Effect of Drill, Foot Position, and Hand-Eye Coordination on Groundstroke Forehand Drive Ability in Novice Tennis Athletes

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Abstract: The purpose of this study was to test the influence of drill drills on groundstroke capabilities, the influence of foot position on groundstroke ability, the influence of hand-eye coordination on groundstroke ability to know the interaction between drill exercises, foot position, and hand-eye coordination to groundstroke forehand drive ability. The research was designed using quasi-experiments with factorial design. The samples in this study used purposive sampling or aiming samples; then, participants were tested using groundstroke forehand drive punch tests to determine success and accuracy levels. The data were analyzed with the ANOVA and Tukey tests. There can be significant differences in drill training models using machines and feeders against groundstroke forehand drive capabilities, there is a significant difference in influence between athletes using foot position close stance and open stance against groundstroke forehand drive ability there is a significant difference in influence between athletes who have the hand-eye coordination to groundstroke forehand drive, there is a significant interaction between the machine drill training model and feeder against the capability of groundstroke forehand drive punch, there is a significant interaction between the engine drill model and feeder against groundstroke forehand drive capability, there is a significant interaction, between foot position against groundstroke forehand drive, there is a significant interaction between drill training model, foot position, and hand-eye coordination to groundstroke forehand drive capability in novice tennis athletes. This study may improve the design of training protocols for learning groundstroke forehand drive punches.

Keywords: drill, foot position, hand-eye coordination, groundstroke forehand drive capability.

训练、足部位置和手眼协调对网球新手正手击球能力的影响

摘要：本研究的目的是测试操练对击地能力的影响、脚位对击地能力的影响、手眼协调对击地能力的影响，以了解操练、足部位置和手-
眼睛协调对地击正手击球能力。该研究是使用具有析因设计的准实验设计的。本研究样本采用有目的抽样或瞄准样本；然后，参与者使用击地正手击球测试进行测试，以确定成功和准确度。使用方差分析和图基检验分析数据。使用机器和喂食器的训练模型对地击正手击球能力的影响可能存在显着差异，使用脚位闭合站姿和开放站姿对抗地击正手击球能力的运动员之间的影响存在显着差异运动员之间的影响存在显着差异对地击正手击球手眼协调能力强的人，机钻训练模型和进给器对地击正手击球能力有显着交互作用，机钻模型和进给器对地击正手击球能力有显着交互作用能力， 足部位置与击地正手击球能力之间存在显着的交互作用，练习训练模式、足部位置和手眼协调对网球新手的击地正手击球能力有显着的交互作用。这项研究可能会改进学习地击正手击球训练方案的设计。

关键词：钻，脚的位置，手眼协调，击球正手驱动能力。

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1. Introduction

There are basic techniques or basic strokes to play tennis. One of them is a groundstroke. A groundstroke is a hit when you hit the ball that has bounced off the ground. Groundstroke is a shot that is made after the points have started. Although these shots can be played from anywhere on the court, they are usually taken from the baseline and after the ball has bounced [1]. Groundstroke is one of the most commonly used techniques in tennis, especially in singles. Return service is one of the groundstroke techniques performed by a player whose ball can be hit by the receiving service only after the ball has bounced. In one game, 80% of the technique used in the game is groundstroke. Apart from maintaining a defensive position and attacking, tennis players can stroke from behind the back of the line to create opportunities to attack the opponent's defense by hitting the ball at a difficult point for the opponent to reach. Consistency in making groundstroke strokes (forehand and backhand) greatly determines a tennis player's success in winning a match [2].

Tennis matches play a period of high-intensity work interspersed with rest periods [3]. The players concluded that most of the total distance was traveled by short effort and high intensity [4]. The total distance traveled, in this case, relates to the step and position of the foot at the time of carrying out the blow. The sport of tennis has 2 ways to place the position of the legs, namely the position of the closed stance legs and the position of the legs' open stance. The lower body and upper body rotation are significant energy sources on a forehand punch. Energy is transferred upwards from the legs to the pelvis, shoulders to the arms, and then to the racket. In the kinetic chain of the lower body, the knee joint is considered a critical middle link in proximal force transfer [5]. The torso and pelvis rotation involves a force of torque in the lower body, not only during the forward swing but also during follow-up, where this rotational energy is being dispensed. Research into the kinetics of the lower extremities of a closed forehand (CS) has shown that leg propulsion is essential for creating high axial hip rotation torque to aid torso rotation [6].

