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An analytical study of some biokinematic variables of the forehand volley skill in tennis and its relationship to the speed of learning the forehand volley skill in padel for players

Saif Ali Hussein, Mohammed Ali Hussein and Layth Falih Kadhim

Abstract

The purpose of this paper is to identify the values of some biokinematic variables of the forehand volley in tennis and padel, as well as to identify some biokinematic variables of the tennis forehand volley skill and their relationship to the speed of learning the forehand volley skill in padel. The researchers hypothesized that there is a correlation between some biokinematic variables of the tennis forehand volley skill and their relationship to the speed of learning the forehand volley skill in padel. The researchers used the descriptive approach due to its suitability to the nature and problem of the research. They selected the most important biokinematic variables under investigation in the performance of the forehand volley skill in tennis and padel. The researchers reached the most important results: a significant correlation between some biomechanical variables of tennis and padel for the forehand volley skill, as well as a correlation between some biokinematic variables of the tennis forehand volley skill and the speed of learning the forehand volley skill in padel.

Keywords: Forehand volley, tennis, padel, biokinematic variables

Introduction

In its early days, the practice of sports was primarily aimed at demonstrating human strength or as a form of entertainment, limited to a few primitive sports without scientific study. However, as human society evolved in many areas, sports became a significant part of this development, in terms of infrastructure, sports laws, and the athlete's physical and skill levels (Saleem Radhy, *et al.* 2025) ^[6]. This development has been instrumental in helping other sciences effectively solve many of the problems facing these sports, and has even played a clear role in reaching higher levels.

Tennis is one of these sports that has undergone remarkable development and is simultaneously an enjoyable sport for players and spectators. It is one of the best ways to spend leisure time on a social level, as tens of millions of men and women of all ages practice it. It also plays an important role in preparing individuals physically, mentally, psychologically, and socially by developing their abilities and potential to participate positively in serving society (Madloul, *et al.*, 2025) ^[2]. Various countries around the world have begun to develop and derive new and innovative games. Among these games is padel, a racket sport derived from tennis and squash. Padel has received special and significant attention in terms of infrastructure and the provision of all necessary requirements for its widespread dissemination, as well as interest in its development and the development of targeted strategies through local and international padel sports federations (Naser, *et al.*, 2025; Radhi, & Obaid, 2020) ^[3, 4]. Significant efforts have been made to raise the level of the game. The rapid and exceptional development has led to an expansion of the game's base and reflected its true value. Other sciences have played a major role in this development in terms of technical, physical, psychological and functional performance. Motor learning and biomechanics are among the most important sciences that have led to many appropriate solutions, whether for cases related to the game's equipment, its movement paths, or the forces affecting the athlete himself, bringing him to the best level.

Research problem

By observing and reviewing many official matches played by the researchers in padel, both inside and outside Iraq. As a former tennis coach and current racquet sports teacher, the researchers noticed that there were similarities in some skills between tennis and padel. This similarity led to accelerated learning of some padel skills. Therefore, the researchers decided to study and analyze some of the biokinematic variables of the forehand volley skill in tennis and their relationship to the speed of learning the forehand volley skill in padel.

Research objective

- To identify the values of some biokinematic variables of the forehand volley in tennis and padel.
- To identify some biokinematic variables of the forehand volley skill in tennis and their relationship to the speed of learning the forehand volley skill in padel.

Research hypotheses

- There is a correlation between some biokinematic variables of the forehand volley skill in tennis and their relationship to the speed of learning the forehand volley skill in padel.

Research fields

- **Human field:** Middle Euphrates Tennis and Padel Advanced Players
- **Time field:** (2/1/2025) to (30/8/2025)
- **Spatial field:** The outdoor tennis court at the College of Physical Education and Sports Sciences, University of Kufa, and the padel court at the Al-Ghadeer Village Complex.

