ISSN: 2456-4419
Impact Factor: (RJIF): 5.88
Yoga 2025; 10(2): 373-379

www.theyogicjournal.com
Received: 07-08-2025
Accepted: 10-09-2025

Saif Ali Hussein
Faculty of Physical Education and Sports Sciences, University of Kufa, Iraq

Dhelal Takleef Hasan
Faculty of Physical Education and Sports Sciences, University of Kufa, Iraq

Shaymaaa Ali Abd Al Ameer
Faculty of Physical Education and Sports Sciences, University of Kufa, Iraq

Corresponding Author:
Saif Ali Hussein
Faculty of Physical Education and Sports Sciences, University of Kufa, Iraq

The effect of special exercises using auxiliary tools according to mechanical principles on students learning of the forehand stroke skill in tennis

Saif Ali Hussein, Dhelal Takleef Hasan and Shaymaaa Ali Abd Al Ameer

DOI: https://www.doi.org/10.22271/yogic.2025.v10.i2e.1810

Abstract
The purpose of this paper is to designing assistive devices based on mechanical principles, developing specific exercises based on mechanical principles for the forehand stroke learning process, and identifying the values of some kinematic variables of the forehand stroke. The researchers used the experimental method because it suited the nature of the problem. The researchers identified the research community as third-year students at the University of Kufa, College of Physical Education and Sports Sciences, consisting of two sections (A, B), numbering (60) students, with (30) students for each section. A sample of (12) students was selected from each section using a simple random method (lottery) to represent the research sample. Thus, the sample percentage was (40%) of the research community. Section (A) represented the experimental group, and Section (B) represented the control group. One of the most important results reached by the researcher is that: Exercises using assistive devices, based on mechanical principles, contributed to the development of tennis forehand skill, as they included the use of learning auxiliary tools. One of the most important recommendations recommended by the researchers is that: The necessity of using assistive devices based on mechanical principles in teaching curricula for teaching tennis skill performance.

Keywords: Special exercises, auxiliary tools, mechanical principles, forehand stroke, tennis skill

Introduction
Tennis is a game characterized by activity, vitality, speed, and strength. Reaching the highest levels in this game requires utilizing all performance-related sciences to raise the player's physical fitness level (Saleem Radhy, *et al*. 2025: Madloul, *et al*.,2025) [5, 3]. This enables the game to develop and advance to international and Arab levels, which it has recently reached through the use of technology, sports equipment, and educational auxiliary tools in sports arenas. Hardly any sporting event is devoid of a device or aid that accompanies the educational or training process (Naser, *et al*.,2025)) [4]
Kinematic analysis is an important aspect of learning tennis skills because it contributes to identifying errors that accompany the learning process. Through this analysis, the correct foundations are laid for learning different skills, including the forehand. By using auxiliary tools, the learning process, based on these foundations, becomes successful, correct, and as error-free as possible. Hence, the importance of research in finding the best support methods in educational units that assist in the process of teaching the forehand kick skill to third-year students (Fadhil, *et al*., 2025: Al Edhary, *et al*., 2024)) [1, 2]. It is believed that these methods will yield good results, achieve correct skill performance, and avoid technical errors. It is well known that the performance of athletic movements and skills is related to the principle of the angles achieved in the various joints of the body. By exploiting all the various mechanical laws to achieve the goal of the skill and its components, video cameras can be used to observe and record the athlete's movements for analysis, then determine the correct performance so that the various skills can be learned according to this analysis.

Research problem
Through fieldwork by researchers studying tennis, one of whom is a racquet sports instructor, and through careful observation of student positions and forehand stroke performance, they

identified difficulties in the teaching process. Some difficulties were related to the player (readiness stance and gripping the racket), while others related to skill performance and hitting the ball. Through the researchers' observations and error diagnosis, they noted that the racket was positioned incorrectly when performing the forehand stroke, and these errors continued as the student progressed in learning the skill. In order to reduce these errors and teach the students the skills correctly, the researchers decided to design various teaching auxiliary tools and special exercises based on mechanical principles. These auxiliary tools would help correct the kinematic paths of the forehand stroke and reduce the time required for the learning process within a limited period.

Research objective
- Designing assistive devices based on mechanical principles.
- Developing specific exercises based on mechanical principles for the forehand stroke learning process.
- Identifying the values of some kinematic variables of the forehand stroke.
- Identifying the effect of exercises specific to assistive devices based on mechanical principles for the forehand stroke learning process.

