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The Effect Of Arm Strength And Target-Based Training Models On Forehand Groundstroke Accuracy Of Beginner Tennis Players At Krass Tennis Club In 2025

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Abstract

The purpose of this study was to determine the effect of arm strength and training models on forehand accuracy of beginner tennis players. This research used an experimental method with a 2×2 factorial design. The subjects of this study were 32 beginner tennis players at Krass Tennis Club. The research instrument used was the ITN 10.3 Groundstroke Placement test to measure forehand accuracy. Data analysis techniques used normality test, homogeneity test, and two-way ANOVA. The results showed that arm strength had a significant effect on forehand accuracy with F = 6.842 and Sig. = 0.014. Training models also had a significant effect with F = 18.527 and Sig. = 0.001. Furthermore, there was a significant interaction between arm strength and training models with F = 9.315 and Sig. = 0.005. The follow-up test showed that different training models produced different effects depending on the level of arm strength. It can be concluded that arm strength and appropriate training models are important factors in improving forehand accuracy of beginner tennis players.

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INTRODUCTION

Tennis is one of the sports that requires a combination of technical skills, physical condition, coordination, and decision-making abilities. One of the fundamental techniques that plays an important role in tennis is the forehand stroke. The forehand stroke is frequently used during matches because it can function as both an attacking and defensive stroke. The success of a forehand stroke is not only determined by the ability to perform the stroke movement but is also influenced by the player's ability to control the direction and accuracy of ball placement.

In beginner players, a common problem found is the low ability to control stroke direction and place the ball accurately in the target area. This occurs because beginners are still in the stage of developing basic techniques, requiring systematic training methods that are appropriate to their ability characteristics. Stroke accuracy is an important indicator in the development of tennis skills because the ability to place the ball accurately can improve playing effectiveness.

One physical factor related to forehand stroke ability is arm strength. Arm strength is the ability of muscles to produce force during movement. In tennis, arm strength plays an important role in generating racket swing acceleration, maintaining racket stability during ball contact, and helping players control stroke direction. Players with better arm strength tend to produce more stable and consistent strokes.

In addition to physical factors, the improvement of tennis skills is also influenced by the training model applied. A fixed target training model provides opportunities for players to perform repeated movements consistently, thereby helping develop movement patterns and stroke accuracy. Meanwhile, a changing target training model provides varied stimuli that are more similar to actual match situations because players are required to adjust stroke direction according to changing targets.

Previous studies have shown that physical abilities and training methods contribute to improving sports skills. Gallo-Salazar et al. (2019) explained that physical characteristics of tennis players are associated with the ability to produce effective stroke performance. Furthermore, motor learning principles indicate that variations in training can improve movement adaptation and skill acquisition.

However, research that combines arm strength factors and training models in relation to forehand accuracy among beginner tennis players still needs further investigation. This is important because the effectiveness of a training model may differ depending on the player's physical ability level.

Based on these problems, this study aims to determine the effect of arm strength and training models on forehand accuracy in beginner tennis players and to examine the interaction between arm strength and training models in improving forehand performance.

METHODS

Research Design

This study used an experimental method with a 2×2 factorial design. The research design was used to determine the effects of two treatment factors, namely arm strength and training model, on the improvement of forehand stroke accuracy.

The first factor was arm strength, which consisted of:

(1) high arm strength (A1), and

(2) low arm strength (A2).

The second factor was the training model, which consisted of:

(1) fixed target training (B1), and

(2) changing target training (B2).

Based on the combination of these two factors, four treatment groups were obtained: A1B1, A1B2, A2B1, and A2B2.

Training Model	High Arm Strength (B_1)	Low Arm Strength (B_2)
Fixed Target (A_1)	A_1B_1	A_1B_2
Changing Target (A_2)	A_2B_1	A_2B_2

Participants

The subjects of this study were 32 beginner tennis players from Krass Tennis Club. The participants were grouped based on the results of the initial ability measurement and arm strength categories. All participants followed the training program according to their respective treatment groups.

Instrument

The instrument used to measure forehand stroke accuracy was the ITN 10.3 Groundstroke Placement Test developed by the International Tennis Federation (ITF). This test evaluates the player's ability to perform forehand groundstrokes by measuring the accuracy of ball placement in predetermined target areas. The score obtained represents the player's ability to control the direction and placement of forehand strokes.

