uzaktaydı ve kamera odak merkezinden (1,50) metre ölçülen bir yükseklikte ve ayrıca bir Ayak Tarama kurulumunun yerleştirildiği bir Ayak Taraması kurulumundaydı. oyuncunun durduğu yer. Ana deney 10/4/2021 Cumartesi günü saat 18.00'de Duhok Spor Kulübü kapalı basketbol salonunda yapıldı. Kameralar ve Ayak Taraması, önceki keşif deneyinde ölçülenlerle aynı yere ve aynı yükseklikliere yerleştirildi. Değerler, elde edilecek istatistiksel pakete (SPSS) dayanılarak (aritmetik ortalama, standart sapma, varyasyon katsayısı ve (Pearson) basit korelasyon katsayısı) istatistiksel olarak ele alındı ve araştırmacı, maksimum arasında önemli bir negatif korelasyon olduğu sonucuna vardı. Yerdeki kuvvet ve çarpışmanın başlangıç pozisyonundaki dayanak açısı.Yerdeki maksimum kuvvet ile itme fazında ortaya çıkan üç boyutlu yer değiştirmenin uzunluğu ve hızı arasında önemli bir pozitif korelasyon vardır.Ayrıca, yerdeki maksimum kuvvet, yükselme aşamasının süresi, X, Y, Z gibi üç boyutla sonuçlanan yer değiştirmenin uzunluğu, yükselecek açısal farkın miktarı ve yörüngenin değeri arasında pozitif ve anlamlı bir korelasyon. yükselen fazdaki cismin kütle merkezi.Ayrıca, yerdeki maksimum kuvvet ile cismin geri kalanı arasında önemli bir korelasyon yok. Değişkenleri tüm aşamalarında inceleyin.

Anahtar Kelimeler: Basketbol, turnike atış, Kinematik, Kuvvet-Zaman Eğrisi, Değişkenler.

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Chapter I

1. Research Introduction:

1.1 Introduction and the Significance of the Study:

It seems that many developed countries in the field of sports dedicate their scientific efforts to prepare their players and sports teams on scientific and modern bases in order to determine their position in the civilized calendar among countries. Among the fields that play a role in these scientific efforts is sports physics (sports biomechanics), where the quantitative aspects of movement play as its speed, strength and thrust, or qualitative aspects such as the flow and flexibility of movement. Research methods differed in the sports field, and the champions appeared, where the competition moved from athletes to scientists and researchers. Accordingly, they started comparing movements that were similar in a certain aspect or differing in them, and they invented mechanical and electrical devices where each country had its secrets and theories.

We all agree that sports games in general and basketball in particular, are characterized by dynamic performance, speed and high dynamism. Basketball is one of the team games that have received a lot of attention from specialists and coaches, both in theory and practice, as it needs movement requirements and great kinematic compatibility, especially basic skills, whether offensive or defensive. It is worth noting that basketball is the second popular game in Iraq after football, as it has a large popular base. Therefore, it is important to focus on efforts to find out the most important strengths and weaknesses in some offensive and defensive skills, which are commensurate with their role in competitions since it is a key factor in determining winning and losing on the one hand and raising the level of players' performance on the other hand. Since the boundary between winning and losing is scoring of all kinds, which is the main goal that crowns the performance of all skills, the team can win the match by scoring more points than the opposing team at the end of the match time. Among the types of basketball scoring is layup scoring, which occupies a large space in deciding matches.

Developed countries in the field of sports are trying and devoting efforts to prepare their players on accurate scientific bases, through which they aim to determine the positions of countries in the civilized calendar. The movement analysis is one of the branches of biomechanics, whose study of movement is a descriptive study through the characteristics and properties, as it is the basis for any movement form, and these properties are: length, distance, size, angle, velocity, acceleration, and kinematic path (Khrabit and Shalash, 1992: 28-29).

As well as being linked to many applied sciences, including biomechanics, which is one of the important sciences, which gives an important indication about the subject of the study and to achieve the objectives of the research accurately by describing the skill and analyzing it kinetically and kinematically, through applying mechanical laws and principles to the movements of the human body and using modern, accurate and appropriate devices to reach to the variables to be extracted (Ismail, 2006:21).

The importance lies in knowing the extent of the contribution of the curve of the force and time function and its relationship to some bio-kinematic variables among basketball players where it seems to the researcher’s knowledge that there is no or lack of research in the field of

sports biomechanics, specifically in the field of basketball at the level of universities and colleges of physical education and sports sciences in Iraq, which will be of benefit to coaches and specialists to know the exact matters in this type of scoring and thus stand on the strengths and weaknesses and address them and highlight the positives and install them by movement analysis.

1.2 The Problem of the Study:

Through the researcher's experience in the field of sports and basketball, as a practitioner, lover and follower of the game, he noticed that the players and coaches had less interest in the mechanical aspect of the body completely and focus on the physical and psychological aspect, and this is due, according to the researcher's opinion, to the fact that matters related to the mechanics of the player's movement require modern devices and techniques to measure the skill of peaceful shooting in an integrated manner in terms of body and ball. Thus, reaching positive results that contribute to the service of players, coaches and bodies related to basketball. Hence, the research problem lies in focusing on the biomechanical variables that influence the layup shooting.

1.3 Aims of the Study:

The researcher aims to introduce the followings:

1- The values of the force-time function in the layup shooting of basketball.
2- The values of some bio-kinematic variables in the layup shooting of basketball.
3- The relationship of the force-time function in some bio-kinematic variables in the stage of the takeoff phase of basketball layup.

1.4 Hypothesis of the Study:

The researcher assumes that there is a significant correlation between a number of force-time variables in the layup shooting in basketball with the bio-kinematic variables.

1.5 Scope of the Study:

1.5.1 Human field: A number of advanced players in the Iraqi Premier League.

1.5.2 Time domain: 30.12.2020 – 20.11.2021

1.5.3 Spatial domain: Indoor Basketball Hall in the Duhok Sports Club.

Chapter II

2. Theoretical and Related Studies

2.1 Theoretical Studies:

2.1.1 Biomechanics:

Biomechanics is a word of Latin origin consisting of two words: Bio, which means life, and the word Mechanic, which means machine, instrument, or mechanics. The combination of the word means biological machine (or biomechanics) (Al-Basir, 1998: 15).

The process of directing and selecting the appropriate individual for the type of sports activity practiced is the first step towards reaching the level of the championship. Therefore, specialists in various sports activities decided to determine the relevant necessary specifications for each activity, which help to choose the beginners in sport according to specific scientific bases with the aim of reaching the highest levels of sports (Sana Abbas and Abu Yusef, 2000:109).

Definitions of Biomechanics:

Scientists and researchers have put most of their attention and focus on the subject of biomechanics and have given it different definitions according to their points of view. Roger Bartlett defines biomechanics as “the study and analysis of human movement patterns in sport". (Roger, 2007, 1). Qasim Hassan and Iman Shaker claim that biomechanics is the science of applying mechanical laws and principles to the conduct of sports movements under certain biological conditions (Hassan and Shaker, 1998:14). Susan Hill asserts that it is the application of mechanical foundations in the study of human motions (Susan, 1995:13).

Biomechanics has developed from what it was in the past, especially at the beginning of the nineteenth century, and it has various and wide directions. In the year (284-323 BC), Aristotle was the first to refer to biomechanics in his books dealing with the center of the body’s gravity and the laws of levers and their impact on the movement of bodies and the effect of the movement of the arms on the speed of running. In the year (1727-1642 AD), Isaac Newton was an important and prominent figure in the development of mechanics and motion by setting the basic mechanical laws that are the basis nowadays for biomechanics. The two German scientists (Edur and Weber) in (1836 AD) published the mechanics of human walking machines and developed a series of movement analysis. In the year (1877 AD), there was the invention of cameras, which pushed movement research steps forward (Omar, 2018:9).

Biomechanics has been divided into two main branches:

1- Statics.
2- Dynamics.

1- Statics:

It is the science that studies the state of stability and equilibrium of bodies. When this science is applied to the living body, it is called biostatics, which is to maintain the position of the body and its parts on the base of the anchor in a stable state. It was defined as the science that

covers the cases in which all the forces acting on the body are balanced and the body is in a state of rest or stability. It deals with important phenomena in our daily life such as levers and the center of gravity of the body.

2- Dynamics:

It is the science that studies the movement of the body in terms of the nature of the dynamic and unbalanced forces, which cause a change in its speed and direction. It deals with important laws in our lives such as the laws of force, energy and movement acceleration. Moreover, it is the science that is concerned with the study of the moving bodies with an increasing or decreasing acceleration or both. This science is divided into two important parts:

A- Kinematics:

This science refers to the geometry of motion and describes it abstractly without looking into its causes. It describes the movement of objects from the aspects of time, displacement, distance, angles, velocity and acceleration, and studies the section of kinematics in transitional straight which is called (linear kinematics) or around a fixed axis which is called (circular kinematics).

B- Kinetics:

It is the science that studies the forces that produce or change motion, and it describes the motion of bodies in terms of weight, mass, momentum, force, work, and energy. The kinetic may be a straight line (linear kinetic) or circular as (circular kinetic) (Omar, 2018:13-14).

2.1.2 Movement Analysis:

Movement analysis in the sports field is regarded as one of the important sciences that depends on various other sciences such as anatomy, mechanics, physics, mathematics and psychology. Therefore, it is not possible to perform the analysis of sports movements without completing all the elements affecting that performance. Furthermore, kinesiology is one of the sciences that is concerned with the study of movement from the point of view of structural and muscular work, in addition to the mechanical principles and foundations that are related to the movement of the human body" (Hossam Al-Din and others, 1998:127).

Mahgoub points out that movement analysis is one of the main pillars of evaluating the level of performance, through which we can help the teacher or coach to know the extent of the success of their curricula in achieving the required level, in addition to identifying weaknesses in performance and working to correct them to raise the level of players. For this, the movement analysis is the most reliable scales in evaluation and guidance (Mahgoub and Al-Talib, 1982:10).

The science of movement analysis examines performance and the movement’s parts and components to reach its accuracies, in pursuit of a better technical performance. In the sense that they are Practical procedures that look into the details of sports movements from a mechanical point of view and their interpretation to a scientific point of view and then finding logical solutions that serve educational, training and curative aspects (Najah and Thamer, 2015:16).

As for the concept of analysis in general, Moor defines it as sorting and tabulating many information for its main elements and then processing it statistically or logically to work on

summarizing it into a limited numerical result that can be interpreted when compared to an appropriate and specific standard from its quantitative, quantitative formulas to others with useful meanings (Moor, 1979:155-160).

Through Movement analysis, we can answer many questions related to sports performance, for example, how does the movement take place? Or how do we achieve the intended goal? Or what is it like? What is its effect on the body? Or what are the mechanical, physiological or anatomical characteristics of movement? How does the novice athlete differ from the advanced athlete in motor performance? These questions are models of many questions that can be answered in movement analysis to achieve high achievement (Mahgoub and Talib, 1987:15).