Research hypotheses
- There is an effect of exercises specific to assistive devices on developing tennis students' forehand.
- There is an effect of exercises specific to assistive devices on developing the forehand of students in the experimental sample in the post-test between the two groups.

Research fields
- **Human field:** Third-year students at the College of Physical Education and Sports Sciences at the University of Kufa for the 2024-2025 academic year, numbering 24 students.
- **Time field:** (15/11/2024) to (16/5/2025)
- **Spatial field:** The outdoor tennis court at the College of Physical Education and Sports Sciences, University of Kufa

Research methodology and field procedures
Research Methodology
The researchers used the experimental method because it suited the nature of the problem, as it is the closest scientific research method to solving problems scientifically. This approach is also appropriate for the nature of the research, as it designed two equivalent groups (control and experimental) with pre- and post-tests to achieve the research objectives and hypotheses.

Community and sample research
The researchers identified the research community as third-year students at the University of Kufa, College of Physical Education and Sports Sciences, consisting of two sections (A, B), numbering (60) students, with (30) students for each section. A sample of (12) students was selected from each section using a simple random method (lottery) to represent the research sample. Thus, the sample percentage was (40%) of the research community. Section (A) represented the experimental group, and Section (B) represented the control group.

Homogeneity of the research sample
The researchers conducted homogeneity testing on the research sample members, consisting of two groups (experimental and control). The researchers verified the homogeneity of the sample members through variables related to anthropometric measurements (body height, mass, age, and arm length). The researchers used the skewness coefficient to verify sample homogeneity, as shown in Table 1.

Table 1: statistical parameters (arithmetic mean, standard deviation, median, and skewness coefficient for the variables body height, mass, age, and arm length).

Variables	Measuring unit	Mean	Mean	Std. Deviations	Skewness
Height	Cm	183.041	183.5	5.94	- 0.23
Mass	Kg	70.20	69.5	8.82	0.23
Age	Year	22.20	22	1.07	0.56
Arm length	Cm	74.95	74.5	3.62	0.37

Since the results of the skewness coefficient were all between (+1), the research sample members were homogeneous in the aforementioned variables.

Equivalence of the Two Research Groups
The researchers attributed the differences in the results of the post-tests to the influence of the experimental factor. The researchers verified the equivalence of the two groups using the t-test for non-matched samples.

Methods, Devices, and Tools Used
The researchers utilized several methods, tools, and devices, including the following:

Research Methods
The researchers utilized the following research methods:
- Arabic and foreign sources and references.
- Observation.
- Personal interviews.
- Questionnaire.
- Tests and measurements.

Devices and Tools Used
The researchers used the following devices and tools:
- (1) Chinese Dell laptop computer.
- (3) high-resolution cameras for the purpose of kinetic analysis of performance. - Medical scale.
- (40) Ford legal tennis balls.
- (1) basketball basket.
- (17) tennis rackets.
- (2) wooden poles.
- Phosphorescent markers to identify body joints.
- Mechanical analysis program (kinovea).
- (1) drawing scale (1 meter).

Auxiliary tools used
The researchers designed the auxiliary tools based on the biomechanical variables of the model in the educational exercises, as shown in Figure (1), which was prepared for the experimental group. These auxiliary tools are:
- The educational aid (the tied ball):
- The open board slightly larger than the size of the racket head:
- The ball tied to a spring bar.
- The racket's movement on a wire similar to the path of a forehand stroke.

