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The Effect of Soft Toss Machine Training on Some Kinematic Variables and backhand accuracy of Tennis Players U16 years

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Abstract

The importance of the research is evident in the use of exercises with the training device, which is one of the modern techniques in teaching the abilities of players, especially in teaching the skill of the backhand, and in improving the accuracy of the performance of players and increasing the contribution to the formation of a base for the game for players who have a good level of learning and upgrading the game to reach a certain achievement, and the research issue was represented in the lack of accuracy in sending balls to the required areas to achieve points, especially in the performance of the skill of the backhand due to the speed of play during the course of the match, and the study aimed to introduce modern technology using the training device and to know its effect on the accuracy of performing the skills invested It was found that the device used during the standardized exercises used by the researchers on the accuracy of the backhand performance and it was found that the device used proved effective in the accuracy of the skill performance of tennis players under the age of (16 years), which achieved the aim of the research.

Keywords: Mechanical learning, Kinematic variables, Accuracy, Tennis skills, Young Player.

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Introduction

Science has not only had an effective impact on many sports activities, but it has also played a great role in the development of tennis, which is considered one of the activities with high physical and technical requirements. Thanks to the theoretical sciences, many skills of this game have been improved and used to understand the important stages in each skill and facilitate the process of learning it. For example, sports science contributes to understanding the optimal movements and angles that players must make to achieve the highest possible performance in tennis, and analyzing movements and using mathematical models can help coaches and players improve their performance and correct their mistakes, (Easa et al., 2022) tennis has benefited from advanced technologies and devices in the field of motor learning and sports biomechanics, and kinetic analysis and sensing techniques have been used to understand the forces and balance that affect players' performance, (Kadhim, 2023) and this knowledge gained enables coaches to improve training and design more effective training programs and modify players' optimal movement pathways. This acquired knowledge enables coaches to optimize training, design more effective training programs, and modify players' optimal movement pathways, as confirmed by study (Satar & Makey, 2011) which is to focus on building good technique and identifying and correcting weaknesses that may occur during performance with the use of assistive devices (Obaid & Abdul Azeez, 2020).

The tennis backhand is a stroke that is made by swinging the racket from the non-dominant side of the player and is one of the most important skills in the game of tennis and is often difficult to learn and control effectively (Alexandros et al., 2013)Backhand accuracy in tennis varies among players based on their skill level and training methods and studies have shown that there is a significant correlation between the quality of technical performance forehand and backhand accuracy (Khan et al., 2017) (S. Zhang et al., 2022) and players with high accuracy tend to coordinate racket movements more effectively with impact heights and adjust speeds and racket angles based on improving accuracy (Matković, 2015).

Where the researchers confirmed the use of a training device to modify the kinematic pathways of the accuracy of the backhand in tennis, and a study (Alhawary, 2019) confirmed the use of the MFT device, and the Hexagon device, (Jawad Kadhim, M., & Salman Ahmed, 2016) in improving the kinematic path of performance, which is the main factor in giving the ball the correct path to enter, as there is a study that showed that exercises using specialized training devices significantly improve the accuracy of tennis players' performance (Feng et al., 2023).

Backhand accuracy in tennis refers to the precise execution of the backhand with a focus on hitting the ball in the correct direction consistently, and this includes factors such as success rate, accuracy of placement, and speed of the ball (Negro et al., 2023). Accuracy includes stages

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such as perception, decision, execution, and feedback, focusing on technical and tactical aspects within the framework of the procedure (Ngatman et al., 2022).

The Problem, Through observation and analysis of the playing performance of these ages, it was found that there is a dispersion in the balls, and do not fall accurately in the required areas to achieve points, especially in the skill of the backhand due to the speed of the game during the match, so the researchers decided to go into this study and use a training device that helps in the accuracy of the performance of the skill of the backhand, to improve the technical level of tennis players aged (15-16 years) and identify the weaknesses and find the necessary solutions to avoid the problem.