Research methodology and field procedures

Research Methodology

The first step a researcher takes when conducting research is to choose a methodology that is appropriate to the nature of the research problem. "The methodology is the method the researcher follows in studying the problem to discover the truth" (Ahmed Badr. 1987) ^[1]. Therefore, researchers chose the descriptive methodology and the method of interrelationships (correlations), given its suitability to the nature and problem of the research. The descriptive methodology "is an investigation that focuses on a phenomenon as it exists in the present with the aim of diagnosing it, revealing its aspects, and determining the relationships between its elements or between it and other phenomena" (Rahim Younis Karou Al-Azzawi. 2008) ^[5].

Community and sample research

The sample is the group that is examined or studied, i.e., the group on which the research is conducted. It may consist of one, two, three, or four (Wajih Mahjoub. 1987) ^[7] individuals. The researchers selected the research community, which is the Middle Euphrates tennis and padel players for advanced students, numbering (8) players. The research sample was chosen intentionally, which included a group of (5) Middle Euphrates tennis and padel players for advanced students.

Thus, the percentage of the research sample is (0.62%), which is an appropriate percentage to truly and honestly represent the research community. The researchers gave each player three attempts, thus the research sample is a sample of (15) attempts for each player, on whom the main experiment will be conducted.

Methods, Devices, and Tools Used

The researchers utilized numerous methods, devices, and tools, including the following:

- Arabic and foreign sources and references.
- Observation and analysis.
- Personal interviews.
- Tests and measurements.
- Questionnaire.
- Four high-resolution Exilim-Casio cameras with a frequency of (300) frames per second and a tripod for the cameras (four) for skill analysis.
- An electronic device for measuring mass and length.
- One (1) Chinese-made Acer laptop calculator.
- Kinovea motion analysis software.
- One (1) basketball basket.
- (40) Ford legal tennis balls.
- Seven (7) tennis rackets.
- Colored adhesive tape.
- One (1) meter drawing scale.
- Phosphorescent markers to identify body joints.
- Numbered dresses (1-15).
- (2) Wooden poles.
- (14) Meter long rope.
- (2) Measuring tapes, (1.5) meter long and (25) meter long.

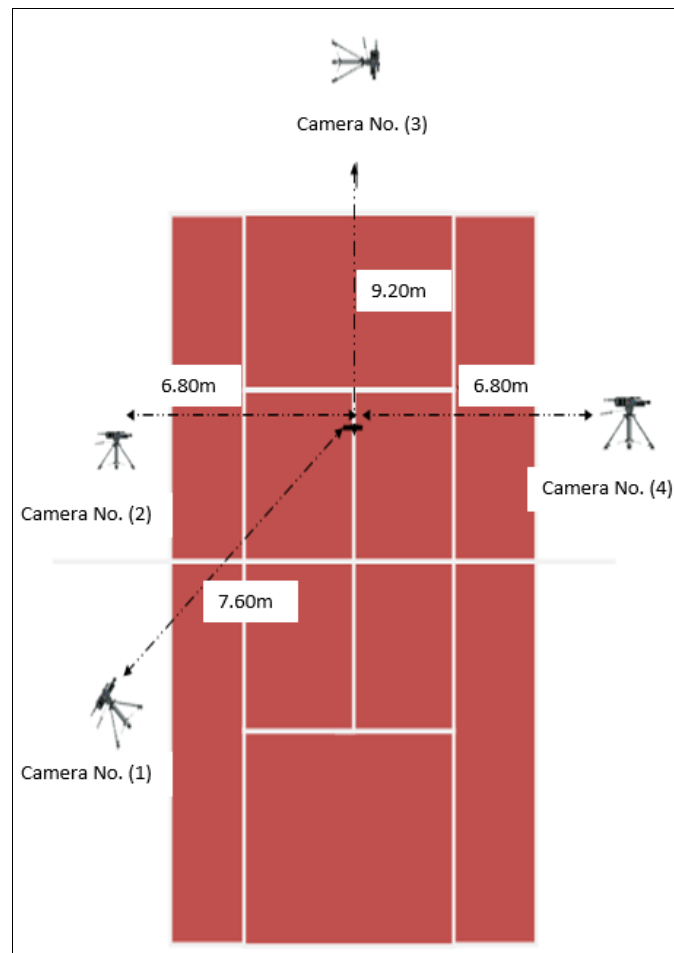
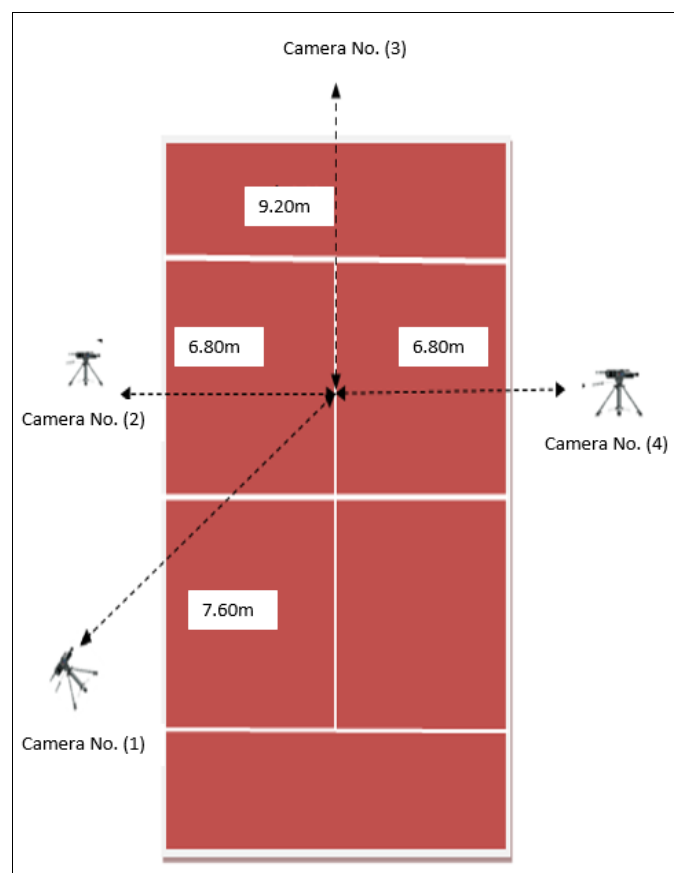
Field Research Procedures