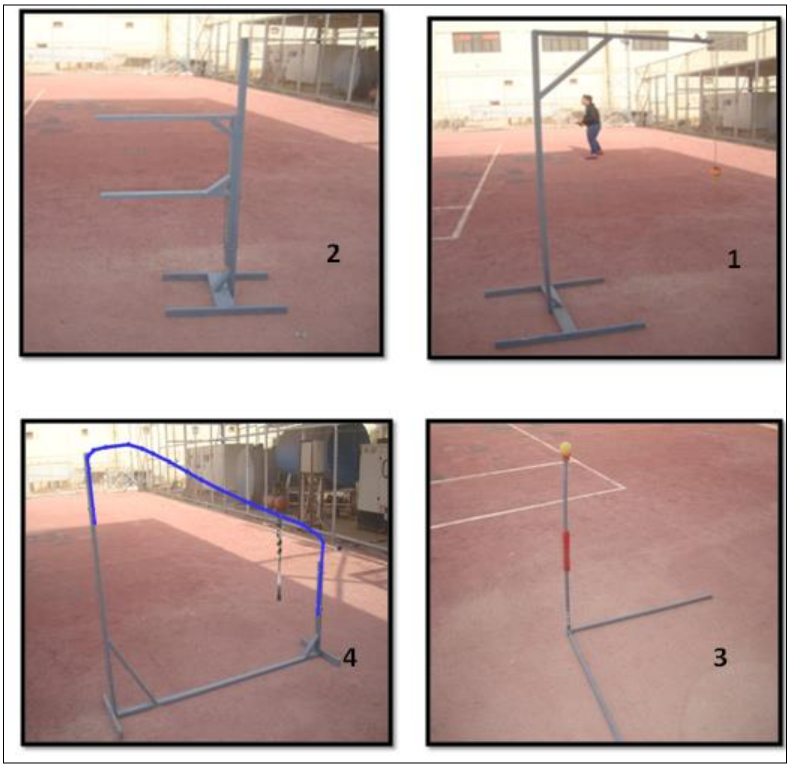

Fig 1: Auxiliary means used.

Field Research Procedures

Identifying Biomechanical Variables

To enable researchers to identify the most important biomechanical variables for the forehand kick skill, using sources, references, and previous studies, a questionnaire was also presented to survey the opinions of experts and specialists in the field of biomechanics. These variables were documented in a questionnaire to identify the most important variables associated with the skill, which consists of three parts (preparatory part, main part, concluding part). The researchers were able to determine the importance of each variable and observe the extent to which it can be relied upon in analysis and measurement processes. In general, the researchers analyzed the biomechanical variables for the technical performance of the forehand kick skill. After extracting the importance value, transcribing the collected questionnaire information, and processing it statistically, variables that collected less than the required percentage were excluded.

Most Important Biokinematic Variables

By presenting the variables form to specialists and experts, researchers were able to identify and select the most important biokinematic variables that have an effective impact on the performance of the forehand stroke. The most important biokinematic variables are the following:

- Shoulder joint angle in the preparatory section: This is the angle between the humerus line (the straight line from the elbow joint to the shoulder joint) and the torso line (from the shoulder joint to the hip joint) (Yasser Najah Hussein and Ahmed Thamer Mohsen. 2015)) [7].
- Right knee joint angle in the preparatory section.
- Elbow joint angle at the moment of impact.
- Height of the ball's starting point at the moment of impact: This is the vertical distance between the point of collision of the ball with the racket and the horizontal line on the ground.

Videography

The researchers installed three cameras to capture all mechanical aspects related to the forehand ground stroke skill and to analyze the biokinematic variables of the student's body and the tool. These cameras are mounted on tripods in a way that allows the player's movement to be captured perpendicular to the rotation axes, achieving a complete view of the technical performance details of the forehand stroke skill. The locations of the cameras were determined according to the optimal extraction of the kinematic variables, as shown in Figure (2).

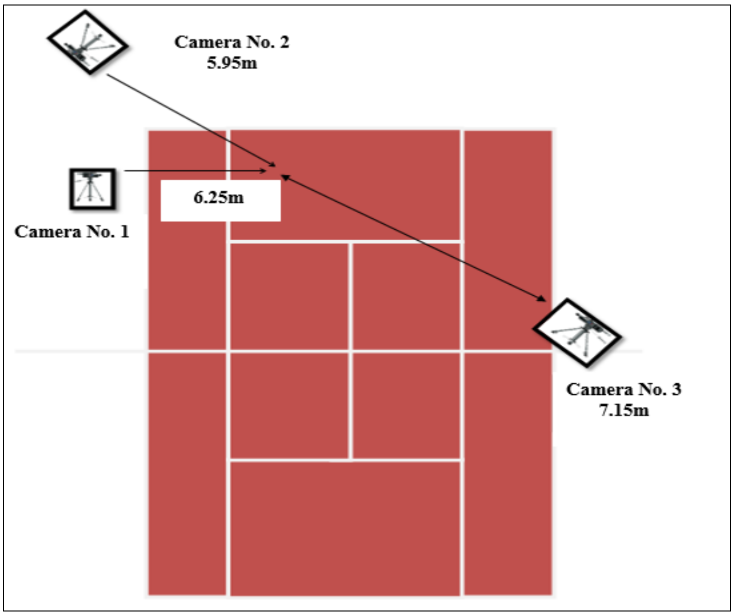

Fig 2: shows the location of the cameras for the forehand strike skill.