Coordination is an ability possessed by the body to perform movements that combine several abilities with precise and controlled rhythms to produce effective and efficient motion [7]. Hand-eye coordination when performing forehand drive punches on the court tennis is very decisive in athletes' success in making a motion. The eye is a sense of vision that serves to actualize certain objects, hit the ball with a racket, and distinguish the events it sees. A two-handed backhand grip is no more effective than a one-handed backhand punch, in terms of targeting in the sport of tennis and two-handed-eye coordination capabilities [8]. Vision is part of the main component because seeing the opponent's movement and the ball's direction is very difficult and must be done with eye observation [9].

Unfortunately, eye-hand coordination and foot position when making a stroke is not a determining factor for an athlete's forehand drive ability, but the training method also influences it. The foot's position that does not match the hitting distance will result in a ball impact against the racket that does not match the power zone. The right foot (for right-handed players) is placed behind when the player advances to the side and prepares for the ball when the shoulders and hips are rotated to anticipate the approaching ball [10]. The open forehand stance was described inadequately in the early literature and has been noted as simply not the right thing to do if explained at all. The reference states that if the foot is parallel to the net when the player hits the ball, the position is wrong [11]. Vision is part of the main component in tennis [9]. Coordination has various levels of difficulty in carrying out movements that are fast, efficient, and fully accurate. It stimulates muscle performance when a person stops stimuli against the muscle, requiring an appropriate training method adapted to training a stroke in tennis. The hitting techniques in tennis are strongly influenced by good eye-hand coordination skills [8].

Various studies on the groundstroke forehand drive ability of tennis players have been carried out. Several studies have been conducted in several regions, such as Galé-Ansodi, Castellano, & Usabiaga [3], Fernandez, Sanz, & Mendez [4], Hoskins-Burney & Carrington [12], and Yildiz, Pinar, & Gelen [13]. On the other hand, several studies in Indonesia have also been carried out. However, the analysis of the ability of the groundstroke forehand drive in Indonesia seems to be more focused on the contribution of hand-eye coordination [14], [15], [16] and the contribution of the open and closed leg positions to the forehand stroke [17]. In line with this information, research that examines drill exercises, foot position, and hand-eye coordination on the groundstroke forehand drive ability of novice tennis players in East Kalimantan tennis clubs have never been carried out. This research needs to provide information about how the foot position, hand-eye coordination, and groundstroke forehand drive ability in novice tennis athletes. In addition, the findings obtained can form the basis of development research carried out in mentoring novice athletes. The results can also be used based on the coach in providing guidance and training to athletes. Therefore, this study aimed to analyze the effect of drill practice, foot position, and hand-eye coordination on the groundstroke forehand drive ability of novice tennis players in the East Kalimantan tennis club.

2. Method

The research method used quasi-experiments with factorial design. The study subjects as many as 100 novice tennis club-athletes in East Kalimantan. The samples were determined with purposive sampling techniques. Participants are divided into two groups, namely groups with high and low hand-eye coordination and then grouped again into groups with drill exercises using machines and feeders and then grouped again by foot position when performing blows that are open and close.

Instrument collection of hand-eye coordination data using ball throwing test on target with a diameter of 30cm and a certain distance with a test validity of 0.84 and test the reliability of 0.62 [18]. Testee threw 10 right-handed pitches and 10 left-handed pitches. The ball, which was caught with a right hand before falling to the floor, was declared successful and scored 1. The precision of forehand drive punch is the ability of learners to perform forehand drive punches after participating in tennis practice using drill methods measured using Hewitt Tennis Test [19].

The test for forehand groundstroke tennis skills was modified from the Hewit Tennis Test by Mulyono Biyakto [19], with an instrument validity value of 0.9067. A tennis court, directly above the net, is stretched parallel to the net and is 2.4 m from the floor. In the tennis court, four lines are drawn parallel to the backline (baseline), the distance between two adjacent lines is 2 meters. In addition, two lines are also drawn with a distance of 1.2 meters each from the single line of play on the right and 1.2 meters from the single line of play on the left. These lines intersect to form a target area with values 1, 2, 3, 4, and 5. The test begins with the testee standing in the middle of the baseline (center mark) facing the target area across the net, ready to perform the test. Before the test begins, testees are allowed to try to forehand groundstrokes the ball fed from the backline across the net 5 times. In carrying out the test, the testee did forehand groundstrokes 6 times against the ball fed by a feeder from the backline at the net and tried to get the ball fed to fall slightly behind the service line. Each forehand groundstrokes the ball passing between the net and the rope, and the ball falls in the target area, obtaining a score equal to the value of the target area.

The author checks the data of the research results before the data is analyzed. The analysis involves Microsoft Excel and SPSS software. The research variable data is calculated equally, and the standard deviation is based on the respondent's achievement score. After the respondents were given a score following the provisions presented in the data collection procedure section, the data was then analyzed using ANOVA analysis followed by a Tukey test. Also, the data was conducted via regression analysis, then data normality test with Kolmogorov Smirnov test and homogeneity test with Levene's test.