Analysis in the sports field is an important science that depends on other sciences such as anatomy, mechanics, physics and mathematics. So, it is not possible to conduct an analysis of sports movements without completing all the elements affecting performance (Hassanin, 1995:139).

Those interested in Movement analysis should use "concepts taken from physics, anatomy, and mathematics to determine the amount of movement, time, speed and force after the results of the theory of movement are not helpful in developing a scientific plan to estimate the achievement of the real performance of the movement based on the description of movement and the diagnosis of mechanical and anatomical factors and environmental factors in clarifying the rules of biomechanics and movement learning" (John, 1976:3-10).

2.1.2.1 Biomechanical Analysis Sections:

First: kinematic analysis or what is called descriptive analysis:
Second: Kinetic analysis or what is called causal analysis:

First: kinematic analysis or what is called descriptive analysis:

Kinematic analysis is conducted from the abstract descriptive aspects in terms of its geometric and temporal paths, as well as studying the variables of displacement, velocity, acceleration and other variables, whether linear or angle, and the relationship that links these variables with each other regardless of the force that causes movement (Hasna, 2000:7).

kinematic analysis is divided into two types:

1- Quantitative Analysis.
2- Qualitative Analysis.

1- Quantitative Analysis:

The method of kinematic analysis of motor skills is concerned with clarifying and describing the different types of movements by using the relevant equations of velocity and acceleration that were developed on the basis of distance and time measurements (Hussein and Shaker, 2006:43).

This implicitly includes the following two forms:

- Accurate analysis, i.e. the use of precise and elaborate standard equipment such as cinematography, circular photography (sequential) or imaging with conventional imaging

machines. The analysis here depends on the basis of photographing large numbers of movements simultaneously.

- Approximate analysis, i.e. analysis using inaccurate relative information for the incoming standard devices with the calculation of factors in general and general approximate information for multiple sports movements (Majid and Shalash, 2002:13).

2- Qualitative or Procedural Analysis:

This type of analysis contains visual observation, which usually produces or describes movement. This movement is based on strength and weakness in sports performance, and the reliance of qualitative analysis on visual observation in itself is useful in terms of not needing expensive devices or equipment, but on the other hand, it lacks accuracy (Simonian, 1981:150). Qualitative analysis gives a general evaluation form of performance without resorting to numerical analyzes, that is, it identifies the type of performance as good, weak, heavy, long, flexible, rotational (Susan, 1995: 13).

Second: Kinetic analysis or the so-called causal analysis:

It aims to study the causes of movement. Accordingly, one should take into account the internal and external forces surrounding the movement. Movement analysis, like other sciences related to sports movement, has gone through multiple stages in which (Winter Top), (Logan) and (Mackeny 1974) ended up categorizing it into three main types.

1- Movement analysis without the use of visual recording.
2- Movement analysis using imaging (sigmoidoscopy - video).
3- Movement analysis using composite (sigmoid-video) imaging.

(Al Butany, 2002:11)

Both types represent a fact that draws linkage in scientific research. The biomechanical field and the educational field contribute effectively to the identification of the results of movement in the athlete's body with a complex and constantly changing Movement system. Below are several levels of Movement analysis in the sports field (Abd al-Rahman and Husam al-Din, 1994:210).

1- Analysis for the purpose of identifying the technical characteristics of the skill.
2- Analysis for the purpose of detecting performance defects.
3- Analysis for the purpose of comparing performance with optimal performance or the so-called theoretical approaches.
4- Analysis for the purpose of studying the theory of movements and models.

A person interested in Movement analysis uses concepts from physics, anatomy, and mathematics to determine the path of movement (Jhon, 1984:3-10).

2.1.2.2 Importance of Movement Analysis:

It lies in the followings:

1- Explanation and clarification of sports movements.
2- Researching and developing the laws and conditions of sports movements.
3- Improving the sports movements or the required technique.

4- Analysis is used to solve problems related to motor learning and high sports achievement.
5- The Movement analysis answers many questions related to sports achievement, how to achieve the set goal, or how the movement takes place.
6- The Movement analysis helps the trainer to visualize the movement first and then deliver it to the learner secondly.
7- It helps to give accurate scientific advice, which helps to speed learning and reach the correct techniques (Mahjoub, 1987:14).

2.1.3 Force-Time Curve:

It is the amount of force produced during a specific time unit, and it means that there are two components: force in the vertical or horizontal direction - and time in the horizontal direction or vertical and horizontal in the negative value and time in the positive horizontal direction. This case is studied in order to know the effect of the kinetic on the kinematic variables on the basis that the kinetic is the basis for movement and where there can be no movement in the universe without a force. The kinetic means the study of the causes of motion, i.e. the causative force. The function is plotted when the activity is from motion and starts from zero. Force with newton unit is in the vertical direction and time in seconds is in the horizontal direction. The first, second and third force have their own time from the beginning of the movement to its end, that is, until the action of the force stops by leaving the ground after jumping (Amin, 2015:1).

The integration of the (force - time) function between two moments represents the effect of the force (push of force) or the impulse of the force, and it represents the change (push) during a certain time, and it is calculated according to the following equation:

$$\int_o^t f(t)dt = mv(t) - mv_0$$

whereas

$\int_o^t$ represents the function (force-time) from time equal to zero to a specific time.

F represents the force

(t) represents time.

dt represents the change in time.

mv(t) is the mass times the velocity in a given time (the second time).

mv_0 is the mass times the velocity at the first time.

(Hassan and Shaker, 1998:155)

The method of measuring force used in motion: Force is the mechanical action that changes or attempts to change the state of the body acting on it. The methods of measuring and using force have been defined as follows: The athlete's muscular strength, the body's muscle groups, the degree of relationship between muscle strength and external force, the degree of focus, the reaction of mass volume, the correct position for performance in movement transport, that is, when all parts of the body are balanced. How to measure the time it took to move: Measuring the time that the movement took in its field, and the field means the point at which the skill begins to the point at which it ends (Sufian and Youssef, 2014:62-63).

2.1.3.1 Function Contents or Function Components:

1- The vertical force at the moment of impact is called the first force F.
2- The force at the moment of absorption (maximum flexion of the knees), which is called the stage of absorption.
3- The vertical force at the moment of thrust (the maximum force of the thrust phase).
4- The time from the moment of initiation to the moment of absorption.
5- The time from the moment of absorption to the moment of push.
6- The time from the moment of push to the end of leaving the land.
7- The area under the curve is 2 cm.
8- The area under the curve is time, which is the sum of the area under the curve / time, cm2 / sec
9- Weighing system = mass x ground acceleration + weight of the tool, if any.
10- Weight system index = weight system / area under the curve in time.

2.1.3.2 Importance of Studying the (Force-Time) Curve:

It lies in the followings:

1- Obtain the average force recorded from the beginning of the movement to its end.
2- Obtaining an assessment of the body's movement when colliding with the platform when descending and its rapid movement when directing the force to the ground, so that the latter responds with an opposite reaction to the foot when pushed.
3- They give us the values of the force applied to the ground by impact, absorption, thrust, the amount of time it takes, and the vertical distance for the performance of the foot and the speed of movement.
4- Curves provide us with the possibility of balancing the different attempts of the players and each player individually to identify the weaknesses on the performance path (Payne, 1968:83-86).
5- It helps the coach to know the possibility of the player's best performance because the shape of the curve and its components are only an expression of the player's performance art (technic).
6- They provide us with objective values and accurate measurements of the situation to be studied for each individual player, because each player has his own characteristics, physical characteristics, a specific level of performance, and his own method of performance.
7- When measuring the force by means of a measuring platform, the force of the fulcrum reaction gives more accurate numerical values than other methods by means of mathematical equations. In addition, the force-time curve gives an indication of the maximum and explosive force at each moment of time (Al-Janabi, 2004).

2.1.4 Basketball

Basketball is the second popular game after football in many Arab countries, and it is one of the popular team sports for many individuals of all levels and age groups. It is also a fast, exciting and entertaining game that depends in the preparation of its players on the development of the physical, skill and planning aspects. Also, the game of basketball includes multiple basic skills in defense and attack (Jassim, 2008:72).

Basketball is played between two teams of five players each. The purpose of each team is to throw the ball into the opposing team's basket and to prevent the other from taking possession of the ball or hitting the goal. The ball may be passed, thrown, hit, rolled or dribbled in any direction, within the limits of the provisions stipulated in the rules of law.

Initial Basic Rules of Basketball Practice:

1- The ball can be thrown in any direction with one hand or both hands.
2- The ball can be hit in any direction with one hand or with both hands, not with the fist.
3- The player cannot run with the ball, but must throw it from the point where he caught it.
4- The ball must be caught with the hands, not the arms or the body.
5- It is forbidden for the player to use roughness, holding, pushing, blocking or hitting, and any player's violation of this rule will be counted against him.
6- Hitting the ball with the fist is considered a mistake.(Kabalan and Al-Ghafry, 2009:170)

2.1.4.1 Basic Offensive Skills in Basketball:

The basic offensive skills of basketball determine the level, arrangement and success of sports teams in competitions. Any victory depends on how well the team members master these skills. And the excellent basketball team is the one whose players are able to perform passes quickly, tightly and precisely in the various circumstances and situations in which they are in, and to shoot the basket accurately and quickly, and to move with or without the ball with lightness and control, and one of these skills is shooting.

2.1.4.2 Shooting:

The result of the basketball match is determined by the number of successful shots the team scores in the opponent's basket, whether the shot was from close, medium or far areas. Cooper defines it as the movement of pushing the ball towards the goal by the player by throwing the ball using one or both hands. In view of the different playing conditions and situations in which the player is, in addition to the type of defense and defender who is in front of him, several methods of shooting appeared, including layup shooting (Cooper, 1975:54).

2.1.4.3 Layup Shooting:

In the basketball game, the players were prevented from walking with the ball even for one step according to international law, but at the same time it allowed them to take two steps and then leave the ball either by giving a handling to the colleague or by shooting at the basket in the third step and thus appeared the layup shoot which is also called Triple.

2.1.4.3.1 Technical and Mechanical Foundations of the Skill of Layup Shooting:

1- The approximate steps stage:

At this stage, the player is coming with an incremental acceleration, so the first step is characterized by the greater distance it travels compared to the second step, as the distance of the first step is 1.386 meters. While the distance of the second step is "1.348", in order to bring the distance towards the opponent's basket and reduce the momentum of the center of gravity of the body. As for the position of the shooting arm, it is under the ball by spreading the tips of the fingers of the right hand (the thrower), as it is stable between the thumbs and fingers in order to control it.

2- The stage of flight and shooting:

This is the main stage in which the motor duty to be performed is carried out, as the forces resulting from the preparatory stage are exploited. The goal of this stage is to convert the horizontal speed to vertical in order to obtain the maximum height that the player can reach. As for the process of shooting towards the basket and recording the two points, it is by gently pushing the ball while the player reaches the highest point and a full extension of the shooting arm, and the ball is pushed by the wrist and fingers only.