Exploration Experiment

The first exploratory experiment was conducted on Sunday (November 3, 2024). This was a pilot experiment of the model, aiming to take appropriate measurements and design assistive devices according to the model's variables (heights, distances, and other variables). The second exploratory experiment was conducted on Sunday (November 17, 2024) at 10:00 a.m. at the outdoor tennis court of the College of Physical Education and Sports Sciences at the University of Kufa. The pilot was conducted on a sample outside the research sample. This was to verify the safety of the cameras, devices, tools, and their operating methods, and to determine the validity and accuracy of the research measurements and tests.

Pre-tests

Pretests were conducted for the research sample on Monday, November 18, 2025, at 10:00 a.m., at the outdoor tennis court of the College of Physical Education and Sports Sciences at the University of Kufa. The researchers and their support team prepared the court, provided the necessary requirements for each test, and arranged the court and tools to ensure accurate test performance. The research sample was also prepared for the tests. The research sample was given sufficient time to warm up. 2-4-6 Main Experiment

Preparing the Proposed Exercises

The researchers conducted two units prior to conducting the experiment. After reviewing numerous available scientific sources and the opinions of experts and specialists in various fields of sports education (racket sports, motor learning, training science, and motor analysis, particularly in the field of biomechanics), the researchers benefited from their insightful opinions and guidance, in addition to the researchers' training experience and expertise in tennis. They designed some auxiliary tools that were compatible with the learning process of the selected skills, utilizing a photograph of the model and taking into account all variables for manufacturing purposes. This was designed to suit the effectiveness and capabilities of the sample, based on the appropriate angle of performance and the correct motor paths for the forehand stroke. Mechanical principles are the set of foundations, rules, and laws that must be utilized to solve the motor task.

Special exercises were prepared based on the mechanical foundations and principles of tennis. The main experiment included teaching the control group using their regular curriculum without the use of auxiliary tools. The researchers taught the experimental group using auxiliary tools designed by the researchers. The sample size was 100. (12 students) were divided into four groups, each consisting of three students. These groups moved from one exercise to the next, as the performance was educational and to protect the research sample from fatigue. The rest period between repetitions, i.e., between one player and the next, was 30 seconds. Since each group had three students, the rest period was (1 minute) between them, and each student was assigned a number of repetitions depending on the difficulty of the method. The performance time for each group was 90 seconds. The rest period between groups, i.e., after completing an exercise and moving on to another, was (2 minutes). Note that a group consisting of three students performed the exercise, and so on, alternating groups. Some of the components of the main section of the educational unit were prepared by the researchers with the following specifications:

- They were used at the beginning of the main part of the educational units.
- The duration of the experiment lasted (10) weeks.
- The total number of educational units was (8) units.
- The number of educational units was one per week.
- The duration of the exercises using the auxiliary tools was (42-64) minutes for the educational unit, and the days specified for the experiment were determined to be Sunday of each week during the first half of the academic year.

Implementation of exercises using assistive devices

The educational curriculum for the experiment was implemented from Sunday, November 24, 2024, until Sunday, January 26, 2025. The duration of the educational unit (90) minutes is divided into:

1. The preparatory section (15) minutes, including:

a) General warm-up (10) minutes.
b) Specific warm-up (5) minutes.

2. The main section (70) minutes, including:

a) The educational section (6-28) minutes.

b) The practical section (42-64) minutes.

3. The concluding section (5) minutes, including calming and relaxation exercises, restoring functional systems to their normal state, returning tools, and then dismissal.

Post-tests

The post-tests were conducted for the two research sample groups, totaling (24) students, on Monday, January 27, 2025, in the same location where the pre-tests were held. The researchers ensured that the conditions used in the pre-test were the same as those used in the pre-test, in terms of time, location, tools used, implementation method, support team, and procedures followed for technical performance of the skill.

Statistical Methods

To extract the research results, the researchers used the statistical package (SPSS), utilizing the following statistical methods:

- Arithmetic mean.
- Standard deviation.
- Median.
- Skewness coefficient.
- Percentage.
- Relative importance.
- Simple correlation coefficient (Pearson).
- T test for correlated and independent samples.

Results and discussion

Presentation and analysis of the results of the biokinematic variables of the forehand stroke for the pre- and post-tests of the experimental group

Table 2: Arithmetic mean, standard deviation, calculated t-value, and significance for the biokinematic variables of the forehand stroke in tennis, pre- and post-tests, for the experimental group.

