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The Effect of Hand Grip Strength and Interval in BOTELI Method Exercises to Improve Rally Groundstroke Forehand Skills

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ABSTRACT

The purpose of this study is to determine: 1) the effect of the BOTELI method exercise on training intervals to improve rally groundstroke forehand skills; 2) the effect of the BOTELI method exercise on hand grip strength to improve rally groundstroke forehand skills; and 3) the interaction effect between training intervals and hand grip strength to improve rally groundstroke forehand skills. The research method used was an experimental design. The sample in this study consisted of 48 sports students of Universitas Sebelas Maret in 2022. Data collection techniques used the Kem-Vincent Rally Test of Rally Skill, and hand grip strength was measured using a hand dynamometer. The data analysis technique used was a two-way factorial ANOVA 2x2 with a significance level of $\alpha = 0.05$ using SPSS version 26 for Windows. The results showed that variable A affected the improvement of rally groundstroke forehand skills with a value ($0.000 < \alpha$ 0.05) and was indicated by the value (F-count = 129.686 > F-table 4.06). Variable B affected the improvement of rally groundstroke forehand skills with a value ($0.000 < \alpha$ 0.05) and was indicated by the value (F-count = 198.793 > F-table 4.06). A and B showed an interaction effect on improving rally groundstroke forehand skills with a value ($0.000 < \alpha$ 0.05) and was indicated by the value (F-count = 18.921 > F-table 4.06). Therefore, to improve rally groundstroke forehand skills, both variables A and B, as well as the BOTELI training method, have an influence.

Keywords: Tennis, Training Method, BOTELI, Racket SportKeywords: Tennis, Training Method, BOTELI, Raquet Sport

INTRODUCTION

Tennis has complex movement characteristics. To train tennis, players perform thousands of repetitions until they truly reach automatic movements, which serve to train precision, accuracy, and speed for highly skilled players (Beckmann et al., 2021). It shows that skilled tennis players demonstrate task-prioritization strategies that support tennis skills in playing situations (Amico & Schaefer, 2022). In playing tennis, efficient and effective training is required to master techniques faster and to improve skills (Wu et al., 2022). The training method will be applied to improve skills in tennis games. Tennis competition has developed rapidly. Movements in tennis require continuous development in terms of designing and improving movement patterns, increasing speed, and training in specific game situations. Training methods can support development to predict how fast the progress of training methods and tennis equipment has affected tennis court playing skills. The development of scientific research in sports, data analytics, and information science is used to modify training methods to be efficient, effective, and tactical in training accuracy, speed, and strength. Tennis is a sport that requires skill (Wei, 2022). BOTELI and training aids in tennis exercises are one of the efficient training methods for forehand groundstroke. The benefit of training aids in training sessions is that they help make it easier to master techniques in sports (Wachholtz et al., 2022).

BOTELI is an acronym for bola tenis bertali (tethered tennis ball in Indonesian). The development of tennis training using the BOTELI method will make tennis training different from others.

Tennis requires specific physical, technical, and tactical preparation. In the current game of tennis, physical needs such as speed, agility, strength, and endurance are required to support performance in tennis (Vodička et al., 2018). The readiness of the nervous system, specific endurance, complex reaction speed, and the strength of the muscular and nervous systems (Kozina et al., 2020) continue to develop, and further research is being carried out on sports, countries, and levels of expertise. In this case, it is easier to clarify whether strength and speed contribute to improved training performance (Weldon et al., 2022). Modern tennis players need strength and speed in the game to overcome situations and conditions in the tennis court. Speed and strength contribute to tennis strokes (Suprunenko, 2021).

High-intensity interval training alternates with rest or low-intensity periods. Interval training is performed with varying durations and intervals (Liu et al., 2022; Vestergaard et al., 2022). It shows that short recovery periods can activate anaerobic glycolysis to a greater extent in the following training intervals as a result of fatigue accumulation. The arrangement of rest periods during training must be considered to reduce fatigue arising during exercise (Tang et al., 2022). The training interval is determined by the volume and intensity of the exercise, allowing adequate recovery for successful interval training based on the work-to-rest ratio or the return of several physiological parameters (Mathieu et al., 2022; Woodfield et al., 2022). It is suggested that interval training can be recommended for longer recovery intervals with a ratio of 1:4, while training intervals with a ratio of 1:1 may be more beneficial for shorter recovery intervals (Mühlberger & Kolbinger, 2020). The study used training intervals with a ratio of 1:1 and 1:3.

Hand and arm strength during muscle contraction was measured using a handgrip dynamometer (Turner, 2018). The measurement units of the hand dynamometer can be seen in kilograms or newtons. Hand grip strength is required in tennis. Hand grip strength serves to control the racket, direct the stroke, and provide the power output of the shot (Grant et al., 2022). When the racket impacts the ball, professional players rely heavily on grip strength to produce fast and powerful shots. Hand grip strength is the final force used to hit the ball accurately (Huang, 2022). The fingers gripping the racket handle generate fast, powerful, and accurate strokes. In the biomechanics principle of the forehand stroke, the movement starts from the foot push-off, hip rotation, shoulder drive, and arm swing. The maximum grip force is used when hitting the ball, and the average grip force value occurs in the 0.5–1 second period with sustained gripping (Fett et al., 2021).