3- The landing stage:

It is the stage in which the movement ends and the body returns to the ground and the legs are bent at the moment of touching the ground using the finger combs in order to absorb the force of gravity and the landing must be on the hamstrings with the knees bent to absorb the landing force, as well as to take the position of preparation for the other action required from the player who shoots in the event of failure of the shot (Salman, 2021:131).

2.1.4.3.2 Technical Performance of the Skill (Layup Shooting):

1- When approaching the basket, the student must keep the ball in front of the body and up near the chin.
2- The student approaches the basket using large steps.
3- The aiming hand should be as close as possible to the basket at its highest height.
4- The fingers must be behind the ball while shooting.
5- Focusing the eye on the specific point of shooting while directing the ball with the fingers to the edge of the basket ring.

2.1.4.3.3 The educational steps of the skill (Layup Shooting):

The skill is divided into the basic movements that it contains, and then the teacher teaches each movement, linking it to the previous movements. This method is better for secondary school students, as the skill is divided into two units, the first unit being the steps of approaching, and the second unit being shooting at the target.

1- Running towards the target from an angle of about 45 to try to touch the part near the back plate with the adjacent hand after raising one foot
2- A training ball is placed on the ground and the student tries to pass over it with a high step, which is the first step before ascending and jumping high.
3- The same exercise as before, with an increase in approach speed.

4- After mastering the approaching steps, he moves to teaching shooting from a place near the target.
5- Linking the approach and shooting with the student running to receive the passing ball and performing the legal steps.

(Shanty, 2016:192-193)

2.1.4.4 Mechanical Analysis in Basketball:

Mechanical analysis aims to know the level of performance of different movements and skills in the game of basketball. Accordingly, we can know the strengths and weaknesses in the level of technical performance and evaluate it objectively and on a scientific basis. All available references indicated that the mechanical analysis of performance is an objective means of evaluating performance and working to develop, improve or modify it, and compare the different methods of performance. It is also used to study the effect of other variables on performance. Mechanical studies contribute to the study and improvement of performance by accessing specific information. Thus, mechanical studies in the branch of sports, including the game of basketball, have become of great importance due to their adoption of objective means in evaluating performance from measuring distances, times and forces affecting performance, in a quantitative and accurate manner, which raises its objectivity and honesty in performance evaluation. Despite the multiplicity of motor skills in the basketball game, and the difference in the mechanics of technical performance in it, the common goal that players seek to achieve in all types of skills is to score points in the opponent's basket with high speed and accuracy. To achieve this goal, the player must have high technical performance and good physical qualities in order to make optimal use of his own strength. As well as the player's ability to use the mechanical laws and his physiological capabilities in the interest of better performance, and economy of effort. The great development in sports achievements cannot be attributed to the development in speed and strength used only, but rather it came as a result of studying the movement as a comprehensive scientific study according to its time and place, as well as the forces causing the occurrence of this movement. For the purpose of studying any of the movements or skills performed by the basketball player, there must be a segmentation of the movement to be analyzed into its overlapping sections, and the estimation of the nature of each part of the movement, where the purpose is to apply the principles and laws of mechanical and anatomical appropriate to the ideal technique of movement (Al-Dulaimi et al., 2010:363-364).

2.2 Relevant Studies

2.2.1 Study of (Mohammed and Mel, 2018):

(*The relationship of some biomechanical variables to the level of performance of the layup shooting of the players of the Basketball Premier League for the season 2016-2017*).

The researchers noticed that there is a discrepancy in the performance of the basic compound offensive skill that ends with the peaceful correction or the motor sequence of the complex skill with the lack of accuracy under the pressure of speed, which gives reflections on the reality of the training process itself and its shortcomings. Therefore, linking skills gives scientific importance in finding more realistic measurements and tests that serve the training process. The study aimed to identify the relationship of some biomechanical variables to the level of the complex offensive skill performance that ended with the layup shooting of the

shooting stage for the players of the six advanced teams from the Iraqi Basketball Premier League for the 2016-2017 season. The researchers used the descriptive approach in the style of correlative relations for its relevance and the nature of the research problem. The research community included the players of the six advanced clubs of the Premier League for the season (2016-2017) AD, who numbered (48) players representing the research community (42) players. As for the statistical means, the statistical program (SPSS), arithmetic mean, standard deviation, median, skew coefficient, Pearson simple correlation coefficient, standard degree were used. It was concluded that there is a relationship of some biomechanical variables in the level of skill performance of layup shooting. The researchers recommended that coaches and workers in the field of basketball should pay attention to the adoption of means to assist in the development of complex offensive skills that end with shooting because it is one of the appropriate solutions according to the players' potential, and to work on developing these skills (Mohammed and Mel, 2018).

2.2.2 Study of (Jawad and Jassim, 2014):

(Analysis of the characteristics of the (force - time) curve and some bio-kinematic variables for the skill of the free throw basketball)

The research aims to analyze the properties of the (force-time) curve and to identify the values of some bio-kinematic variables for the skill of free throwing basketball, as well as finding the relationship between the characteristics of the (force-time) curve and the bio-kinematic variables of the skill of free throwing basketball. The research sample included five players who have a high degree of technical performance for the skill of the free throw. The researchers also used the Statistical Program for Social Sciences (SPSS) program to extract the results. The most important results of the research were summarized that the similarities of the curves among them in terms of the nature of their components as they contain two peaks: the first represented the first push (the beginning of the movement of throwing and pushing with the feet) and the second represented the final push (the moment of throwing the ball on the basket), which is the end of the movement. They are separated by the lowest point in the curve's path, called the absorption phase (negative force), as well as the division of the (force-time) curve into stages. These stages are the first push (the first positive force), the stage of absorption (the negative force) and the stage of the final push (the second positive force) which gives a more comprehensive and broad explanation of the characteristics of the technical performance of the basketball free throw skill. It is clarified the relationship of each of these stages to the other as well as the accuracy of the throw, in addition to the different characteristics of the curves among themselves in terms of the distribution of the force recorded on the curve and the time of its impact on the length of the stages of technical performance of the skill of free throw basketball (Jawad and Jassim, 2014).

2.2.3 Study (Hassan, 2006):

(Studying the characteristics of the force-time curve and some biomechanical variables for the head-scoring skill from jumping)

It also included the research problem, which came through the researcher's observation to the lack of studies in the field of biomechanics in football in general, and in the skill of scoring in the head in particular. Therefore, there was a need to conduct such a study to know and

analyze the kinetic and kinematic variables of the skill of scoring in the head under conditions similar to the cases of playing, as it was not previously known to the researcher, even though this skill was studied in football at the country level from a biomechanical point of view, which made it necessary for the researcher to delve into the midst of this skill to illustrate its importance and study it from various mechanical aspects. This study aims to identify the nature of the (force-time) curve of the jumping head-scoring skill of the research sample, and to identify the values and nature of the relationship for some biomechanical variables (kinetic and kinematic) to each other for the head-jumping skill of the research sample, and to determine the nature of the relationship between the values of some kinematic variables with each other and the nature of the relationship between the values of some kinematic variables with each other also for the skill of scoring by the head from jumping in the research sample. The researcher used the descriptive approach in the style of interrelationships. The researcher also dealt with the description of the sample, the means of collecting information, the devices used, some measurements and physical and skill tests, in addition to testing the accuracy of head scoring from jumping and its scientific foundations, as well as a detailed explanation of the specifications and method of using the force measurement platform and its accessories. In this section, the exploratory research experiences, video photography, the main experiment, and how to analyze the tape (video film) were also discussed, in addition to the measured biomechanical variables and statistical methods.

The researcher came out with several conclusions, the most important of which are:

- There is a similarity in the nature of the curve shape in the skill of scoring with the head from jumping because it contains two peaks represented by the first push and the second by the final push separated by the lowest point of the curve's path after the first peak, which is called the absorption stage.
- The achievement of the research sample of the required values for the height of the hip joint point in the required time is the reason for this that the angles of rise and flight are appropriate for the extension of the joints of the foot, knee and trunk, where clear progress appeared in the values of these angles in order to serve the skillful performance of head scoring from jumping (Hassan, 2006).

2.2.4 Study (Abbas, 2010):

(The relationship of the characteristics of the curve (force - time) and some bio-kinematic variables with the accuracy of shooting from the movement of basketball pivot players)

The research aims to identify the characteristics of the curve (force - time) for the correction of movement for the basketball pivot players, and to identify the values of some kinematic variables to correct the movement of the basketball pivot players, and to determine the relationship of the characteristics of the curve (force - time) and the bio-kinematic variables with the accuracy of the correction of the movement of the basketball players, and to identify the contribution of the (force - time) curve variables and the kinematic variables to the accuracy of the correction of the movement of the pivot players. The researcher used the descriptive approach and in a method of studying the interrelationship and comparison, and the community formed from the pivot players of the Middle Euphrates clubs (Hilla, Al-Tadamon, Al-Rafidain). A sample of (9) players was selected from them, with (3) players for each club. The variables and tests were determined, and a platform for measuring strength was designed that works on an

advanced calculator. The experiment was carried out in the hall of the College of Physical Education / University of Al-Qadisiyah. For the first time, high-speed cameras were used at a rate of 240 images per second. The attempts of the players were photographed from the left and right areas of the basket and from the movement using the rotation movement and the movement of the feet, and the variables included the angles of most parts of the body as well as heights and angular speeds as kinematic variables as well as time The player and the ball have two stages: before the throw and the moment of the throw. It also included a study of the (force-time) curve, which included: (the force, the moment of contact with the free leg, the least force (absorption) and its time, as well as the maximum force (tidal), its time and thrust).

The researcher reached several conclusions, the most important of which are:

- The maximum force on the curve from rotation was recorded greater than the maximum force recorded on the curve from the movement of the feet, as well as for the thrust variable also by the performance of the sample from the left and right side, with a very close total time.
- The maximum force recorded on the curve from rotation and performance from the right side is greater than the maximum force recorded on the curve from the left side and for the other variables (push), and the total performance time is very close.
- Some performance curves for some players varied through the clear cut-off in the curve, which means that there is a lack of aerodynamic performance or a lack of neuromuscular compatibility.
- There are several variables associated with the accuracy variable of the skill of shooting from the movements of the feet from the left of the basket, which are (ankle angle (first touch), knee angle (last touch), shoulder angle (last touch), elbow angle (maximum flexion), and humerus inclination (last touch). MS), the angle of the shoulder before the throw (the angular velocity of the shoulder) and this means that this skill involves multiple movements to complete the requirements for its achievement compared to shooting from the rotation as well as its combined contribution in a different way.

The most indirectly related variables to shooting accuracy are (ankle angular velocity in most stages, torso inclination (first touch, maximum flexion), shoulder angular velocity, hip angle at (first touch), (Abbas, 2010).

Chapter III

3. Research Methodology and procedures

3.1 Research Methodology:

The researcher used the descriptive method for its relevance to the nature of the research.

3.2 Research Sample:

The researcher conducted the final field experiment on a sample of (5) advanced players representing the Iraqi basketball team. Table (1) shows the characteristics of the research sample.