The most important biokinematic variables under investigation in the performance of the forehand volley skill in tennis and padel.

- **First:** The right knee joint angle in the preparatory portion.
- **Second:** The right elbow joint angle in the main portion.
- **Third:** The height of the body's center of mass at the moment of impact (collision).
- **Fourth:** The height of the ball hit.

Videography

The researchers installed (4) cameras to capture all mechanical aspects related to the skill and to analyze the biokinematic variables of the player's body and the tool, as shown in Figure (1). The cameras were installed on four tripods, in a way that allowed the player's movement to be captured perpendicular to the rotation axes and to achieve a complete view of the technical performance details of the volleyball skill in the area identified by the researchers, which is (2) meters away from the T-LINE of the service area. The player stands (70) cm away from this area, as shown in Figure (1) and (2).

**Fig 1: Show tennis court****Fig 2: Padel court**

Exploratory Experiment

The exploratory experiment was conducted on Sunday and Monday (January 12-13, 2025) at 10:00 a.m. at the outdoor playground of the College of Physical Education and Sports Sciences at the University of Kufa and the Al-Ghadeer Village padel playground. The experiment was conducted on a sample outside the research sample. The objective was to verify the safety of the cameras and equipment and their operating methods, and to determine the validity and accuracy of the research measurements and tests.

Main Experiment

The main experiment was conducted on a sample of (5) tennis players and (5) padel players over two days, Tuesday, January 14, 2025, and Wednesday, January 15, 2025, at 10:30 a.m. at the outdoor playground of the College of Physical Education and Sports Sciences at the University of Kufa and the Al-Ghadeer Village padel playground. The researchers prepared all the necessary equipment for the experiment with the assistance of the support team. The players were given

sufficient time to warm up and perform the technical performance of the forehand volley. The researchers were careful to ensure consistent conditions in the exploratory experiment and avoid errors in terms of time, location, tools used, implementation method, and the support team.

Statistical Methods

To extract research results, the researchers used the following statistical methods:

1. Arithmetic mean.
2. Standard deviation.
3. Median.
4. Simple correlation coefficient (Pearson).

Results and discussion

Presentation, Analysis, and Discussion of Results

Presentation, analysis, and discussion of the results of the arithmetic means, standard deviations, and simple correlation coefficient values between the biokinematic variables of the forehand volley in tennis and padel.