Variables	Measuring unit	Pre-test		Post-test		T value calculated	model	Level Sig	Type Sig
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation				
Shoulder joint angle	Degree	41.5	15.01	32.33	12.33	2.368	31.75	0.037	Sig
Right knee joint angle in the preparatory section	Degree	141.25	10.64	151.08	14.96	2.630	172.35	0.023	Sig
Elbow joint angle at the moment of impact	Degree	131.33	24.70	156.08	21.76	2.53	158	0.028	Sig
Starting point height	Meter	0.79	0.16	1.12	0.31	3	1.13	0.012	Sig

At a degree of freedom of (22) and below a significance level of ≤ (0.05)

Discussion of the results of the forehand ground stroke variables for the preparatory section:

Table (2) shows significant differences for most of the biokinematic variables of the experimental sample, presenting the results of the pre- and post-tests in the forehand stroke skill. The Sig value for the right shoulder joint angle in the preparatory section was (0.037), which is less than (0.05), indicating significant differences in favor of the post-test. The shoulder joint angle in the preparatory section indicates that the racket head is lower than the belt level, utilizing the biomechanical principles of movement and using them during the forehand stroke movement of the main section at a calm pace to achieve the mechanical target. The researchers attribute this result to the experimental group's reliance in its training on the auxiliary tools designed by the researchers to hit the ball at the belt level. The variable was the right knee joint angle in the preparatory position, which had a Sig value of (0.023), which is less than (0.05), meaning there were significant differences in favor of the post-test. The researchers attribute this development to the exercises used by the research sample, the experimental group, to correct the kinetic path of the tool that affects speed, as well as to teach the kinetic path of the forehand strike, which includes and requires neuromuscular coordination and high and good balance to achieve an ideal body position in order to achieve the appropriate biokinetic variables, which leads to directing the ball towards a specific point on the field. The student in the preparatory position was in a well-balanced position, and the knee angles were appropriate to keep the center of mass of the body close to the ground to increase balance and stability and then to master the kinetic paths of the forehand strike. The sig value for the elbow joint angle in the main part was (0.028), which is less than (0.05), which means there were significant differences in favor of the post-test. This indicates that the arm was well extended when hitting the ball. This is one of the most important specifications for a successful hit in achieving a basic goal: developing the radius and thus increasing the peripheral velocity, which is directly related to the radius. The hitting arm reaches the greatest length in the radius, and then increasing the peripheral velocity. Thus, the projectile body acquires the greatest possible linear velocity after the ball collides with the racket. The researchers attribute this to the fact that the exercises used by the experimental sample had an effective impact in developing the students' level of performance. This indicates the effectiveness of the assistive devices by determining the ideal distance between the students and hitting the ball on the assistive devices. The variable of the height of the ball's launch point now of hitting, which had a value of (Sig) (0.012) which is less than (0.05), showed that there are significant differences in favor of the post-test. The researchers attribute the reason for this to the fact that the higher the collision point between the ball and the racket at the level of the belt, the player can direct the ball to the opponent's court with greater accuracy and a high ability to control the angle of hitting the ball and its launch. This is due to improving all the movement paths in the extension of all the joints and hitting the ball in the correct direction.

Presentation and analysis of the results of the biokinematic variables of the tennis forehand for the pre- and post-tests of the control group

Table 3: Arithmetic mean, standard deviation, calculated t-value, and significance for the biokinematic variables of the tennis forehand for the pre- and post-tests of the control group.

Variables	Measuring unit	Pre-test		Post-test		T value calculated	model	Level Sig	Type Sig
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation				
Shoulder joint angle	Degree	43.42	6.20	53.17	32.34	1.010	31.75	0.334	Non Sig
Right knee joint angle in the preparatory section	Degree	139.25	11.59	138.92	14.04	0.062	168.32	0.952	Non Sig
Elbow joint angle at the moment of impact	Degree	141.83	25.19	141.08	11.85	0.093	158	0.927	Non Sig
Starting point height	Meter	0.81	0.25	0.86	0.31	0.482	1.13	0.639	Non Sig

At a degree of freedom of (22) and below a significance level of ≤ (0.05)

Discussion of the results of the forehand stroke variables for the preparatory section

