

# Contribution of Some Special Physical Abilities and Biomechanical Indicators to the Accuracy of the Front Strike Performance of Junior Tennis

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## Abstract

The importance of research came in the fact of knowing the contribution of each of the physical and biomechanical variables to the level of performance of the front strikes, as well as seeking to develop some physical and mechanical capabilities of the accuracy of the performance of the front ground strike to improve the performance of the research sample for the junior group (14-16) years. As for the research problem: Despite the development of the tennis game in Iraq, it suffers from difficulties that impede the course of its development, and through the experience of the two field researchers, the research problem was identified and the previous studies and follow-up of the tennis tournaments for age groups were identified. Performing optimally and among these requirements are special physical abilities and biomechanical conditions that must be characterized by the skills of tennis, especially the forehand skill. Accordingly, the two researchers found the necessity to conduct tests on the physical abilities of tennis players, and to conduct a kinematic analysis to identify the biomechanical conditions of the striking and forehand skills, especially for tennis players aged (14-16) years, considering that knowing these variables for these ages can lead us to the correct path of skill performance and the need for Knowing the precise contribution of each variable to the performance to be later emphasized on these variables that contribute more accurately to performance and development, and to reinforce the other variables less contributing to training and development.

**Keywords:** *physical abilities, biomechanical, front strike performance, indicators*

## Introduction

There is a scientific renaissance in the world in the field of sports in general and the game of tennis in particular, and the development that occurred in this game is a reflection of the use of methods and training methods according <sup>1</sup> to scientific foundations, and the more competition between players increases, the need to follow modern training methods to develop the physical capabilities of the players and to improve the level of performance from By increasing the tendency to specialize in training to develop the performance requirements of ground tennis players <sup>2</sup>.

Tennis skills are among the rotational movements of most parts of the body, and these skills are related to many physical abilities within the range of movement of the arms, legs and torso that contribute to these movements, its maximum limits are in order to build

these forces and thus improve performance according <sup>3</sup> to the biomechanical conditions specified for these skills and the extent of their association with them and the percentage of each variable's contribution to the success of that performance <sup>4</sup>, which aims to achieve an increase in the range and speed of movement, and it is one of the biomechanical principles that can be used to evaluate the performance in parts of the body of the player tennis, as well as the link between the special physical abilities that are related to the movement of the tennis player, and which have a major role in determining the path of movement in the movements of the tennis player during the performance in these biomechanical conditions <sup>4</sup>.

The game of tennis is one of the games whose performance is characterized by speed, strength and endurance, which require special physical abilities that distinguish them from other games for the length of the

game runs, as well as the basic skills of the player, which depend on the speed and force of the strike<sup>5</sup>, reaction speed and accuracy of the hit as well as the speed and strength of the movements of the arms, torso and legs which is affected by the integration of technical performance and in reducing the resistance shown by these parts in the stages of performing the front ground strike, the ground strike and its accuracy in the game of ground tennis<sup>6,7</sup>. Through the foregoing, the importance of research came about the fact of knowing the contribution of each of the physical and biomechanical variables to the level of performance of the front and back strokes, as well as seeking to develop some physical and mechanical abilities of performance and the accuracy of the front ground strike of the research sample of young tennis at ages (14-16) years.

### Methodology

The approach is one of the important factors that the researcher follows to solve the research problem to be studied, and the appropriate method is chosen for the research topic to be studied. The two researchers used the descriptive approach - the study of correlational relations because it is consistent with the nature of the research problem.

#### Research community and sample:

The young players in the Jadriya Tennis Academy were identified, which amounted to (12) players, whose ages ranged from (14-16) years, and for the starting point to be one, the research sample was chosen by a simple random method.

#### Devices, tools and methods used in the research:

##### Methods for data collection:

- Arab and foreign sources and references.
- Personal interviews.
- Questionnaire forms for selecting and testing physical abilities, special biomechanical indicators, and how to test and measure them.
- Results analysis form.
- Tests and measurements.

Devices and tools used:

- Computer.
- Dynamometer (measuring grip strength).
- Tennis rackets.
- Tennis balls.
- Tennis Court .
- A high speed video camera number (2).
- The Kenova program.
- A tape measure number (1).
- Stop Watch.

#### Field research procedures:

##### Defining tests for variables:

##### First: The grip strength test:

**The purpose of the test:** to measure the strength of the grip muscles.

**Tools:** Hand dynamometer has scale included.

**Performance description:** The tester holds the thermometer in its fist and applies fist pressure on the dynamometer to try to produce the maximum force possible.