Table 1: Show the results of the arithmetic means, standard deviations, and simple correlation coefficient values between the biokinematic variables of the forehand volley in tennis and padel.

Variables	Measuring unit	Biokinematic variables of tennis		Biokinematic variables of padel		Correlation coefficient value		Type Sig
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation	Calculation	Tabular	
Right knee joint angle in the preparatory portion	degree	132.80	7.05	132.40	7.96	0.54	0.51	Sig
Right elbow joint angle in the main portion	degree	124.20	11.69	136.60	16.80	0.74		Sig
Height of the body's center of mass at the moment of impact	meter	0.73	0.05	0.75	0.05	0.59		Sig
Height of the ball hit	meter	1.37	0.12	1.32	0.11	0.72		Sig

* Table correlation coefficient value (0.51) under a significance level of (0.05) and a degree of freedom of (13).

Table (1) shows the values of the correlation coefficients between some biokinematic variables of tennis and padel. After comparing them with the table value of (0.51) under a significance level of (0.05) and a degree of freedom of (13), it was found that the correlation value for the right knee joint angle in the preparatory part (0.54) was greater than the table value, meaning the correlation was significant. The right elbow joint angle in the main part had a correlation coefficient value of (0.74), which is greater than the table value, meaning the correlation was significant. The height of the center of body mass now of striking had a correlation coefficient value of (0.59), which is greater than the table value, meaning the correlation was significant. The height of the ball struck had a correlation coefficient value of (0.72), which is greater than the table value, meaning the correlation was significant. The researchers attribute this to the presence of prior acquired experience among the players. The performance of tennis players in performing the forehand volley skill led to a positive impact on the speed of acquiring motor skills for the padel game, which depends largely on the transfer of the learning effect due to the similarity of the motor path between these two games, and that motor analysis is considered the "mirror of technique" (Yasser Najah Hussein, and Ahmed Thaer Mohsen. 2023) ^[8] and that technique is the basis of every skill, as there is no skill without its own technique. After analyzing the forehand volley skill for both games through quantitative analysis, the researchers found a great convergence between the biomechanical variables, which led

to the speed of learning the forehand volley skill for padel players. Through the above results, it became clear that the right knee joint angle in the preparatory part was significantly related to it, and the researchers attribute the reason for this to the fact that the forehand volley requires neuromuscular coordination and good balance to achieve the biomechanical variables to direct the ball towards a specific point so that the stroke is successful. As for the right elbow joint angle in the main part, the correlation was significant, and the researchers attribute the reason for this to the fact that the player exploited the biomechanical principles of movement and used them in a rhythmic movement. The elbow angle gives the player the freedom to reach the ball by increasing or decreasing it. It is preferable for the arm to remain at a specific angle at the moment of impact to ensure that the movement is not fragmented and to achieve a good level of directing the forehand volley. The height of the body's center of mass at the moment of hitting was significantly related, and researchers attribute the reason for this to the fact that the height of the body's center of mass at the moment of hitting has an actual and influential relationship with the height of the ball's launch point (the moment the racket meets the ball), which in turn affects the achievement. The coordination and compatibility between body parts led to the ideal application of biomechanical conditions and the occurrence of coordination in the movement of body parts, which led to the exploitation of the player's mechanical principles and maintaining the rates of rhythmic movements and synchronization and achieving

the best results. The height of hitting the ball was significantly related, and researchers attribute the reason for this to the fact that the higher the collision point between the ball and the racket is appropriate and the arm is extended, the player can direct the ball to the opponent's court with greater accuracy, as the ability to control the angle of hitting the ball and its launch is high.

Conclusions and Recommendations

Conclusions

- There is a significant correlation between some biomechanical variables of the tennis and padel forehand volley.
- There is a correlation between some biomechanical variables of the tennis forehand volley and the speed at which players learn the forehand volley.

Recommendations

- Incorporate skill-based training by coaches.
- Conduct further analytical studies of other technically similar skills, such as the backhand volley and the smash.

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