The aims of the research were

- Identify the effect of training with the soft toss machine on some kinematic variables in tennis players U16 years.
- Identify the effect of training with the soft toss machine on the accuracy of the backhand in tennis players U16 years.

The hypotheses of the research were

- There are statistically significant differences by using the soft toss machine in some kinematic variables between the pre-test and post-test for the experimental and control groups of tennis players U16 years.
- There are statistically significant differences between the pretest and posttest of the experimental and control groups. In the accuracy of the backhand in the research sample.

Fields of the research

The research sample included (12) tennis players under (16) years old and the experiment with the applied method was performed on the courts of the Iraqi Hunting Club in Baghdad for the period from (1/2/2024) to (3/3/2024).

Materials and Methods

The researchers used the experimental method by designing the experimental and control groups with pre and post-tests as a basis for the implementation of the research (Ehab Mohammed Farhan & Abdulwahhab Ghazi Hammoodi, 2021), because of its suitability and the nature of the issue to be researched, and the research community was represented by young players in the courts of the Hunting Tennis Club in Baghdad, represented by (20) players as the original community, and the sample was selected by the random method, as the ages of the sample ranged from (15 - 16) years and the number of (12) players, where they represent (60%) of the community, and the researchers homogenized the research sample according to the variables of training age, chronological age, height and mass. (16) years and the number of (12) players, where they

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represent (60%) of the community, the researchers conducted homogenization among the members of the research sample according to the variables of training age, chronological age, height, and mass, as shown in Table (1).

Table (1): Characterization of sample homogeneity

Mass kg	Height Cm	Training Age	The Age	The club	Player Name	No.
70	169	3	15	Hunting Club	Ahmed Mustafa	1
60	160	3	15	Hunting Club	Youssef Mohamed	2
65	167	3	16	Hunting Club	Murtaza Muftin	3
61	163	2.5	15	Hunting Club	Khattab Omar	4
66	170	2.5	16	Hunting Club	Harith Muhammad	5
71	175	3	16	Hunting Club	Hasnain Muhammad	6
59	159	2.5	16	Hunting Club	Muhammad Haider	7
65	173	2.5	16	Hunting Club	Muhaymen and Wissam	8
60	160	3	15	Hunting Club	Ali Abbas	9
63	168	3	16	Hunting Club	Mohammed Ismail	10
59	162	2.5	16	Hunting Club	Abdullah Zalzala	11
61	169	2.5	16	Hunting Club	Ayman Mustafa	12

The researchers used a set of devices, tools, and means of data collection, which consist of (a soft toss machine - a SONY digital video camera for filming field procedures - a triple camera stand - a computer (laptop) - An electrical plug- legal tennis balls - legal tennis rackets - whistles - electronic stopwatch - electronic scale - cones - tape measure).

The purpose of the device used is learning and training, which is the target part of the research, as well as adjusting the timing of the racket meeting the ball in addition to adjusting the correct places for the player's distance from the ball, which comes through practice and repetition that the interesting factor adds to the device during training to master the technique during play, and is used for training purposes and players' skills concerning backhand and backhand groundstrokes as well as working on and learning other skills for the game, and we can say that the device used is a basic modern work that the world uses at the present time and has become an essential part of learning and training Just like the equipment and tools used during training modules.

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Soft toss machine

1. Device stand

It has three arms covering an area of (60) cm to ensure stability and balance during work, made of aluminum material that is lightweight and rigid, and Figure (1) shows the device part.

Figure (1): Shows the device stand

2. The armrest or support

It is a tube made of aluminum material whose height can be changed by a gear located in the middle of the arm and the lowest height is (100) cm and the highest height is (170) cm and Figure (2) shows the device part.

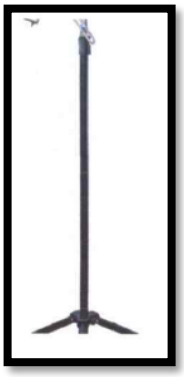

Figure (2): Shows the armrest or support

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3. setting sliders for the ball hugger

It is a ruler made of hardened aluminum material that is not subject to twisting, characterized by its hardness, contains from its center a hole (explanation) through which the slope of the ball incubator is controlled, and this slope determines the speed of the fall of the balls, as the greater the slope towards the ground, the faster the ball falls, and the less the slope is less, and Figure (3) shows the shape of the device part.