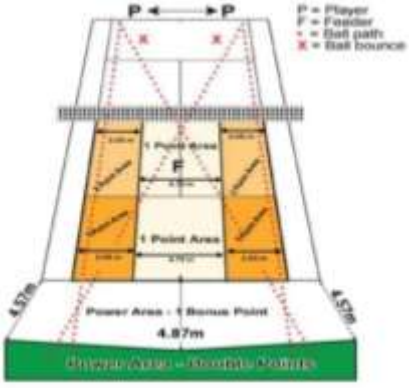


Figure 1.Area of Accuracy Test for Forehand Groundstroke in the International Tennis

International Tennis Number (ITN) 10.3 (ITF, 2004)

Test Procedure

1. The participant stands at the baseline area (around the center mark of the court) and prepares to receive the ball from the feeder.
2. The feeder delivers 12 consecutive balls toward the participant.
3. The participant performs a forehand groundstroke on each delivered ball.
4. The first six balls are hit using a straight forehand (down the line) stroke.
5. The following six balls are hit using a cross-court forehand stroke.
6. The participant attempts to place the ball accurately into the designated target areas.
7. Balls that are not delivered properly or are unsuitable to be hit due to an error by the feeder are not included in the scoring assessment.

Scoring System:

The score for each stroke is determined based on the area where the ball lands for the first time and where the ball bounces for the second time. The feeder must ensure that all delivered balls land between the service line and the baseline, as shown in the diagram. If the ball delivered by the feeder is not appropriate or favorable, the participant is not required to hit the ball.

Scoring Criteria:

1) Score 1: If the ball lands for the first time in the middle of the service box or in the area between the service line and the baseline (a distance of 4.73 meters).
2) Score 2: If the ball lands for the first time in the service box area (before the service line) toward the right or left side of the singles court area (a distance of 2.05 meters).
3) Score 3: If the ball lands for the first time behind the service box and before the baseline, toward the right or left side

of the singles court area (a distance of 2.05 meters).

Scoring Examples:

1) A score of 4 points is awarded when the ball lands for the first time in area 3 and the second bounce occurs behind the baseline.
2) A score of 6 points is awarded when the ball lands for the first time in area 3 and the second bounce occurs beyond the bonus line.
3) A score of 0 points is awarded when the first bounce of the ball occurs outside the singles court area.

Maximum Score:

The maximum score that can be obtained in the ITN forehand and backhand groundstroke accuracy and consistency test is 84 points, with the following details:

1) 6 straight forehand strokes = a maximum of 36 points
2) 6 cross-court forehand strokes = a maximum of 36 points

The points obtained increase based on the total score achievement in the accuracy assessment of the forehand groundstroke. The more accurately the ball is placed in the target area, the higher the score obtained (ITF, 2004).

Training Program

The intervention program was conducted for 16 weeks with three sessions per week. Each training session lasted approximately 120 minutes, consisting of warm-up, main training, situational game, and cool-down activities.

The participants were divided into two training groups based on the target training model: fixed target training and changing target training. Both groups received forehand groundstroke training with different target approaches.

The fixed target group performed forehand drills using a consistent target area throughout the training session. This training emphasized repetition, movement consistency, racket control, and accuracy development.

The changing target group performed forehand drills using varied target areas. The target direction was modified during the exercise to stimulate adaptation, decision-making ability, and accuracy in changing game situations.

The training intensity was controlled using the Rating of Perceived Exertion (RPE) scale, ranging from 12–14 (moderate intensity). The training volume gradually increased from 3 sets × 10 forehand strokes in the early sessions to 5 sets × 12 forehand strokes in the later sessions.

Compoment	Fixed Target	Moving Target
Duration	16 weeks	16 weeks
Frequency	4 sessions/week	4 sessions/week
Session Duration	120 minutes	120 minutes
Intensity	RPE 12-14	RPE 12-14
Main Exercise	Forehand to fixed target area	Forehand to varied target areas
Training Focus	Consistency and accuracy	Adaptation and decision making
Volume Progression	3–5 sets × 10–12 strokes	3–5 sets × 10–12 strokes

Procedure

The study began with a pretest to determine the participants' initial forehand accuracy ability. After the pretest, participants were assigned to the treatment groups and followed the training program according to their respective groups. The training groups received different training models, namely fixed target training and changing target training, based on the research design. After completing the training program, a posttest was conducted using the same instrument to evaluate

changes in the participants' forehand stroke accuracy.

Data Analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS). The prerequisite tests included the normality test using the Shapiro-Wilk test and the homogeneity test using Levene's Test. Hypothesis testing was conducted using Two-Way ANOVA with a significance level of 0.05. If a significant interaction effect was found between factors, further analysis was conducted using Pairwise Comparisons to determine differences between treatment groups.