This study discusses the effect of the BOTELI training method on improving rally groundstroke forehand skills in terms of hand grip strength and training interval. The purpose of the research is to determine whether there is an effect of the BOTELI training method on hand grip strength and training interval for improving rally groundstroke forehand skills, and the interaction between hand grip strength and interval in improving rally groundstroke forehand skills using the BOTELI method. The importance of this research lies in providing a reference method for tennis training that is enjoyable, effective, time-efficient, cost-efficient, and does not require an actual tennis court, it can be performed anywhere with a flat surface.

MATERIALS AND METHOD

Method

The method used in this study was an experimental method to determine the effect of independent variables on the dependent variable.

Participant

The sample in this study consisted of sports science students at FKOR UNS in the Coaching Education program in 2022. There were 48 male students divided into group A1 (training interval 1:1), group A2 (training interval 1:3), group B1 (above-average hand grip strength), and group B2 (below-average hand grip strength), with each group consisting of 12 students. The samples were male athletes who had sports backgrounds and were new to the game of tennis.

Variables and Instruments

The data collection technique used the Kem-Vincent Rally Test of Rally Skill for rally groundstroke forehand skills, with the norm of performing forehand rallies for 3 minutes, each sample's number of successful strokes was recorded. Hand grip strength was measured using a hand dynamometer. The manipulated independent variable in this study was BOTELI training with intervals of 1:1 and 1:3; the attributive variable was hand grip strength (above average and below average), and the dependent variable was rally groundstroke forehand skill.

Research Procedure

The procedure began with a pretest using the Kem-Vincent Rally Test of Rally Skill and a hand grip strength test using a hand dynamometer. After the pretest, the research samples were divided into factorial cells.

Table 1. Grouping of samples into research groups

Training Interval	Hand Grip Strength	
	Above Average (B1)	Above Average (B1)
1:1 (A1)	A1B1	A1B2
1:3 (A2)	A2B1	A2B2

A1B1: Interval training 1:1 and hand grip strength above average.
A1B2: Interval training 1:1 and hand grip strength below average.
A2B1: Interval training 1:3 and hand grip strength above average.
A2B2: Interval training 1:3 and hand grip strength below average.

Then the treatment was given using the BOTELI method with training intervals of 1:1 and 1:3, and ended with a post-test using the Kem-Vincent Rally Test of Rally Skill. This research was conducted at the Tennis Court of FKOR UNS for 8 weeks. The treatment in this study was rally groundstroke training using the BOTELI method with intervals of 1:1 and 1:3, with comparisons of hand grip strength above and below average. The treatment was conducted for 16 sessions. Each sample performed 300 rally groundstroke forehand strokes per session using the BOTELI method. The total number of strokes performed in each session was divided into: (1) hand catch stroke, (2) racket catch stroke, (3) rally groundstroke forehand using BOTELI. Each training session lasted for 3 hours.

Data Analysis

The data analysis technique used was a two-way ANOVA with a 2x2 factorial design. Data testing was carried out at a significance level of $\alpha = 0.05$ using SPSS version 26 for Windows. The data normality test used the Kolmogorov–Smirnov test, and the homogeneity test used Levene's test on rally groundstroke forehand skills. The data analysis results used a two-way ANOVA at a significance level of $\alpha < 0.05$.

RESULT

The results of the study were obtained from the final test of rally groundstroke forehand skills, which resulted from the BOTELI method training with intervals of 1:1 and 1:3 and hand grip strength above and below average. Thus, the total score of the rally groundstroke forehand skill test was influenced by training interval and hand grip strength.

Hypothesis testing using two-way factorial ANOVA 2x2 with SPSS version 26 for Windows showed that the results of the rally groundstroke forehand skill test of students are presented in the following table.

Table 2. Analysis of Variance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	98.417[a]	3	32.806	115.766	.000
Intercept	46500.750	1	46500.750	164094.846	.000
Interval	36.750	1	36.750	129.686	.000
HGS	56.333	1	56.333	198.793	.000
Interval * HGS	5.333	1	5.333	18.821	.000
Error	12.469	44	.283		
Total	46611.635	48			
Corrected Total	110.885	47			
a. R Squared = .888 (Adjusted R Squared = .880)					

The Effect of BOTELI Method Training on A to Improve Rally Groundstroke Forehand Skills

Based on the results of the analysis of factor A (interval), the 1:1 and 1:3 intervals had an effect on rally groundstroke forehand skills. This was proven by the significance value being smaller than 0.05, with a value ($0.000 < \alpha$ 0.05) and indicated by the F-value = 129.686 greater than F-table, with degrees of freedom 1 and 44, value 4.06 (F-count = 129.686 > F-table 4.06). H_0 was rejected, so it can be concluded that training using the BOTELI method with 1:1 and 1:3 intervals affects rally groundstroke forehand skills. Thus, it can be concluded that rally groundstroke forehand training with intervals 1:1 and 1:3 is better using the 1:3 training interval. This is proven by the average number of interval 1:3 (A2 = 31.96) being higher than interval 1:1 (A1 = 30.21).