Figure (3): Show setting sliders for the ball hugger

4. Ball guide

It is a piece of aluminum that is smooth from the inner surface and contains slightly raised edges to ensure that the line of travel of the balls during the descent before the performance, its length (60) cm, the height of the side edges (4) cm and Figure (4) shows the part of the device.

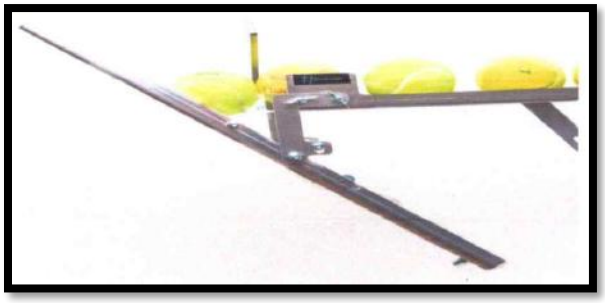

Figure (4): show the ball guide

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5. Ball holder

It is a part made of tempered aluminum material smoothed from its inner part to facilitate the sliding of the balls and contains edges on both sides with a height of (4) cm to ensure that the balls run in the same line, and consists of two front and rear pieces, between them is a separator (height separator) The task of the rear piece is to increase the rear piece is to increase the pressure on the balls Pressure on the balls, which is an auxiliary factor with the inclination and the force of attraction of the ground, which causes the smooth descent of the balls to the rear piece, the length of the stand as a whole for the rear and rear pieces (1) meter, the height separator consists of a small lever located from the sides that connects to (nets) and Figure No. (5) shows the part of the device.

Figure (5): show the ball holder

6. Back stands

It is two pieces of aluminum attached to the ball hugger from the front and the ball guide from the middle, Tabet in the upper part, allows movement of the part attached from the bottom (ball guide), and its function is to carry the guide in addition to the smooth movement of the guide after compressing the balls when they descend, height (10 cm), and Figure (6) shows the part of the device.

Figure (6): show the back stand

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7. Interval lever

It is called the separating lever because it separates the fall of one ball from another during performance, the lever is a piece of metal made of aluminum that works mechanically (20) cm long, which is the strongest piece in the device, hardened and inflexible, and this part is very important as it is responsible for the descent of the balls sequentially one after the other and at the same times to ensure the control of variables During training, it is connected to the ball incubator from above in a way that facilitates its movement (up and down), similar to the work of the gate closing and opening, located at the front of the ball incubator, and from the bottom it is connected to the ball guide with a metal wire that will mechanically deliver the command to descend the ball to open the field again for the next ball and Figure (7) shows the part of the device.

Figure (7): show the Interval lever

Figure (8): Shows the final shape of the device

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Regarding the exploratory experiment that was conducted on Monday (29/01/2024) at 5:00 p.m. on two (2) players from the research sample on the courts of the (hunting club), and the aim of this experiment was (initializing the device used and trying it before starting work on it and determining the locations of the players when using the device and determining the angles of photography that show the use of the device and players' work).

The field tests on the sample, namely the accuracy of the backhand, forehand, and backhand, were conducted by the International Tennis Federation (ITF), which are standardized tests that will be the first starting point for innovation using other exercises in the future in relation to the work on the device used in the research.

The main experiment for the tribal tests of the experimental group was conducted at 5:00 pm on Tuesday (30/01/2024) on the courts of the Hunting Tennis Club in which there were (6) players, where the device used was placed on the center mark of the baseline and cameras were used to photograph to review the work of the device and technique and preview the place of the fall of the balls, if necessary. The camera (No. 1) was placed behind the baseline and at a distance of (2) meters from the device, and camera (2) was placed along the sideline of the court and at a distance of (2) meters to ensure that the camera is not broken by playing balls, as well as taking into account the quality of photography and extracting some kinematic variables related to the research, namely (NAJAH Hussein & Thamer Mohsen, 2015):

1- Elbow Angle: This is the angle between the elbow line and the humerus line during the moment of the backswing.