Table (3) shows that there were no significant differences for most of the biokinematic variables of the control sample, as shown by the results of the pre- and post-tests in the forehand stroke skill in the preparatory section. The Sig value for the right shoulder joint angle in the preparatory section was (0.334), which is greater than (0.05), meaning that there were no significant differences, but by a small percentage. If we look at the arithmetic means, we find that there are some differences. The increased shoulder joint angle in the preparatory section indicates that the racket head was higher than the belt level, and the biomechanical principles of movement were poorly exploited and used during the forehand stroke. The researchers attribute the reason for this group's failure to master the motor pathways of the skill to their reliance on the traditional curriculum and the failure to use the auxiliary tools that would enable the student to master the motor pathways of the skill, which forces the student to flex the shoulder joint during performance. The variable was the right knee joint angle in the preparatory position, which had a Sig value of (0.952), which is greater than (0.05), meaning that there were no significant differences in favor of the post-test. The researchers attribute the decline of this group to their lack of exposure to educational tools that help the learner quickly grasp the skill. Rather, they were taught according to the traditional curriculum, in which some skills and initiatives were absent, which made students adhere to performing the skill in each educational unit and the same traditional style. The angle was not close to the angle of the model, and the student in the preparatory position had less flexion in the body joints and a lack of harmony in the movement between the knee to transfer force and kinetic energy from the feet to the trunk and arms to extend the joints from the bottom to the top until the kinetic paths of the forward strike were mastered. The elbow joint angle variable, which had a sig value of 0.927, is greater than 0.05. This indicates no significant differences, in favor of the post-test. The elbow joint angle of the striking arm in the control group was not extended when hitting the ball. The researchers attribute this to the fact that the traditional curriculum followed by the subject teacher does not include educational tools that would enable students to quickly master this skill. The variable, the height of the ball's starting point at the moment of hitting, had a sig value of 0.879, which is greater than 0.05. This does not mean there are no significant differences, but only to a small degree. If we look at the arithmetic means, we find differences, but at a small percentage. The researchers believe the rate of development is low, due to this group not following specific exercises using auxiliary tools based on mechanical principles that help quickly develop the motor path of the skill.

Presentation and analysis of the results of the biokinematic variables of the tennis forehand for the control and experimental groups in the post-tests:

Table 4: Arithmetic mean, standard deviation, calculated t-value, and significance for the biokinematic variables of the tennis forehand for the control and experimental groups in the post-tests

Variables	Measuring unit	Pre-test		Post-test		T value calculated	model	Level Sig	Type Sig
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation				
Shoulder joint angle	Degree	53.17	32.34	32.33	12.33	2.09	31.75	0.049	Sig
Right knee joint angle in the preparatory section	Degree	148.83	13.33	151.08	14.96	0.39	172.35	0.701	Non Sig
Elbow joint angle at the moment of impact	Degree	141.08	11.85	156.08	21.76	2.10	158	0.048	Sig
Starting point height	Meter	0.86	0.31	1.12	0.31	2.09	1.13	0.049	Sig

At a degree of freedom of (22) and below a significance level of ≤ (0.05)

Discussion of the results of the forehand tennis stroke variables for the control and experimental groups in the post-tests