RESULTS AND DISCUSSION

Result

Participant Characteristic

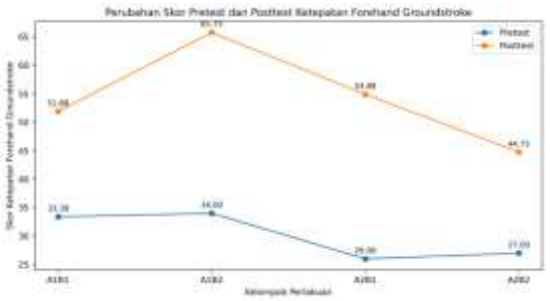
The participants in this study consisted of 32 beginner tennis players from Krass Tennis Club. Participants were classified based on arm strength level and training model.

Training Model	High Arm Strength (B_1)	Low Arm Strength (B_2)	Total
Fixed Target (A_1)	8	8	16
Changing Target (A_2)	8	8	16
Total	16	16	32

Descriptive Statistics

The descriptive statistics of forehand accuracy scores before and after treatment are presented in table.

Group	Pretest Mean	Posttest Mean	Gain
A1B1	33,38	51,88	18,50
A1B2	34,00	65,75	31,75
A2B1	26,00	54,88	28,88
A2B2	27,00	44,75	17,75



The results indicate that all groups experienced an improvement in forehand accuracy following the training intervention. Among the four treatment groups, the A1B2 group (high arm strength with changing target training) achieved the greatest improvement compared to the other groups.

Normality Test

The normality test was conducted using the Shapiro-Wilk test to determine whether the data distribution met the assumptions required for parametric analysis.

Data	Shapiro-Wilk Sig.	Description
Pretest	>0.05	Normal
Posttest	>0.05	Normal
Gain Score	>0.05	Normal

The results showed that all data had a significance value greater than 0.05, indicating that the data were normally distributed.

Homogeneity Test

The homogeneity test was performed using Levene's Test.

Variable	Levene Sig.	Description
Gain Score	>0.05	Homogeneous

The result indicates that the variance among groups was homogeneous, meaning the data fulfilled the requirements for further analysis using Two-Way ANOVA.

Two Way Anova

The hypothesis testing was conducted using Two-Way ANOVA to determine the main

effects of arm strength, training model, and their interaction.

Source	F	Sig.
Arm Training	6,842	0,014
Training Model	18.527	0,001
Interaction AxB	9,315	0,005

The results of the analysis showed that arm strength had a significant effect on the improvement of forehand accuracy. The training model also had a significant effect on forehand accuracy improvement. Furthermore, there was a significant interaction between arm strength and training models in influencing the improvement of forehand accuracy.

Pairwise Comparisons

Because the interaction between arm strength and training model was significant, a follow-up analysis was conducted using Pairwise Comparisons to identify differences among treatment groups.

Comparison	Result
A_1B_1 vs A_1B_2	Significant difference
A_1B_1 vs A_2B_1	Significant difference
A_1B_2 vs A_2B_2	Significant difference
A_2B_1 vs A_2B_2	Significant difference

The follow-up analysis showed that differences occurred between several treatment groups. The A_1B_2 group produced the highest improvement, indicating that participants with high arm strength obtained better results when combined with changing target training.

Discussion

The findings of this study indicate that arm strength contributes significantly to forehand accuracy improvement. Arm strength supports racket acceleration, stability during ball contact, and control of stroke direction. Therefore, players with better arm strength are able to produce more consistent and accurate forehand strokes.

The training model also affected forehand accuracy improvement. Fixed target training provides repeated practice opportunities that help players develop movement consistency. Meanwhile, changing target training provides more complex stimuli because players must adjust stroke direction based on different target positions.

The significant interaction between arm strength and training model indicates that training effectiveness depends on player characteristics. Players with high arm strength showed greater improvement when receiving changing target training because they had sufficient physical capacity to adapt to more complex training situations.

These findings suggest that tennis training programs for beginners should not only focus on technical repetition but also consider physical characteristics and appropriate training variations. Combining physical conditioning with structured technical training can provide more effective improvements in forehand performance.

CONCLUSION

Based on the results of this study, it can be concluded that arm strength and training models influence the improvement of forehand stroke accuracy in beginner tennis players. Arm strength serves as a supporting factor in producing stable and controlled strokes, while training models provide different stimuli in the process of skill acquisition. Furthermore, the interaction between arm strength and training models indicates that the effectiveness of training is influenced by the physical characteristics of the players. This study contributes to the development of beginner tennis training programs by emphasizing the importance of combining physical conditioning factors and appropriate training methods to achieve more effective skill improvement.

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