2- Knee angle at the moment of striking: This is the angle between the hip line and the shin line at the moment of the backswing.

3- Height of the release point: It is the vertical distance from the center of gravity of the ball in the air to the ground.

4- Release Angle: It is the angle between the horizontal line connecting the two centers of gravity of the first ball at the moment of hitting the ball with the racket and the second after the ball leaves the racket when it is in the air.

5- Release velocity: It is the distance traveled by the ball over the time taken and is measured in (m/s).

The post-tests of the research sample were conducted at five o'clock on Tuesday

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(05/03/2024) at the courts of the Hunting Tennis Club, taking into account the procedures taken in the pre-tests in terms of photography, recording results and all organizational and scientific matters related to the research.

The researchers used the statistical package (SPSS) to process the research results and data by extracting the following statistics: (mean, standard deviation, t-test for independent samples).

Results

Table (2): shows the mean value, a standard deviation of the differences and the calculated t-value in the pre and post-tests for the control group for the backhand skill test

No.	Variables	control group		t-test value	Sig value	sig
		mean value	standard deviation			
1	Knee joint angle at the moment of hitting	10,82	4,77	26,441	0,051	non-significant
2	elbow angle	11,70	4,99	2,344	0,002	significant
3	Speed of the ball	3,22	1,03	3,126	0,071	non-significant
4	The height of the release point	5,11	0,89	5,741	0,000	significant
5	Ball release angle	2,01	0,51	3,941	0,001	significant

Table (3): shows the mean value, standard deviation of the differences, and the calculated t-value in the pre and post-tests for the experimental group for the backhand skill test

No.	Variables	experimental group		t-test value	Sig value	sig
		mean value	standard deviation			
1	Knee joint angle at the moment of hitting	8,99	0,34	26,441	0,001	significant
2	elbow angle	10,72	0,01	72,66	0,000	significant
3	Speed of the ball	2,10	0,03	70	0,000	significant
4	The height of the release point	5,12	0,66	7,757	0,002	significant
5	Ball release angle	1,33	0,02	66,5	0,001	significant

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Table (4): shows the mean, standard deviations, calculated t-values, and significance of differences for the experimental and control groups in the post-test of the backhand skill.

Sig	Sig value	t-test value	S. error	Mean Difference	control		experimental		Variables	No.
					standard deviation	mean	standard deviation	mean		
significant	0.000	8,57	1,02	6,68	2,99	177	7.24	162	Knee joint angle at the moment of hitting	1
significant	0.001	7,33	1,07	20,55	0,22	134	2,33	173	elbow angle	2
significant	0,001	7,01	0,71	1,88	0,12	1.26	1,77	2,88	Speed of the ball	3
significant	0,010	3,66	6,88	31,01	3,44	145,27	0,19	128.5	The height of the release point	4
significant	0.000	9,43	0,44	3	0.23	7	0,17	4	Ball release angle	5

The level of significance is significant when the value of (sig) is smaller than (0.05) and in front of the degree of freedom (df) (12-1=11) and through the display of table (2), we find that the results of the comparison were all significant except for two variables.

Discussion

Table (3) shows that all the significant results in the post-tests in the experimental sample were attributed by the researchers to the factor of excitement and breaking the routine followed in training, which was added by the device used during the standardized exercises used by the researchers and aimed at the accuracy of the performance of the backhand and using the exercises on the training device performed by the players (AL-Rammahi & Sattar, 2022).

Any exercise that the player continues within the training schedule must have an impact on the player in terms of the accuracy of the performance of the skill and according to the direction of the goal of the exercise (Kocić et al., 2022), and because the exercises concerned with the skill that the specialized trainer gave to the experimental and control sample, which aimed in its details

and content to the accuracy of the performance of the backhand for players, we find that the results were significant for the experimental group, especially for the target variables of the research (Abdul-gani et al., 2024).