**Registration:** Each player is given two consecutive attempts, and the best is given to him.

##### Second: Test the partridge for the maximum distance in (10 seconds):

**The purpose of the test:** to measure the velocity characteristic of the leg muscles.

**Tools:** playground, tape measure, chalk, stopwatch.

**Performance description:** standing on one foot of the partridge to the maximum distance on a line drawn on the ground in any part of the body other than the foot of the partridge, and the test is performed once on the right leg, then the left leg.

**Evaluation :** the distance in a time of (10) seconds, the test is repeated on the second foot, the level is measured, the test dimensions are twice, and the best attempt is taken).

**Third: Test the accuracy of the front strikes:**

**The purpose of the test:** to evaluate the accuracy of the front stroke skill.

**Procedures:** After making sure that the players are warm, each laboratory is given (12) attempts and the player must hit the ball so that he directs the ball to the specified areas, while the assistant must give the balls to the laboratory in the middle of the area between the base line and the service line, and the points are calculated based on where the ball fell points are calculated and scored:

**Registration points:**

- (1) A point when the ball falls in the specified center area that is away from the individual side line from both ends (1) m and away from the bottom from the base line (50) cm to reach the net.
- (2) A point when the ball falls into the specified midfield from the individual side line to a distance of 3.20 m and from the mid-service line.
- (3) A point when the ball falls in the specified midfield between area (1) and the base line from inside and away from the side line (1) m from both ends.
- (4) points when the ball falls in the specified area of the service line, 4,985 m away from area (5).
- (5) points when the ball falls in the area that is away from the side line (1) m and from inside the court (50) cm, as in the figure, the highest degree can all be (30) degrees

**Figure (1) shows testing the accuracy of front strikes**

**Determine the physical abilities, biomechanical and skill indicators and how to measure:**

After reviewing the scientific sources and references in the field of sports training and biomechanics in the game of tennis, the researchers identified a set of physical abilities and special biomechanical indicators with their tests, and they were prepared in a questionnaire form to be presented to the scientific committee of experts in the field of biomechanics and tennis, and the appropriate ones were chosen in line with Research problem and objectives. These indicators include: -

**Grip strength test:** measuring the absolute strength of the arm muscles using the Dynafort device.

**The partridge test for the maximum distance in (10 seconds):** - Measurement of the force characteristic of the velocity of the leg muscles.

**Forward Strike Accuracy Test:** Measure the accuracy of the forehand skill performance (Dr. Hasna Starr's test).

**Description of the biomechanical tests and variables for the momentary strength of the arms and legs that have been chosen:** - The two researchers explained an explanation of the physical tests and the biomechanical indicators that were selected by the specialized committee in the field of biomechanics, training and tennis, and in consultation with the supervising lady according to the sources and references, the test, the test method and how to measure it were explained as follows:

$$Arms\ instantaneous\ power = \frac{Arms\ mass * peripheral\ velocity}{N^2}$$

- The momentary strength of the two legs is through:
  - Ball stroke speed.
  - The circumferential velocity of the racquet head.
  - The starting angle of the ball.
  - Ball launch speed.
  - The distance between the feet of the player at the moment of hitting the ball.
  - Momentum from the moment it starts to the moment the ball is struck.
  - The angles of the player's body (arm - torso - knee) while hitting the ball.

**Exploratory experience:**

The researchers have carried out several exploratory experiments related to videography and skill performance to identify obstacles that the researcher will conduct before carrying out the pre-tests, in terms

of understanding the sample research for the tests, the adequacy of the test time, the clarity of the image in relation to the videography and the location of the camera, and the application of the test properly by the assisting work team, to avoid all obstacles that the researcher will face during the implementation of the pre-tests.

The researchers distributed the tests over a period of (two days):

The first day: videotaping of skilled performance on (1/11/2020) to

The second day: for the special physical capabilities of the arms, torso and legs, on (2/11/2020).

**The main experience:**

The researchers conducted the main experiment on Thursday 5/11/2020 at three o'clock in the evening,

when the two researchers applied tests of physical abilities and tested the accuracy of the front blow performance of the individuals in the total research group of (12) junior tennis players, and recorded the results in a registration form The data is to be extracted and processed statistically and ended on Thursday, corresponding to (12/11/2020).

**Statistical means:**

The researchers used the statistical bag program (spss) and the following statistical methods:

- Mean.
- Std. Deviation.
- Person correlation.
- Percentage .

**Presentation, analysis and discussion of results:**

**Table (1) statistical description, correlation, and shareholding ratio.**

N	Variables	Descriptive		Pearson		Model Summary		
		Mean	Std. Deviation	R	Sig	R Total	R.Sq	Sig
1	Accuracy	31.03	7.305					
2	Velocity Starting	15.52	.284	-.558	.030	.93	.87	.037.
3	Ball starting angle	24.04	2.059	.025	.469			
4	Ball height from the ground	.794	.080	-.298	.174			
5	Player field movement	.521	.135	.209	.257			
6	Arm angle the moment ball struck	122.40	1.199	.607	.018			
7	Torso angle the moment ball struck	80.61	6.739	-.725	.004			
8	Knee angle the moment ball struck	109.22	5.703	.022	.473			

Significant at (R.Sq) ≤ (0.05).