3. Results and Discussions

The results of this study are presented in Table 1.

Table 1 Summary of drill training model data, food position, and hand-eye coordination with groundstroke punch

		MEDIA LATIHAN DRILL (A)				
		MESIN (A1)		**FEEDER (A2)**		**Amount**
FOOT POSITION (B)		**Open (B1)**	**Close (B2)**	**Open (B1)**	**Close (B2)**	
Head Eye Coordination	High (C_1)	$\Sigma X_1 = 117,0$ $X_{1rata} = 10,6$ Min = 6,0 Max = 13,0 SD = 2,1 $n_1 = 11$	$\Sigma X_1 = 189,0$ $X_{1rata} = 15,7$ Min = 10,0 Max = 18,0 SD = 2,4 $n_1 = 12$	$\Sigma X_1 = 255,0$ $X_{1rata} = 23,2$ Min = 22,0 Max = 25,0 SD = 1,2 $n_1 = 11$	$\Sigma X_1 = 288,0$ $X_{1rata} = 26,2$ Min = 24,0 Max = 29,0 SD = 1,7 $n_1 = 11$	$\Sigma Xb_1 = 849,0$ $Xb_{1\ rata} = 18,9$ $nb_1 = 45$
	Low (C_2)	$\Sigma X_1 = 71,0$ $X_{1rata} = 7,9$ Min = 5,0 Max = 13,0 SD = 2,3 $n_1 = 9$	$\Sigma X_1 = 109,0$ $X_{1rata} = 13,6$ Min = 12,0 Max = 15,0 SD = 1,2 $n_1 = 8$	$\Sigma X_1 = 173,0$ $X_{1rata} = 18,2$ Min = 17,0 Max = 22,0 SD = 1,6 $n_1 = 9$	$\Sigma X_1 = 159,0$ $X_{1rata} = 17,6$ Min = 17,0 Max =19,0 SD = 0,7 $n_1 = 9$	$\Sigma Xb_1 = 512,0$ $Xb_{1\ rata} = 14,7$ $nb_1 = 35$
Amount		$\Sigma Xk_1 = 188,0$ $Xk_{1rata} = 9,4$ $nk_1 = 20$	$\Sigma Xk_1 = 298,0$ $Xk_{1rata} = 14,9$ $nk_1 = 20$	$\Sigma Xk_1 = 428,0$ $Xk_{1rata} = 21,4$ $nk_1 = 20$	$\Sigma Xk_1 = 447,0$ $Xk_{1rata} = 22,3$ $nk_1 = 20$	$\Sigma Xk_1 = 147,0$ $Xk_{1rata} = 17,1$ $nk_1 = 80$

Table 1 is a known description of the group of research samples with eight treatments. The results of the first group of research, namely the group with drill media with machines and coordination of high-hand eyes and open foot positions were known from 11 respondents obtained a score (M = 10.6; SD = 2.1) and a minimum score of 6.0 and a maximum score of 13.0. The second group in the media drill with machines, high hand-eye coordination, and foot position close is known from 12 respondents who obtained a score (M=

15.7; SD = 2.4; min = 10.0; max =18.0). The third group received drill exercise treatment with feeder, high hand-eye coordination and open foot position known from 11 respondents obtained a score (M= 23.2; SD = 1.2; min = 22.0; max =25.0). The fourth group in this study was treated with a drill method with feeder, high hand-eye coordination, and foot position close known from 11 respondents obtained value (M= 7.9; SD = 2.3; min = 5.0; max =13.0). Overall the number of samples in the eye coordination group was high at 45 people (M = 18.9; SD = 6.4), and the number of samples in the low-hand eye coordination group of 35 people (M = 14.6; SD = 5.3).

The research results in the fifth group, namely the group with drill training media with machines and low eye coordination and foot position open, found that 9 respondents obtained values (M = 7.9; SD = 2.3; min = 5.0; max = 13.0). In the sixth group in the drill training media with machines, low eye-hand coordination, and close foot position, it was known that the 8 respondents obtained the values (M = 13.6; SD = 1.2; min = 12.0; max = 15.0). The seventh group received drill training with a feeder, low eye coordination, and open foot position. It was found that 9 respondents obtained the value (M = 18.2; SD = 1.6; min = 17.0; max = 22.0). The eighth group in this study was treated with the drill training method with a feeder, low eye coordination, and close foot position. It was known from 9 respondents that the value was obtained (M = 17.6; SD = 0.7; min = 17.0; max = 19.0). Overall the number of samples in the machine drill group with open foot position was 20 people (M = 9.4; SD = 2.5), the number of samples in the machine drill group and foot position close was 20 people (M = 14, 9; SD = 2,3), the number of samples in the drill training group with feeder and foot position open was 20 people (M = 21.4; SD = 2.5) and the number of samples in the drill training group with feeder and foot position close as many as 20 people (M = 22.3; SD = 4.5).