Table (1) shows the specifications of the research sample

No.	Variables	Arithmetic mean	standard deviation
1	**Age**	30.8	4.9
2	**Height**	193.0	13.4
3	**Weight**	90.4	17.8
4	**BMI**	24.1	1.9
5	**Shoe Size**	46.0	2.8

As shown in Table (1) the sample is homogeneous because the value of the coefficient of variation is less than 30% for all sample specifications.
The shoe has been measured to provide data for a foot scan device.

3.3 Devices and Tools:

3.3.1 Devices:

- Japanese digital camera (SONY), 2 pcs.
- Japanese laptop computer (Lenovo) for the platform.
- Foot Scan.
- Laser Printer (CANON), with laser discs.
- An electronic scale for measuring body mass.

3.3.2 Tools:

- Metric tape measure.
- Drawing scale (1) m.
- Forms for recording attempts.
- A wide yellow and red adhesive tape, number (2).
- An electric wire with a length of (50) m.

3.4 Means of Data Collection:

1- Questionnaire:

The researcher prepared a questionnaire form for the bio-kinematic variables, which was distributed to the specialists to determine the most appropriate variables that serve the research. Appendix (1) shows the questionnaire for the biomechanical variables, and appendix (2) shows the names of the experts.

2- Measurement:

- Body Height (cm):

The lengths of the research sample members were measured using a device (measuring height and weight) type (Dluresan), and the person conducting the measurement process lowered a small metal ruler onto the laboratory head from the metal post, and the number at which the indicator stood represents the length of the laboratory in centimeters.

- Body Weight (kg):

The masses of the research sample members were measured using a device (measuring height and weight) type (Dluresan), after waiting for the device to beep. The laboratory stands on the device platform, wears only sports shorts, and the reading is done after the electronic meter is fixed on a number that represents the laboratory's mass in kilograms.

3. Personal Interview

A number of personal interviews were conducted with specialists in the fields of basketball and biomechanics with the aim of collecting the largest number of scientific and practical information related to the research. The information was collected through personal interviews or by means of communication or via the Internet and this was done on different dates throughout the research period, and Appendix (2) shows the names of experts and specialists.

3.5 Research Variables:

The bio-kinematic variables in the research were divided into two groups. The first group is concerned with the measured variables, which were measured by means of Movement analysis software in the computer. The second group is the extracted variables that were extracted based on the variables measured by physical laws and the variables of the foot scan device.

3.5-1 Measured Variables:

It includes:

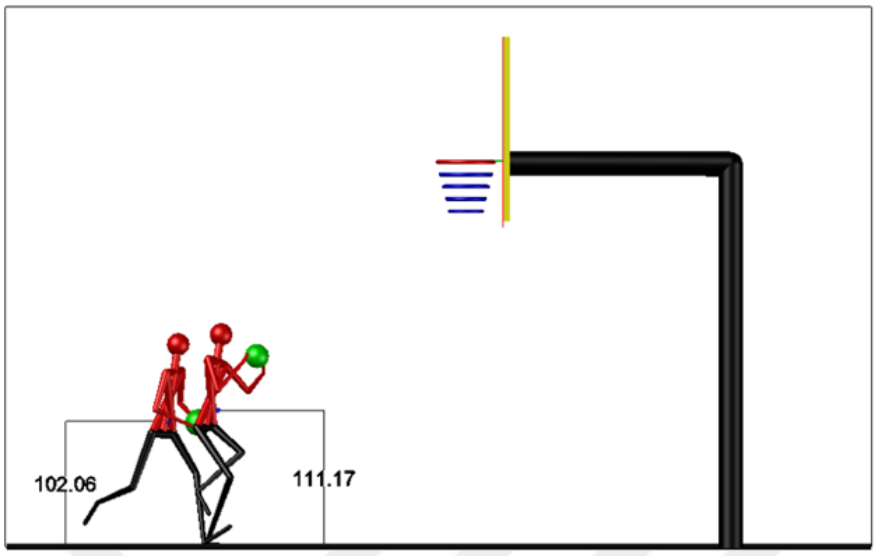

Figure (1): shows:

1- The height of the center of mass of the body above the ground at the beginning of the collision.
2- The height of the center of mass of the body from the ground, the maximum absorption.

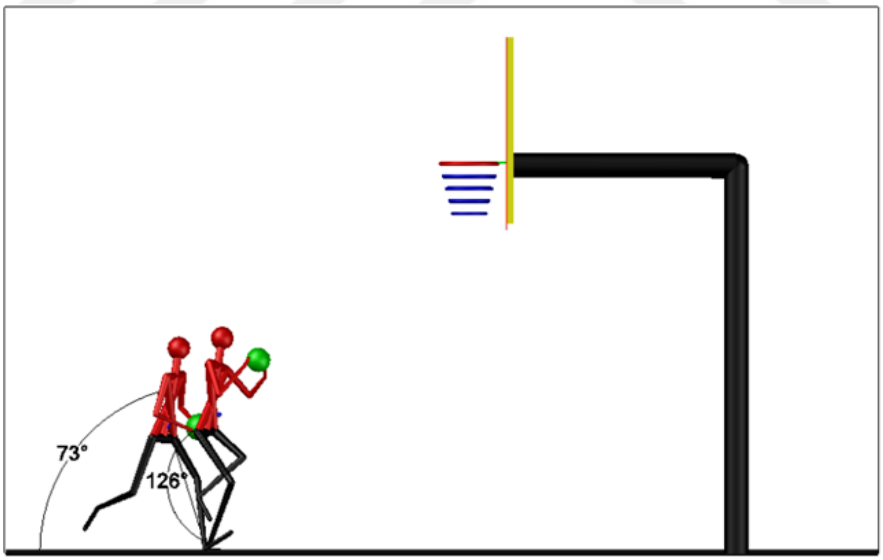

Figure (2): shows:

1- The starting angle of the collision.
2- Maximum knee bend angle for maximum absorption.

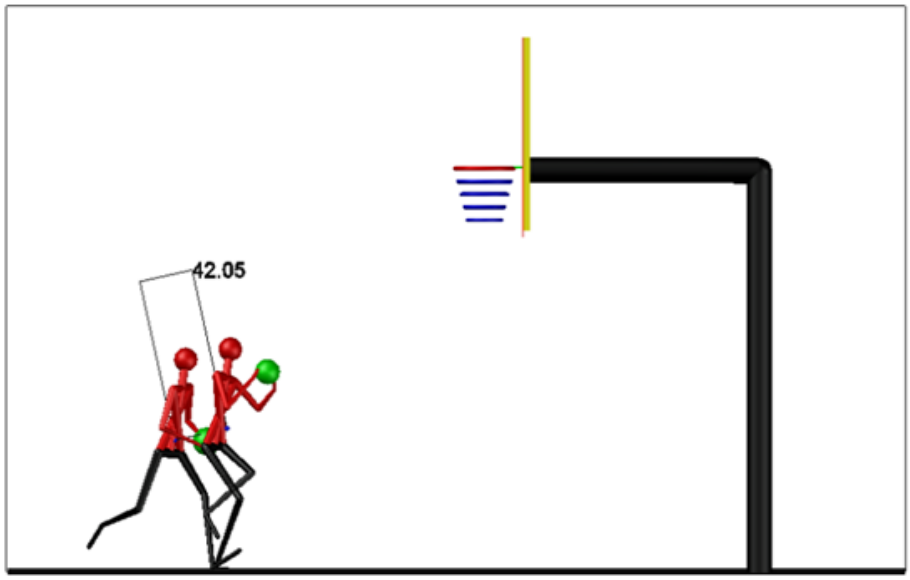

Figure (3): shows the three-dimensional displacement of the collision and absorption phases.

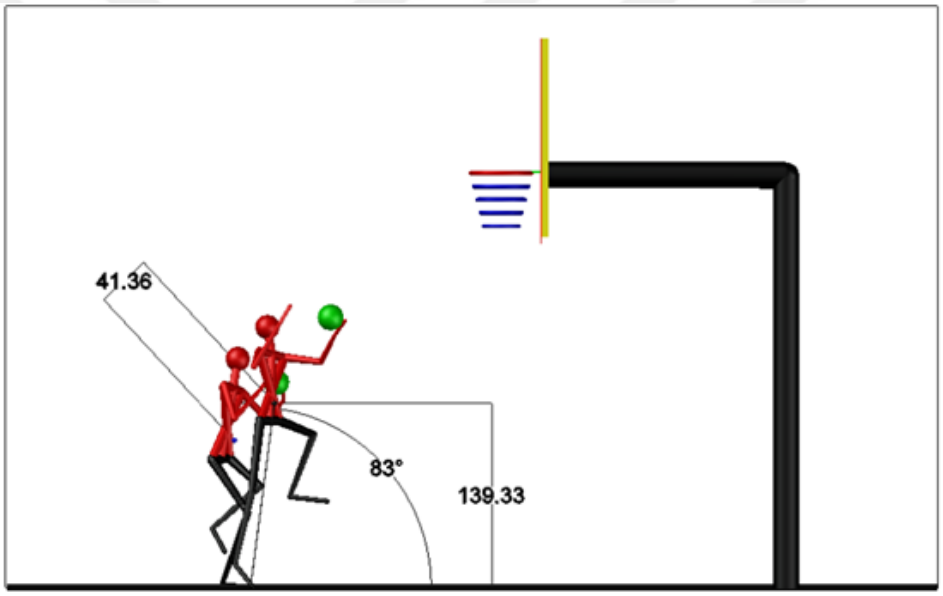

Figure (4): shows:

1- The height of the center of mass of the body above the ground.
2- The angle of leaving the ground.
3- 3D displacement of the push stage.