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As for the non-significance of the results of the control group in the pre and post-tests, which appeared in Table (2), the researchers attribute it to the root cause of the issue, which is not using modern means that would add some important factors in training, including the factors of excitement and breaking the general routine of training in the use of modern equipment, in addition to the fact that the specialized trainer is the one who delivers the ball to the players and the trajectory of the ball was different, (Kazim et al., 2019) which leads to a difference in performance (Muttib et al., 2024). The path of the ball was different, which led to different performance, unlike the use of the training device that delivers a fixed path for the ball to maintain the accuracy of performance and repetition while maintaining the accuracy of the performance of the studied variables in the ideal situation and considering that the group is under development in training, which was the main goal to reach the stage of automation in the accuracy of the performance of the skill of the backhand (Obaid et al., 2022).

We find from Table (3) that all the research variables were significant for the experimental group, whose sequence was (1-2-3-4- 5) where the significance of the differences between the pre and posttests appeared, but with a more accurate and higher degree and reaching the stage of the mechanism in maintaining the studied variables by limiting the work of the coach only to give directions, instructions and correct errors for the studied variables since the device is specialized in delivering balls with an ideal motor path to the players in order to use the ideal motor path and the accuracy of the performance of the skill of the backhand during the use of the device, which was shown by the test results and this confirms the importance of the exercises used by the effect of the device used (Salman & Jabbar, 2021), the use of mechanical feedback in sports training is currently a field that achieves optimal results in adjusting the accuracy of skill performance (Abdulkareem & Hameed, 2017), which highlights the possibility of progress in monitoring and improving sports performance through modern technologies and devices (X. Zhang et al., 2019).

Through the display and analysis of table (2), we find that the results of the control group for the studied variables (2-4-5) came significant for the backhand, while the studied variables, which were sequenced (1-3) and not significant for the backhand, and this is what the researchers worked on in the exercises used and the lack of influence of the device used according to the steps of the experimental research, the stimulus always plays a large role in the outcome of what the player does during performance. (Ali & Jameel, 2020)

Through the display and analysis of table (4), we find that the results of all studied variables were significant in favor of the experimental group, and this indicates that the device used had a significant role in the response of the players in the performance, in addition to the instructions of the coach in modifying the motor path when hitting the ball (Abdulhussein et al., 2024)

One of the things that must be mentioned is that the device used worked on the movement mechanism and its mechanics completely from the moment the stimulus appears until the ball is

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hit, starting from the preparatory mode in which the player stands to prepare until the final mode, which is to hit the ball and continue, and through the use of these devices, players can simulate different presentation modes, improve their skill abilities and gain perfect information on the mechanics of performance in tennis from the initial stimulus to the point of hitting the ball (Wilkens, 2021)(Zaher Yahya et al., 2024).

Conclusions

Based on the results presented above and the researcher's analysis and discussion of those results, the following conclusions were reached

- The device used proved to be effective in practicing the accuracy of the backhand skill of tennis players.
- The results of the experimental sample were characterized by the introduction of modern technology with the effect of the device used had an effective role in the emergence of significant differences for all research results without exception.
- The used exercises that were given to the control group, which aimed at the accuracy of the performance of the skills targeted by the research, had a positive effect on the backhand.
- Despite the similarity of the objective, format, and schedule of the exercise between the experimental and control samples, the experimental results were better than the control group due to the modern method in which the exercise was carried out by using the device by the researchers, which provided the most important elements of a successful exercise.

Recommendations

In light of the conclusions reached by the researchers and based on the discussion of the results and what can be concluded, the researchers make the following recommendations:

- Using the Soft toss machine to measure and test the accuracy of the backhand in tennis.
- Use the Soft toss machine to measure the technique used during performance on all age groups in tennis.
- Conduct similar research using new exercises for all age groups in tennis using the Soft toss machine.

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