From table (1) shows the extent of the correlation of physical abilities in the accuracy of the front stroke of junior tennis, as it reaches the starting speed variable.

**Table (2) (ANOVA) and (Coefficients) the effect of kinematic variables with precision.**

Model	ANOVA				Variables	Coefficients			
	Sum of Squares	Mean Square	F	Sig		B	Std. Error	T	Sig.
Regression	513.18	85.53	5.797	.037	Accuracy	4273.93	8775.34	.487	.647
					Velocity Starting	-175.76	303.08	-.580	.587
					Ball starting angle	-12.63	25.98	-.486	.647
Residual	73.77	14.75			Ball height from the ground	106.46	451.31	.236	.823
					Player field movement	-277.21	336.78	-.823	.448
					Arm angle the moment ball struck	-15.55	37.88	-.411	.698
Total	586.95				Torso angle the moment ball struck	6.149-	35.13	-.175	.869
					Knee angle the moment ball struck	6.89	9.23	.746	.489

df = 6 + 5 = 11 ... the significance of (effect) for (Sig) (ANOVA) and (Coefficients) ≤ (0.05).

**Discuss the Results**

Through what was presented in tables (1), which shows the simple correlation, standard deviation, the arithmetic mean, and the total correlation between physical variables and biomechanical indicators, and table (2) that shows the effect of the group of variables that were related to accuracy, i.e. their contribution percentage, regarding the variables about their correlation with the accuracy of the front strike In tennis for juniors, ages (14-16) years, The table showed the percentage of the contribution of physical abilities with biomechanical indicators equal to (.87), the total correlation equal to (.93.), Which is a high correlation, and the correlation of velocity of departure (558.-),

which is an inverse relationship, and the starting angle of the ball (025.), which is a direct relationship, the correlation of the height of the ball from the ground at the moment of hitting the ball ((298 .-), the correlation of the field of movement of the player (209.) That is, the distance between the player’s feet at the moment the ball is struck, the link of the arm angle of the moment of hitting the ball 607.), torso angle correlation moment of ball hit (725.-), knee angle correlation (022.). We will discuss conclusions from two sides, the first side, the ball variables, and the second side the player variables.

On the one hand, variables of the ball from several directions, the first direction, the velocity of the ball’s launch, the second direction, the angle of the ball’s

launch, and the third direction, the height of the ball's starting point. On the other hand, the player's variables, which is the distance (between the feet), the moment of hitting the ball, and the angles of the body (arm - trunk - knee) also the moment of hitting the ball during the performance of the front kick, and all of what is mentioned is considered one of the basics of the accuracy of the technical performance of the forehand skill of tennis and thus will result from this Variables for the player's body Variables of the ball launch, which reflect the result of accuracy in the forehand tennis, that is, the player's body variables cannot be separated from the ball variables for the moment of hitting the ball, because the angles (arm-trunk-knee) ideal for the player's body for the moment of hitting the ball during the performance the forehand skill leads to giving ball variables which are (launch speed - starting angle - height The ball is off the ground) the moment the ball is struck during the forehand skill performance we will get a high contribution percentage in accuracy.

### Conclusions

they were: There is a different contribution rate between physical abilities and biomechanical indicators in the accuracy of the forehand kick in tennis. On the one hand, variables of the ball from several directions, the first direction, the speed of the ball launch, the second direction, the angle of the ball's launch, and the third direction, the height of the starting point of the ball. The ball and the position here express the accuracy of any forward strike accuracy of the research sample. On the other hand, the player's variables, which is the intermediate distance (between the feet), the moment of hitting the ball and the angles of the body (arm-trunk-knee) also the moment of hitting the ball during the performance of the front kick, and all of what is mentioned is considered one of the basics of the accuracy of the technical performance of the forehand skill of tennis and thus will result from this Variables for the player's body Variables of the ball launch, which reflect the result of accuracy in the forehand tennis.

As for the most important recommendations, they included:

- The necessity of giving coaches sufficient time to train the players at the best angles of the body for the players during the performance of the front blow to reach the accuracy of the skill performance in a high manner.
- The necessity of training players on the accuracy of the forehand tennis performance by means of the ball variables (starting speed - starting angle - the height of the ball from the ground) for the moment of hitting the ball.

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**Conflict of Interest:** None to declare.

**Ethical Clearance:** All experimental protocols were approved under the University of Baghdad, Iraq and all experiments were carried out in accordance with approved guidelines.

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