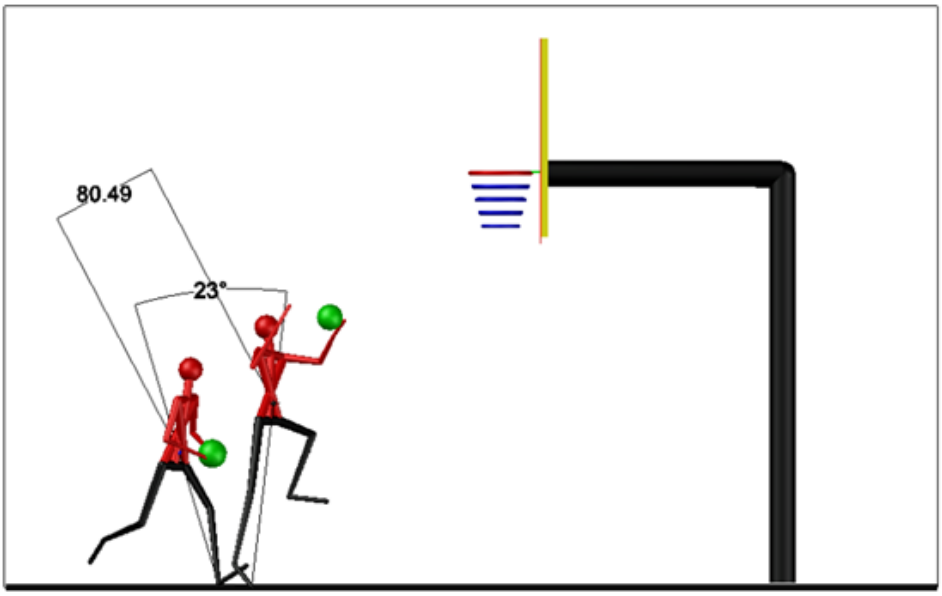

Figure (5): shows:

1- 3D displacement of the rising stage.
2- the angular difference of the rising phase)

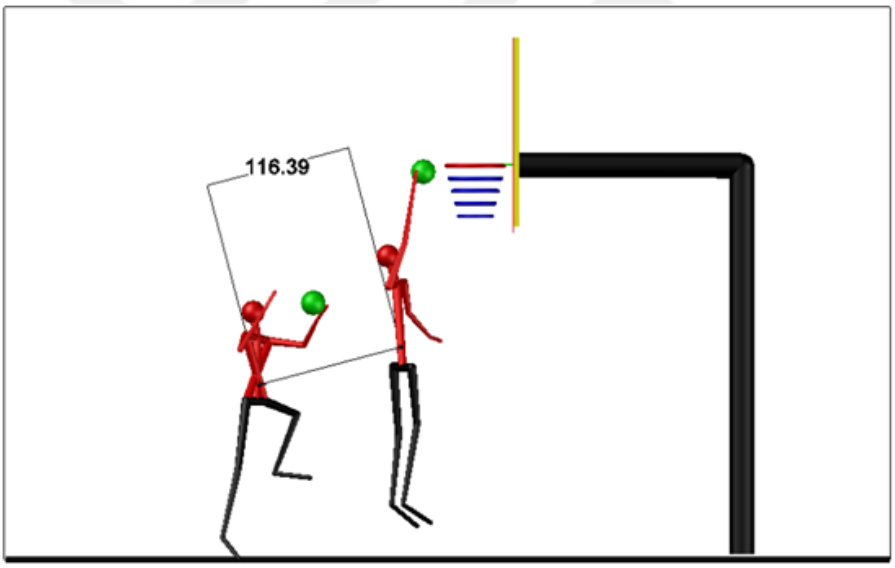

Figure (6): shows a three-dimensional displacement of the flight phase

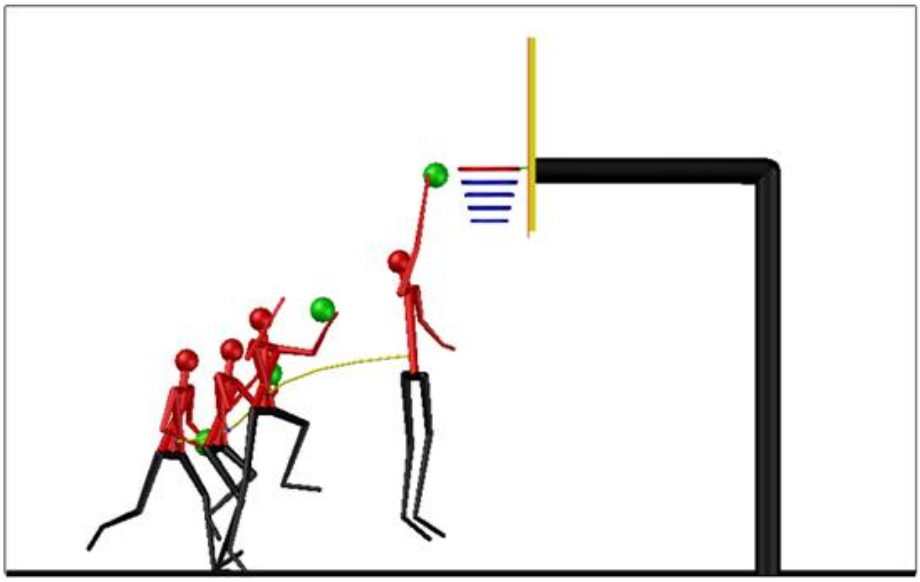

Figure (7): shows the Movement path of the center of mass of a body

5.2 Extracted Variables

The researcher relied on the analysis of scientific sources to reach the most important variables, which were extracted in the most important situations and stages of movement, based on the measured variables, which are:

1- Time variables: The time variable was measured based on the speed of the camera and the number of images during the performance. The time for a single image = 1 / the speed of the camera. Performance time = time of one image x (number of images during performance - 1).

(Mullah Alo, 2005, 50)

2- Speed = Distance / Time = Meters / Seconds. (McGinnis, 1999, 85 M)
3- Angular Velocity = angular velocity = angular change / time = degrees / second.
4- Circumferential Velocity = (angular velocity x m)/ sector.

(Bush and Gerd, 2001, 32)

3.5.3 Variables of the foot scan device:

These variables extracted from the foot scanner are kinetic variables, and the following variables were chosen due to their consistency and the nature of the research under study:

1- Maximum force recorded when pushing per foot.
2- Max force time per foot.
3- The amount of push dispensed from each foot.
4- The area under the curve.

3.6 The exploratory experience:

The reconnaissance experiment was conducted on Friday 9/4/2021 at eleven o'clock in the indoor basketball hall of the Duhok Sports Club in Duhok Governorate, where the national team was camping there. It is worth mentioning that Friday was the day agreed upon by the relatively large work team in terms of number, as it was made up of two professors with scientific and academic specialization from the University of Mosul, Dr. Saad Nafeh and Dr. Thaer Ghanem Mula alo, and there was a professor specializing in the foot scan, Dr. Fereydoun Hassan from Salahaddin University, in addition to two doctors specializing in biomechanics and basketball from the University of Duhok, Dr. Falah Saadoun and Dr. Bilal Khairi. Everyone agreed on Friday, in addition to the extreme difficulty in obtaining the sample, as the coach was afraid of injury to his players during the research procedures.

Through this experiment, all of the following were determined:

1- The location of the side video camera (1).
2- The location of the front video camera (2).
3- The location of the foot scanner.

The exploratory experiment was conducted on the player (Farhad Raadi), a professional player, and the objective of this experiment was to get the best video image for the player (Resolution) according to the dimensions of the two cameras. The side camera was placed to the right of the player at a horizontal distance of (6) meters, and at a height from the ground from the center of the camera's focus (1.50) meters, as well as for the front camera, which was far from the finish line from the player's side (6) meters, and at a height of Measured from the center of the camera focus (1,50) meters, as well as the installation of a foot scan, which was placed in the place of the player's rise close to the zone, as shown in figure (8).

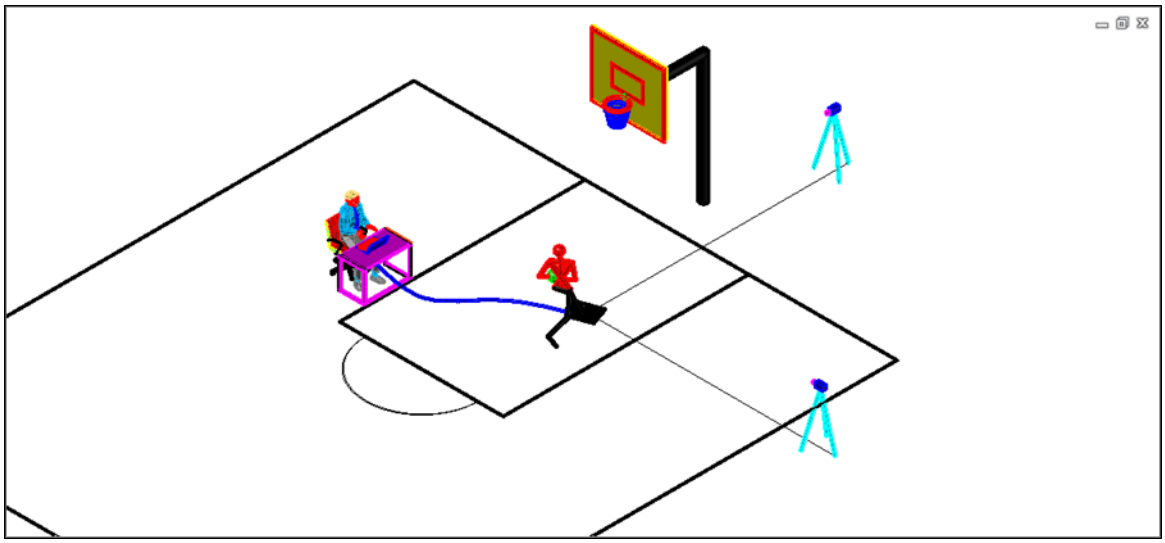

Figure (8): shows the locations of the two cameras and the foot scanner

Several attempts were made by the player, and these video clips were shown to ensure the safety of the video recording and the safety of the foot scan and the smart sensor (SMART SENSOR), which gives all the course of the player's motor performance.

3.7 Main Experience:

The main experiment was conducted on Saturday 10/4/2021 at exactly six o'clock in the evening in the Indoor Basketball Hall in the Duhok Sports Club. The two cameras and a foot scan were placed in the same place and at the same heights that were measured in the aforementioned exploratory experiments.

3.8. Scientific and technical observation:

3.8.1 FOOT SCAN

It is a device intended for biomechanical, therapeutic, sports and scientific purposes. It aims to know the force and pressure variables shed by the areas of the foot on the platform. The device used in the experiment of this research is a three-dimensional metric foot scan, and consists of a platform with dimensions (1 x 40 x 100) cm that is connected to the synchronization box acting as an electric current. A wire comes from outside the box and ends with the laptop, which contains a program for the platform through which the operation of the platform is controlled.

Figure (9) shows the application interface of the program.

The Belgian device from (RS) is intended to measure the kinetic variables of the feet, including force, time, thrust and pressure when pushing or hitting the platform. In order to start recording the attempts of the testers, the program is then run and access to the registration page, where you must first enter the information for each of them, where the most important of which is (first name / second name / births by day, month, year, mass and shoe size) by pressing the (Add Patient) key, as shown in figure (10).