Table 2 Effect of drill exercise model interaction, food position and hand-eye coordination on groundstroke forehand drive punch capability

Variable	**df**	**F**	**Sig**	***Partial Eta Squared***
Model Training *Drill*Food Position* * Head eye coordination	1	9,944	<0,002	0,121

There is a significant interaction between food position and hand-eye coordination against groundstroke forehand drive in novice tennis athletes (F (1.72) =9,944, p<0,002, 2 = 0.121). Further tests to determine the difference in influence between cells were conducted with the BNT test. The full calculation can be seen in the appendix, while the summary is as in Table 3 as follows:

Table 3 Interaction of research sample groups

Interaksi	**Mean (SD)**	**Notasi LSD**
A1B2C2	7,250 (1,28)	a
A1B2C1	10,833 (2,12)	b
A1B1C2	13,222 (1,64)	c
A1B1C1	16,273 (1,74)	d
A2B1C2	18,222 (1,56)	e
A2B2C2	19,222 (1,92)	e
A2B2C1	23,182 (1,17)	f
A2B1C1	26,182 (1,72)	h

These findings are in line with Meta Anggita Sianipar's [20] and Dewi Angraini's [21] findings, who reported feeding exercises to affect the ability of groundstroke forehand drive tennis. Latihan forehand drive uses feeding as an effective form of practice technique to improve forehand drive in the tennis court game because its implementation resembles the real game on the court. After hitting, the athlete must return to the way it was. This exercise is also often given by coaches to athletes, so they are used to this exercise.

A close stance is the most effective groundstroke attitude because there is a forward weight transfer, a rotation of the body, and generally forces the batsman to take extra steps to return after using the ball [22]. The lack of rotation of the body makes it difficult to produce strong punches. The key points of the most important components of groundstroke attitude with close stance are as follows: the initial position of the body and the position of the legs, the transfer of weight, the rotation of the hips). The findings of this study showed the ability of groundstroke forehand drive with foot position close showed higher or better success in novice tennis players. It is in line with the results of Tajul Arifin Muhamad's research [17], which explained that fast forehand stance punches have a much better percentage of success and accuracy among mid-level tennis players.

In principle, more serious coordination with high concentration can be handled well because eye-hand coordination has a key role in success in tennis [23]. To

perform a deadly blow to the opponent, the good eye-hand coordination is needed. That is in line with Sahan and Erman [23], eye-hand coordination becomes important when the ball hits the racket, and the speed of the ball can change. Hand-eye coordination affects elementary school-age novice tennis players [24], [25]. The BNT test results in table 4.5 show the interactions A1B1C1, A1B1C2, A1B2C1, A1B2C2, A2B1C2, A2B2C2, A2B2C1, and A2B1C1 have different notations, which means the groundstroke forehand drive capabilities in those interactions differ significantly. The interaction between A2B1C2 and A2B2C2 has the same notation, which means that those interactions' groundstroke forehand drive capability does not differ significantly. That shows that for improving the groundstroke forehand drive ability, tennis uses drill and foot position training methods and influenced by the ability of motion possessed by the tennis player, namely hand-eye coordination.

4. Conclusion

Based on the research and discussion results, it can be concluded that there are significant differences in the drill training model using a machine and a feeder on the ability of the groundstroke forehand drive. There is a significant difference between athletes who use the foot position close stance and open stance on the ability of the groundstroke forehand drive. There is a difference. There is a significant influence between athletes who have eye-hand coordination on the ability of the groundstroke forehand drive. There is a significant interaction between the machine and feeder drill training model on the ability of the forehand drive groundstroke. There is a significant interaction between the machine drill model and the feeder on the forehand groundstroke stroke drive ability. There is a significant interaction between the foot position and the ability of the groundstroke forehand drive. There is a significant interaction between the drill training model, foot position, and tan eye coordination. Accent on groundstroke forehand drive in novice tennis athletes is known in the tennis club in East Kalimantan.

Based on the findings of the study, athletes should improve their body's ability to meet the increasing demands of exercise and improve understanding of specific forms of technical exercises that can support tennis playing skills, such as Tennis Club Coaches in East Kalimantan, should conduct effective training and planning programming to help design safe, effective and productive programs designed to help optimize the tennis performance of players.

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