Table (4) shows significant differences in most of the biomechanical variables of the experimental sample, showing the results between the control and experimental groups in the forehand stroke skill in the preparatory section. It is clear that the (Sig) value for the right shoulder joint angle in the preparatory section (0.049) is less than (0.05), which means there are significant differences in favor of the experimental group. The control group's development rate was lower than the experimental group's. This is due to the failure to follow specific exercises using modern scientific auxiliary tools based on scientific foundations in accordance with mechanical principles that help raise the racket head to the level of the belt by exploiting the biomechanical principles of movement and using them during the forehand stroke at a calm pace to achieve the mechanical goal. It is clear to us from the same table that the variable is the angle of the right knee joint in the preparatory position, which had a value of (Sig) (0.701), which is greater than (0.05), and this means that there are no significant differences, but we will find that the differences are clear. For the angle of the right ankle joint, the value of (Sig) was (0.560), which is greater than (0.05), and this means that there are no significant differences. We will find differences, but at a small rate. If we look at the arithmetic means, we will find that there are some differences. The elbow joint angle was shown to be (Sig) (0.048) which is less than (0.05) which means there were significant differences in favor of the experimental group. From this, it is clear that the arm was extended when hitting the ball in the experimental group. The researchers attribute the reason for this to the experimental group having a higher development rate than the control group. This is due to following special exercises using modern scientific auxiliary tools built on scientific foundations according to mechanical principles that help extend the striking arm correctly, which leads to an increase in the speed of the ball’s launch. As for the control group, they did not use auxiliary tools but rather used the traditional curriculum followed by the subject teacher, which leads to a simple development of the elbow angle. The same table shows us that the variable of the ball's starting point height in the main section, which had a value of (Sig) (0.049), which is less than (0.05), and which is less than (0.05), the results showed that there were significant differences in favor of the experimental sample. The researchers attribute the reason for this to the experimental group's development rate being higher than the control group, and this is due to following special exercises using modern scientific auxiliary tools built on scientific foundations according to mechanical principles that help raise the ball's starting point correctly, which leads to hitting the ball at the belt level until the biomechanical principles of movement are exploited and used during the forehand stroke movement at a calm pace to reach the mechanical goal. Exploiting the biomechanical laws according to their conditions means achieving their goal, as (Talha Hussam Al-Din. 1999) indicates that "every skill has a goal that the student seeks to achieve, and this goal forms the basis through which he can classify skills, and achieving this goal is linked to the biomechanical foundations of the specific skill and the extent of its suitability for achieving the goal. As for the control group, it did not use auxiliary tools, but rather used the curriculum. The traditional approach followed by the teacher of the subject, which leads to the development of the height of the ball is starting point in a simple way.

Conclusion and Recommendations

Conclusion

- Exercises using assistive devices, based on mechanical principles, contributed to the development of tennis forehand skill, as they included the use of learning auxiliary tools.
- The exercises contributed to establishing ideal and appropriate positions, particularly in the preparatory part of the movement, by improving the angles of the body's joints, including adjusting the knee joint angle and giving the variable center of mass height a technical advantage for better ball direction.
- Improving elbow and arm extension angles, as well as shoulder and elbow angles, contributed to increasing the radius (arm extension), thus increasing peripheral velocity and ball release speed.
- Various assistive devices based on mechanical principles increased students' effectiveness and motivation to learn.

Recommendations

- The necessity of using assistive devices based on mechanical principles in teaching curricula for teaching tennis skill performance.
- Relying on assistive devices based on mechanical principles in learning or developing technical performance for the tennis forehand.
- Use assistive devices according to mechanical principles and foundations, gradually moving from easier to more difficult, to avoid technical errors.
- Provide assistive devices on tennis courts due to their ease of manufacture and low cost.
- Conduct research to find new assistive devices to develop other motor skills in tennis.
- Diversify the use of assistive devices to increase the desire and motivation to learn.

References

1. Al Edhary DF, Hashem NY, Radhi MN, and Kadhim A A. The effect of specialized exercises using the general design model (ADDIE) on learning simple and complex attacks in foil weapons for students. Sport culture. 2024; 15(Special).
2. Fadhil BA, Radhi MN, Abbood MA, and Luaibi SI. The effect of speed-mixing exercises on short-term anaerobic capacity (phosphate) and skill performance of young soccer players. Journal of Studies and Researches of Sport Education. 2025; 35(2); 469-483. https://doi.org/10.55998/jsrse.v35i2.1028
3. Madloul HR, Karim GM, Radhi MN, kurdi HF and Hashoush BAH. Evaluation of the level of knowledge of offensive for-mations of young volleyball players in Iraq. Retos. 2025; 68; 1311-1318. https://doi.org/10.47197/re-tos.v68.116161
4. Naser AA, Dehkordi KJ, Radhi MN, Taghian F, and Chitsaz A. The Effect of Multimodal Exercise on the Levels of BDNF and GDNF in Patients with Parkinson’s Disease. *International Journal of Preventive Medicine*, 2025; *16*;35.
5. Saleem Radhy S, Aboodee Hussein A, Kadhem fairouz HA, Mohammed Karim G and Nasser Radhi M. The effect of special exercises in developing some bio-kinetic abilities and improving the performance of the volley in tennis for players. Retos. 2025; 68; 1644-1653. https://doi.org/10.47197/retos.v68.114 658
6. Talha Hussam Al-Din.. Mathematical Biomechanics, 2nd ed., Dar Al-Kutub Publishing, Mosul; 1999; p. 93.
7. Yasser Najah Hussein and Ahmed Thamer Mohsen. Sports Kinetic Analysis, 1st ed., Dar Al-Diaa Printing House, Najaf Al-Ashraf; 2015; p. 85.