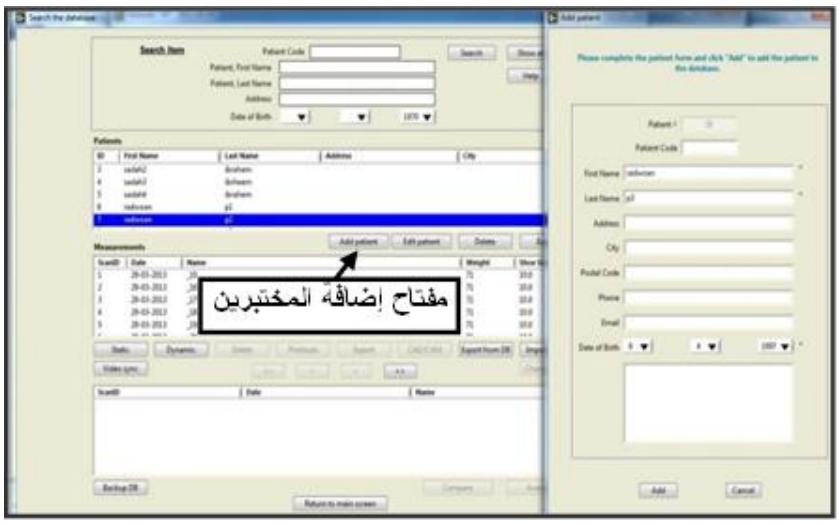

Figure (10): shows the process of starting the program for the foot scan

After that, the players are tested according to their sequence by giving one or two attempts according to the type of test or experiment by pressing (Dynamic) to open a small window asking to enter the player's mass and shoe gauge. This information is requested by the program only on the first attempt to register the player. When registering other attempts, this window opens, but we find the information in it and we do not need to enter it again. There is an important note to be aware of, which is that when choosing a particular player to register a second attempt for him, by clicking on the name of the player in the list of testers names and before pressing (Dynamic) to register the player's second attempt, there should be no (blue) mark on the recorded attempt for this player, which is under the testers names area (sample), because this will open the page for the registered attempt and not register for a new attempt as shown in figure (11).

Figure (11): shows how the player's performance attempt is recorded on the foot scan

Every time approval is given to the weighing window and a new page opens in which the platform divisions are given, and before giving the start signal to the player to perform, the registration signal is pressed at the top of the page as the program starts reading after the foot leaves the platform directly to give the variables.

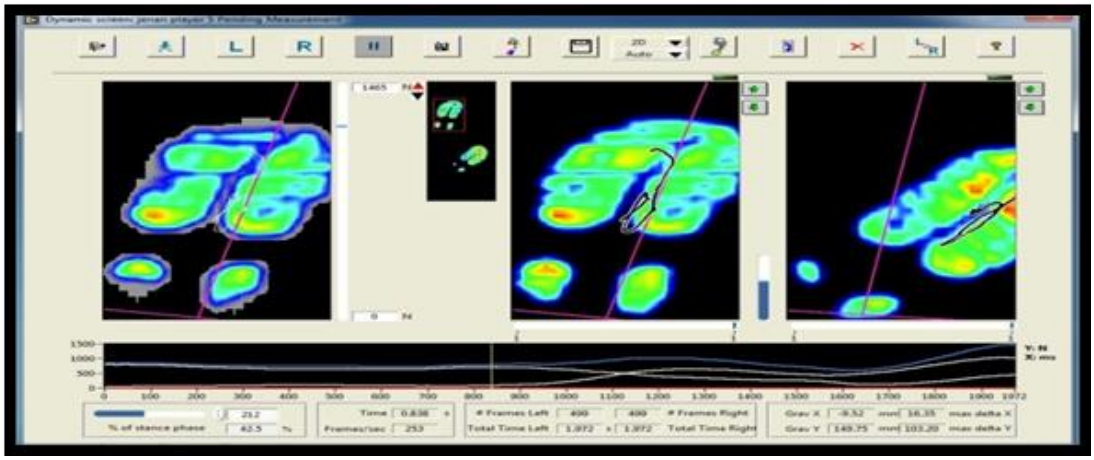

Figure (12) shows the registration page Platform for foot scan.

After that, it is possible to move to the rest of the pages, through which the variables of each recorded attempt and each foot can be known. This system gives details of the values for ten areas of the foot, whether it is for force or pressure in the form of tables and curves.

3.8.2 Kinematic analysis of three-dimensional (3D) video imaging:

The kinematic analysis process goes through several stages:

1- Motion photography:

The research sample was photographed while performing the categorical transmission with two feet apart and converging, using front and side cameras.

2- Transferring the digital film to the computer:

The film was transferred to a computer from the Memory Card Reader of the CASIO Exilim EX-FH20T to start the analysis process.

3- Convert the clipped movie link to Frames:

This is done by using (Adobe After Effects CS4) program, through which it is possible to cut the movement into individual sequential images (Frames), as illustrated in the figure (13).

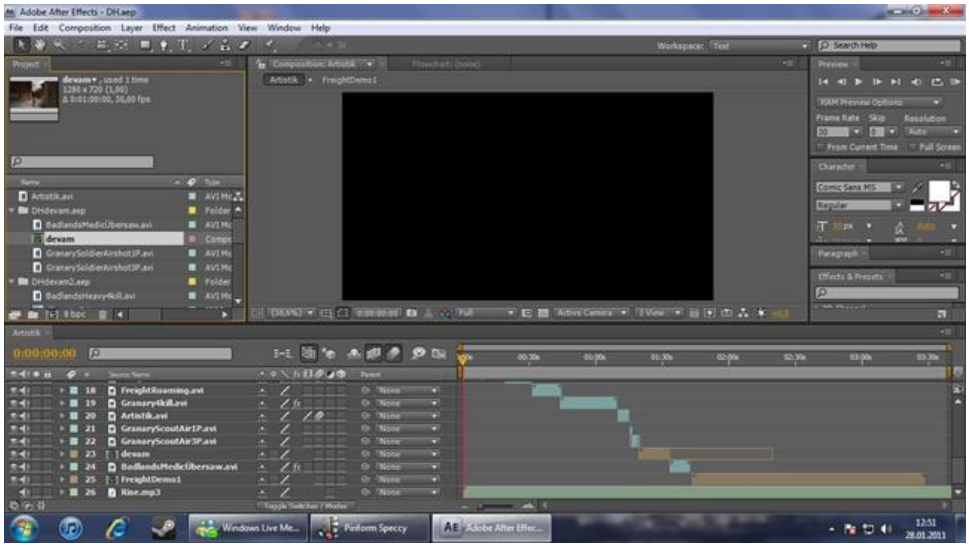

Figure (13): shows the program page to cut the movement into individual images

4- Show pictures for the purpose of determining the beginning and end of the stage:

After the film was cut into pictures, it was shown for the purpose of determining the beginning and end of each stage of the performance for each player separately, and this was done using the program (ACDSee Photo Manager 12), as shown in figure (14).

Figure (14): the program page to display, identify and end each stage

5- Data extraction:

The raw (measured) data and the calculated data were extracted as follows:

- Extraction of measured raw data: The raw data for each of the distances, angles, dimensions, heights and angles were extracted for each image individually, using the program (AutoCAD 2018), which is a global program used in engineering applications and the researcher benefited from it for this purpose.
- Calculated data extraction: The calculated data was extracted by making use of the measured raw data and inserting it into some equations that were entered in the (Excel 2010) program, which is one of the (Microsoft Office) programs, and the researcher benefited from it in the sports processing of the raw data.

3.9 Statistical Means:

The values were statistically processed based on the statistical package (SPSS) to extract:

- Arithmetic mean.
- Standard deviation.
- Coefficient of variation.
- Simple correlation coefficient of (Pearson).

Chapter IV

4. Presentation, Analysis and Discussion of the Results

The results of the layup shooting movement for the advancement stage in basketball will be presented and discussed. It is divided into stages (collision, absorption, propulsion stage (rise stage) and flight stage. Figure (15) shows these stages obtained by the researcher during the main experiment, and the discussion will be according to the research objectives.

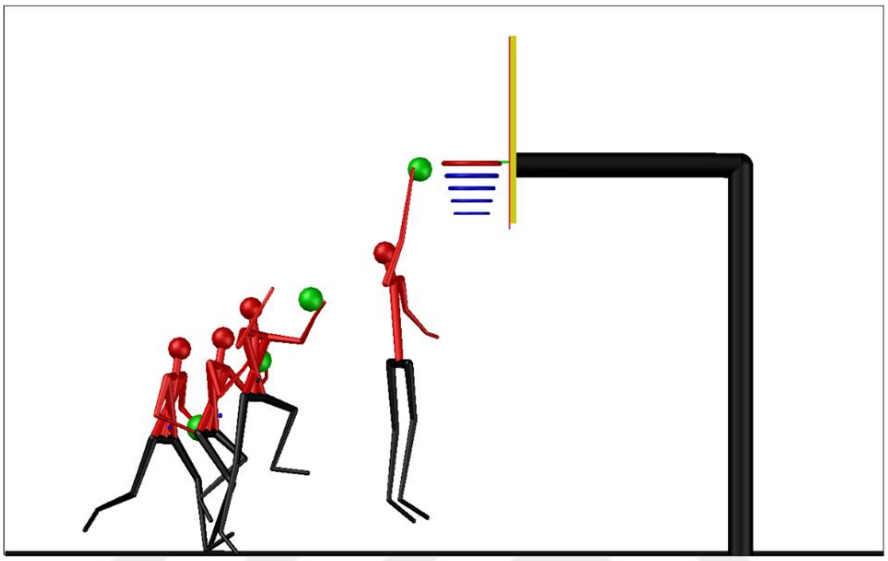

Figure (15): shows the stage of the advancement of the layup shooting in basketball

4.1 Presentation, Analysis and Discussion of the Results

Table (2) shows the arithmetic mean, standard deviation, and R-value of the collision and absorption phase variables

No.	Variables	Variables		Maximum Strength		R	Sig(p)
		AM	STD	AM	STD		
1	Impact and absorption time	0.11	0.02	2601.3	526.25	0.81	0.1
2	Mg height above the ground at the start of the collision	0.75	0.32			-0.8	0.1
3	Msec height from the ground end of absorption	0.69	0.28			-0.8	0.1
4	Body pivot angle	57.31	8.88			-0.9	0.04
5	Rising leg knee joint angle	90.83	31.95			-0.5	0.39
6	3D total displacement X, Y, Z	0.54	0.05			0.75	0.14
7	Sum displacement velocity X, Y, Z	5.12	0.47			-0.75	0.15
8	The path is the center of gravity of the body mass	0.76	0.08			0.73	0.16
9	The velocity of the center of mass of the body	7.23	0.66			-0.75	0.15

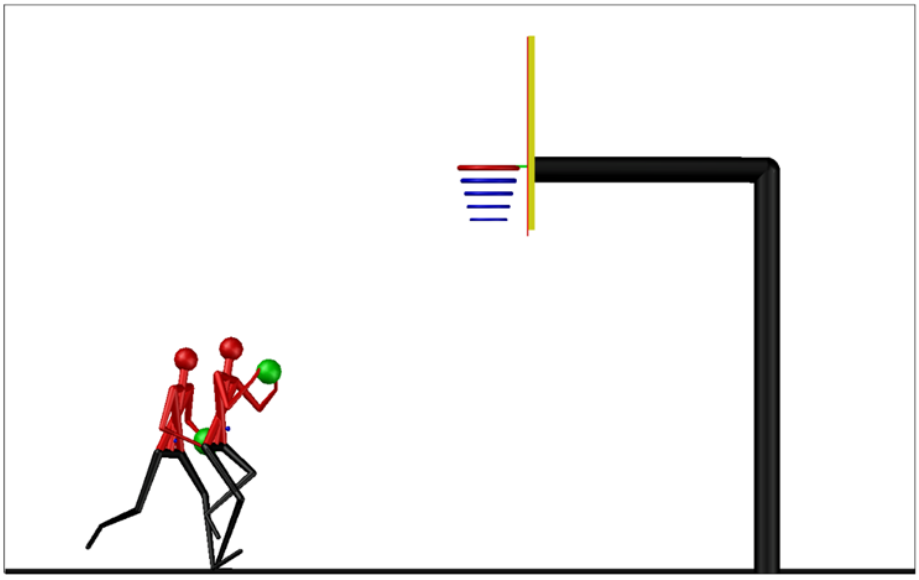

Figure (16) shows the collision and absorption phase of layup shooting in basketball

From Table (2) and Figure (16) the results showed a significant correlation in (body pivot angle), as the value of r calculated on (-0.9) at the degree of freedom (3) and the level of significance ≤ (0.05), and this is confirmed by the degree of significance if it is (0.04) and they are less than (0.05). The researcher attributes the reason for this to the fact that the lower the angle of fulcrum, the greater the scope of the stage of advancement, and thus achieve better performance for the stage of advancement, and this is confirmed by the path of the center of gravity of the body in the stage of rise, which is significant as shown in table (3). This is similar to the jumper in the effectiveness of the high jump in the stage of rising, as (Jacoby & Fraley, 1995) point out that "in order for the jumper to be good, he must be fast and as low as possible (reducing the angle of anchor) as much as possible while he is going to the last step (Jacoby & Fraley, 1995, 95).

As the results showed there is no significant correlation between the variables of the table at the degree of freedom (3) and the level of significance (0.05), and this is confirmed by the degree of significance of the variables and they are greater than (0.05).

Table (3) shows the arithmetic means, standard deviations, and R-value of the Push stage variables

No.	Variables	Variables		Maximum Strength		R	Sig(p)
		AM	STD	AM	STD		
1	Push stage time	0.1	0.03	2601.3	526.25	0.82	0.09
2	The height of the center of mass of the body above the ground (leaving the ground)	0.96	0.26			-0.75	0.15
3	The angle of leaving the ground	68.31	14.28			-0.84	0.07
4	3D total displacement X, Y, Z	0.49	0.08			0.96	0.01
5	Sum displacement velocity X, Y, Z	5.19	0.69			-0.31	0.61
6	The trajectory of the center of gravity of the body	0.81	0.13			0.96	0.01
7	The velocity of the center of mass of the body	8.54	1.12			-0.32	0.61

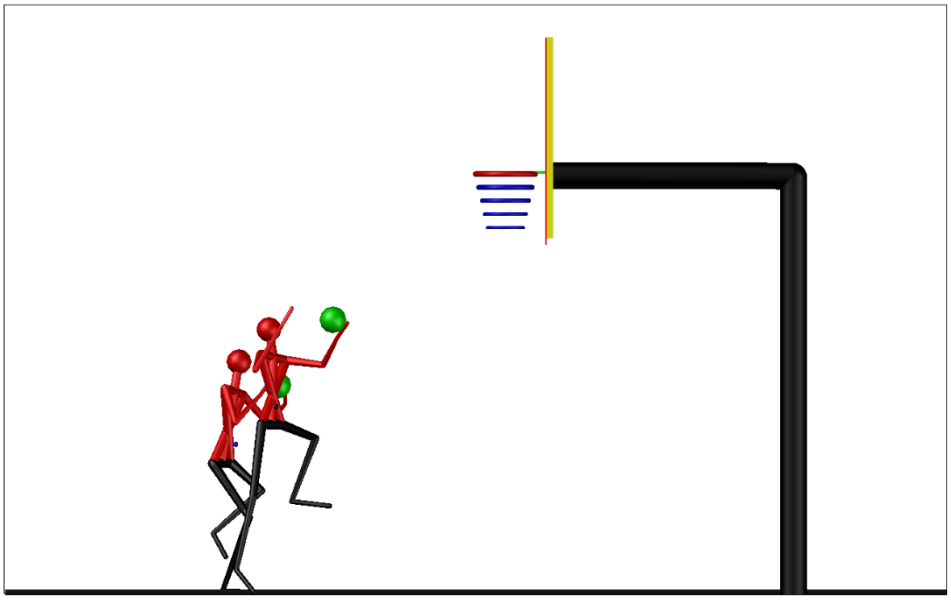

Figure (17) shows the push stage for the layup shooting in basketball

As the results are shown in the table (3) and Figure (17) there is a significant correlation in (the resultant three-dimensional displacement X, Y, Z), as the value of r calculated on (0.96) at the degree of freedom (3) and the level of significance ≤ (0.05)

This is confirmed by the degree of significance if it was (0.01) and they are less than (0.05) and there is a significant correlation in (the path variable of the center of gravity of the body mass), as the r value calculated at (0.96) at the degree of freedom (3) and the level of significance ≤ (0.05). This is confirmed by the degree of significance if it is (0.01) and it is less than (0.05). The researcher attributes that the significant value of the pivot angle in table (2) gave the player a large movement field, which led to an increase in both the total displacement and the trajectory for the center of mass of the body. This results in a better performance of the advancement process, which leads to an increase in the ground thrust force ((The process of jumping is performed by a strong extension of both the legs and the feet, and the jump steps are short and at a speed less than the maximum, where most of the explosive force is used to jump up)) (Zidane, 1997, p. 52).

There is no significant correlation between the variables of the table at the degree of freedom (3) and the level of significance (0.05), and this is confirmed by the degree of significance of the variables and they are more than (0.05).

Table (4) shows the values of the arithmetic means, standard deviations, and the R-value of the variables of the stage of rise and stage of the total path

No.	Variables	Variables		Maximum Strength		R	Sig(p)
		AM	STD	AM	STD		
1	Rise phase time	0.2	0.04	2601.3	526.25	0.93	0.02
2	3D total displacement X, Y, Z	1.51	0.17			0.96	0.01
3	Sum displacement velocity X, Y, Z	7.49	0.66			-0.62	0.27
4	Angular difference to rise	54.38	21.16			0.94	0.02
5	Angular velocity of rise	260.5	66.43			0.71	0.18
6	Peripheral velocity of rise	518.96	60.08			0.61	0.27
7	The trajectory of the center of gravity of the body	1.57	0.18			0.96	0.01
8	The velocity of the center of mass of the body	7.8	0.61			-0.69	0.19

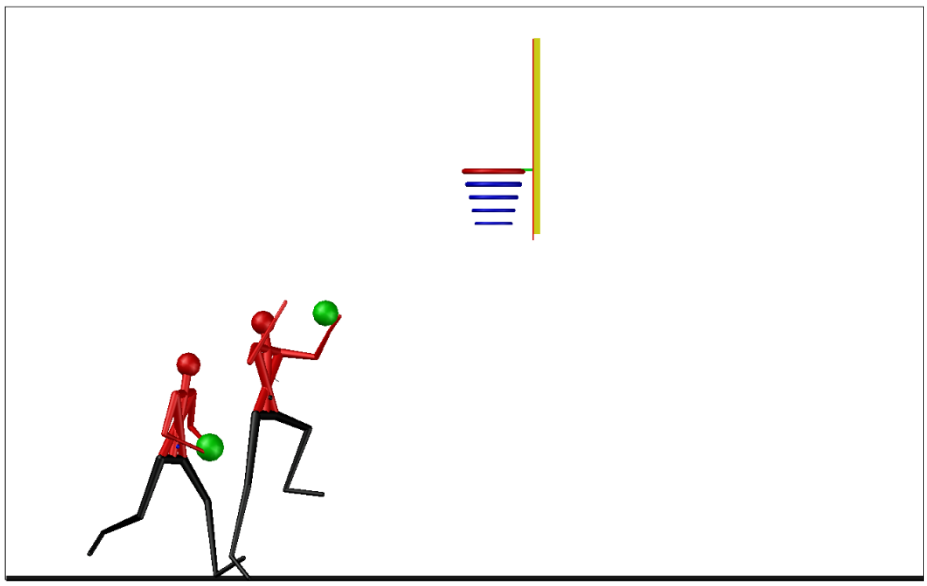

Figure (18) shows the stage of the advancement of the layup shooting in basketball

From Table (4) and Figure (18) it is shown there is a significant correlation in (the time of the stage of rise), as the value of r calculated on (0.93) at the degree of freedom (3) and the level of significance ≤ (0.05), and this is confirmed by the degree of significance if it is (0.02) and they are less than (0.05). There is a significant correlation in (the resultant three-dimensional displacement X, Y, Z), as the value of r calculated on (0.96) at the degree of freedom (3) and the level of significance ≤ (0.05), and this is confirmed by the degree of significance if it was (0.01) and they are less than (0.05). There is a significant correlation in (the angular difference for advancement), as the value of r calculated on (0.94) at the degree of freedom (3) and the level of significance ≤ (0.05), and this is confirmed by the degree of significance if it is (0.02) and they are less than (0.05). There is a significant correlation in (the path variable of the center of gravity of the body mass), as the value of r calculated on (0.96) at the degree of freedom (3) and the level of significance ≤ (0.05), and this is confirmed by the degree of significance if it was (0.01) and they are less than (0.05).

The researcher attributes that the four variables mentioned above were significant due to the optimum exploitation of the motor field of the stage of advancement in order for the player to achieve better flight in order to reach the basketball ring to ensure the achievement of the goal in the basket, as well as to ensure that he gets rid of the competitors so that the competing player does not take it and this came with an increase in the maximum strength on the ground and recorded by a foot scan The phase of the push and the individual leg of the ascent helps in the process of extending the body as a whole until the instep and the trunk remains as it is moderate and the free leg works to secure the pushing process in cooperation with the arms and the movement of the front leg continues until it reaches a right angle with the approximate torso where the arms continue their movement until they reach the level of the eye and the look is forward, and we can say that the process of ascension has succeeded when the effective line of force passes directly through the center of transmission of the body (Osman, 1990, 340).

There is no significant correlation between the variables of the table at the degree of freedom (3) and the level of significance (0.05), and this is confirmed by the degree of significance of the variables and they are greater than (0.05).

Table (5) shows the arithmetic mean, standard deviation, and R-value of the fly phase variables

No.	Variables	Variables		Maximum Strength		R	Sig(p)
		AM	STD	AM	STD		
1	Fly phase time	0.29	0.03	2601.3	526.25	-0.57	0.31
2	Three-dimensional net displacement X, Y, Z	1.15	0.18			-0.59	0.29
3	The sum of the three-dimensional displacement velocity X, Y, Z	3.95	0.36			-0.38	0.52
4	The trajectory of the center of gravity of the body	1.91	0.3			-0.59	00.3
5	The velocity of the center of mass of the body	6.55	0.6			-0.38	0.53
6	Linear momentum of the trajectory of the center of gravity of a body	3.48	0.26			0.01	0.98
7	The total path is the center of mass of the body	7.04	0.54			-0.49	0.41
8	Total velocity center of gravity of body mass	633.06	98.54			0.84	0.07
9	Linear momentum of the trajectory of the center of mass of a body	0.29	0.03			-0.57	0.31

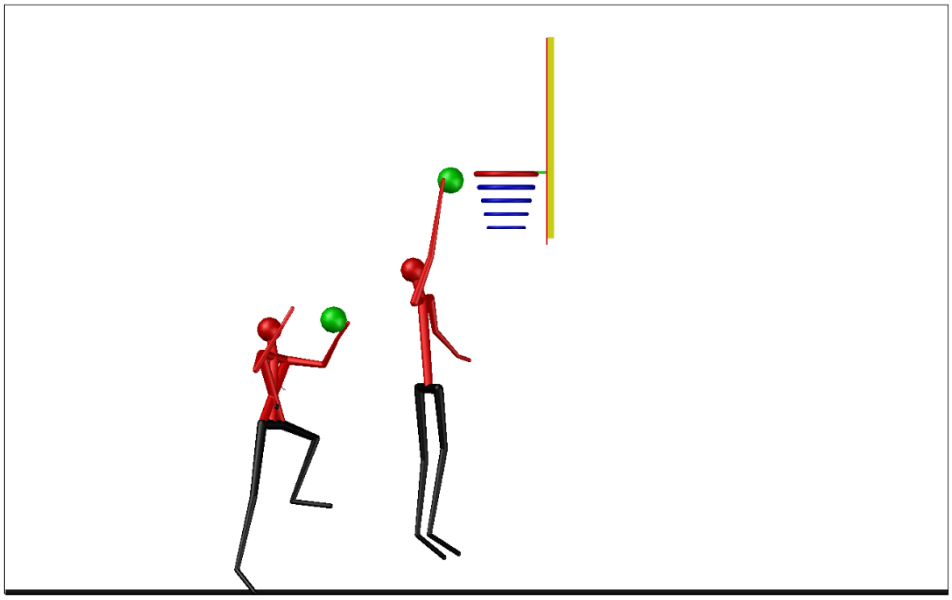

Figure (19) shows the flight stage of the layup shooting in basketball

From Table (5) and Figure (19) it is shown there is no significant correlation between the variables of the table at the degree of freedom (3) and the level of significance (0.05), and this is confirmed by the degree of significance of the variables and they are greater than (0.05).

Chapter V

5. Conclusions and Recommendations

5.1 Conclusions:

- There is a negative significant correlation between the maximum force on the ground and the fulcrum angle at the start of the collision.
- There is a positive significant correlation between the maximum force on the ground and the length and speed of the resulting three-dimensional displacement in the thrust phase.
- There is a positive significant correlation between the maximum force on the ground, the time of the rise phase, the length of the displacement resulting in three dimensions, X, Y, Z, the amount of the angular difference to rise, and the value of the trajectory of the center of mass of the body in the rising phase.
- There are no significant correlations between the maximum force on earth and the rest of the study variables in all its stages.
- There is a significant negative correlation between the value of the area under the curve and the fulcrum angle at the start of the collision.
- There is a significant positive correlation between the value of the area under the curve and the length of the path of the center of mass of body mass in the thrust phase.
- There is a positive significant correlation between the value of the area under the curve with the time of the recovery phase, the length of the displacement resulting in three dimensions X, Y, Z, the amount of the angular difference to rise and the value of the trajectory of the center of gravity of the body mass in the recovery phase.
- There are no significant correlations between the value of the area under the curve and the rest of the study variables in all its stages.

5-2 Recommendations:

- Emphasis on the correct technical performance of the different stage of advancement and monitor the body's movements during the technical performance in order to make more benefit of the force of the earth's thrust.
- Emphasis on producing the maximum impact force and reducing the absorption stage as much as possible to take advantage of the force in the propulsion stage in order for the player to obtain an ideal speed and angle of flight to achieve the best achievement.
- Conducting similar research on larger samples of different levels to have more general and comprehensive results.
- Movement Analysis to identify the most important strengths and weaknesses and develop technical performance and other skills.
- Emphasis on the importance of analyzing the power path of the players to identify and correct errors in performance

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Appendix

Appendix (1)

Tokat Gaziosmanpaşa University
College of Physical Education
Postgraduate Studies / Master

Questionnaire No. (1)

Sub. / Questionnaire form to solicit the opinions of experts and specialists

To the respected expert

Mr.....

The researcher intends to conduct the research entitled **(The Relationship Of The Characteristics Of The Force-Time Curve With Some Bio-Kinematic Variables During The Takeoff Phase Of Basketball Layup).** Please choose the most important variables related to the current study, or any other addition you deem appropriate. Because you are an expert in this field, your opinion is essential and important to the success of this study.

Thanks for your cooperation

Signature:
Name:
Scientific title & date of obtaining it:
Specialization:
University and College:
Date:

MA Student
Qaisar Mustafa Ismael

No.	Stages / Variables	Rise Stage			Note
		Collision	Absorption	push	
Angles of the joints of the body	Right wrist joint angle				
	Left wrist joint angle				
	Right elbow joint angle				
	Left elbow joint angle				
	Right shoulder joint angle				
	Left shoulder joint angle				
	Right hip joint angle				
	Left hip joint angle				
	Right knee joint angle				
	Left knee joint angle				
	Right ankle joint angle				
	Left ankle joint angle				
Body parts angles	Right palm joint angle				
	Left palm joint angle				
	Right forearm joint angle				
	Left forearm joint angle				
	Right humeral joint angle				
	Left humeral joint angle				
	Right leg joint angle				
	Right foot joint angle				
	Left foot joint angle				
	Left leg joint angle				
	Trunk inclination joint angle				
	body joint tilt angle				
	Flying joint angle				
	head joint angle				

No.	Stages / Variables	Rise Stage			Note
		Collision	Absorption	push	
Distances, displacements, and elevations	Height msec.g				
	The distance between the feet				
	The total distance of movement				
	The resultant distance per msec				
	Vertical distance in msec.				
	Horizontal distance in msec				
	Back tendon				
	Palm height msec				
Time	Payment time				
	rise time				
	Performance time of the throwing arm				
	Player's flight time				
	time highest altitude				
	Total time to rise				
	Maximum thrust phase power time (sec.)				
	Area time under the curve (seconds)				
	Time to reach maximum power of the thrust phase (sec)				
Extracted variables	Total speed of msec				
	Horizontal speed Lmc				
	vertical velocity mcg				
	arm angular velocity				
	Attachment angular velocity				
	angular velocity of the palm				
	Horizontal Acceleration				
	Vertical acceleration of LMTC				
	The total acceleration of the m.s.c.				
	Angular acceleration of the arm				

No.	Stages / Variables	Rise Stage			Note
		Collision	Absorption	push	
	Angular acceleration of the elbow				
	Angular acceleration of the palm				
The force-time function	Max recorded power				
	Recorded maximum power time				
	lowest recorded power				
	Minimum recorded power time				
	Time to reach maximum recorded power				
	The time to reach the lowest recorded power				
	average ground reaction force				
	Area under the curve/cm²				
	Wadih Index - Samir $= \frac{\text{Weight system / newtons}}{\text{Area under the curve/time. cm}^2\text{.tha}}$				
Ball related variables	The highest height of the ball at the moment of launch				
	Ball launch angle				
	Ball starting distance				
	Ball launch velocity				

Appendix (2)

Tokat Gaziosmanpaşa University
College of Physical Education
Postgraduate Studies / Master

Questionnaire No. (2)

Sub. / Questionnaire form to solicit the opinions of experts and specialists

To the respected expert

Mr.....

The researcher intends to conduct the research entitled **(The Relationship Of The Characteristics Of The Force-Time Curve With Some Bio-Kinematic Variables During The Takeoff Phase Of Basketball Layup).** Please choose the most important variables related to the current study in **the foot scan device**. Because you are an expert in this field, your opinion is essential and important to the success of this study.

Thanks for your cooperation

Signature:
Name:
Scientific title & date of obtaining it:
Specialization:
University and College:
Date:

MA Student
Qaisar Mustafa Ismael

No.	Variables	Applicable	Inapplicable	Note
1	Maximum power when pushing			
2	time max power			
3	Push amount			
4	area under the curve			

Note:

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Appendix (3)

It shows the names of the specialists on whom the questionnaires were distributed and who were personally interviewed according to their specialization

No.	Specialist Name	Place of Work	Kinematic variables	Personal interviews
1	Prof. Dr. Sareeh Abdul Karim Al-Fadhli	Biomechanics/College of Physical Education/University of Baghdad	✓	
2	Prof. Dr. Ahmed Tawfiq Al-Janabi	Biomechanics/College of Physical Education/University of Salahaddin	✓	
3	Prof. Dr. Hussein Mardan Omar	Biomechanics/College of Physical Education/University of Al-Qadisiyah	✓	✓
4	Prof. Dr. Thaer Ghanem Mula alo	Biomechanics/College of Physical Education/University of Mosul	✓	✓
5	Prof. Nazem Jabbar Jalal	Biomechanics/College of Physical Education/University of Sulaimaniya	✓	
6	Prof. Dr. Jalal Kamal	Basketball/College of Physical Education and Sports Sciences/University of Duhok		✓
7	Prof. Dr. Sri Jamil Hani	Biomechanics/college of physical education and sports sciences/University of Duhok	✓	✓
8	Prof. Dr. Fereydoun Hassan	Biomechanics/College of Physical Education/University of Salah Aldeen	✓	✓
9	A.Prof.Dr. Bilal Khairy Mohammed Saeed	Biomechanics/college of physical education and sports sciences/University of Duhok	✓	✓
10	Dr. Falah Saadoun Omar	Basketball/College of Physical Education and Sports Sciences/University of Dohuk		✓
11	Mr. Miqdad Radhi Mahdi	Basketball/College of Physical Education and Sports Sciences/University of Duhok		✓
12	Mr. Hakar Barki	Biomechanics/college of physical education and sports sciences/University of Duhok	✓	✓
13	Mr. Aziz Bakir	Coach of the Iraqi National Basketball Team		✓
14	Mr. Ali Farhan	Al-Hashd Basketball Club coach		✓
15	Mr. Khaled Yahya Darwish	Al Naft Basketball Club coach		✓

Appendix (4)

Shows the names of members of the cooperating team

No.	Specialist Name	Place of Work
1	Prof. Dr. Thaer Ghanem Malalo	Biomechanics / College of Physical Education / University of Mosul
2	Prof. Dr. Fereydoun Hassan	Biomechanics / College of Physical Education / Salahaddin University
3	Prof. Dr. Saad Nafeh	Biomechanics / College of Physical Education / University of Mosul
4	Prof. Dr. Jalal Kamal Muhammad	Basketball / College of Physical Education and Sports Sciences / University of Duhok
5	A.Prof.Dr. Bilal Khairy Mohammed Saeed	Biomechanics / College of Physical Education and Sports Sciences / University of Duhok
6	Dr. Falah Saadoun Omar	Basketball / College of Physical Education and Sports Sciences / University of Duhok
7	Mr. Hakar Barki	Biomechanics / College of Physical Education and Sports Sciences / University of Duhok
8	Mr. Ali Farhan Darwish	Basketball coach