The Effect of BOTELI Method Training on B to Improve Rally Groundstroke Forehand Skills

Based on the results of the analysis of factor B (HGS), hand grip strength above and below average had an effect on rally groundstroke forehand skills. This was proven by the significance value being smaller than 0.05, with a value (0.000 < α 0.05) and indicated by the F-value = 198.793 greater than F-table, with degrees of freedom 1 and 44, value 4.06 (F-count = 198.793 > F-table 4.06). H_0 was rejected, so it can be concluded that training using the BOTELI method with hand grip strength above and below average affects rally groundstroke forehand skills. Thus, it can be concluded that rally groundstroke forehand training with hand grip strength above and below average is better using above-average hand grip strength. This is proven by the mean value of above-average HGS (B1 = 31.17) and below-average HGS (B2 = 31.00).

The Effect of the Interaction between A and B on Improving Rally Groundstroke Forehand Skills

Based on the results of the analysis of factors A and B (interval * HGS), there was an interaction effect on rally groundstroke forehand skills. This was proven by the significance value being smaller than 0.05, with a value (0.000 < α 0.05) and indicated by the F-value = 18.821 greater than F-table, with degrees of freedom 1 and 44, value 4.06 (F-count = 18.921 > F-table 4.06). H_0 was rejected. Thus, the hypothesis test results proved that there was an interaction between training interval and hand grip strength in the BOTELI method on rally groundstroke forehand skills. To further clarify the interaction between training interval and hand grip strength, it can be seen in Figure 1.

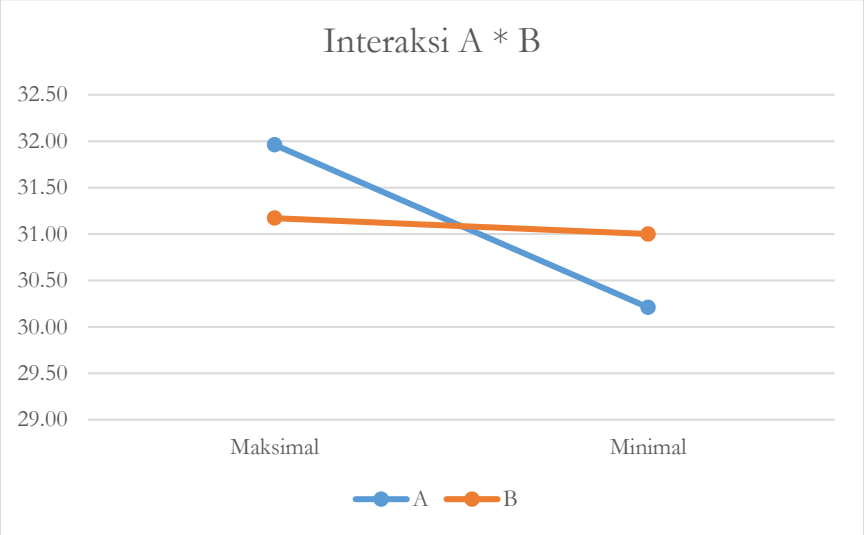

Figure 1. Significant Interaction between Training Interval and Hand Grip Strength

Previous studies have shown correlations with this research because they share the same goal of improving rally groundstroke forehand skills. Among several training methods to improve rally groundstroke forehand skills, the BOTELI method plays a very important role and accelerates the improvement of rally groundstroke forehand skills. The forehand groundstroke is a basic and frequently performed technique in tennis. New findings in this study also revealed that hand grip strength is very important for performing rally groundstroke forehands, and that training interval and grip strength interact to influence rally groundstroke forehand skills.

The BOTELI training method is an exercise using a tool designed to simulate real rally groundstroke strokes. In the BOTELI training method, initially, whole-part training is performed, starting with: (1) hand catch stroke, where the ball is dropped to the ground, hit, and caught by hand; (2) racket catch stroke, where the ball is bounced, hit using a racket, and then caught and controlled using the racket; (3) rally groundstroke BOTELI, where the ball is dropped to the ground, hit using a racket, and hit back again with the racket. Dividing movements before combining them into full actions makes it easier to learn the movement being studied (Alhejaily et al., 2023; Magill & Anderson, 2017). Part practice means learning a skill from specific to general. The advantage of part practice is mastering the skill correctly, minimizing errors, and producing aesthetically pleasing movements (Sánchez-Torres et al., 2021; Schmidt & Lee, 2014). Whole practice means teaching the entire movement directly. The skill is taught as a complete process first (Maudrich et al., 2022), then divided into components. Whole practice helps learn from general to specific movements, where the complete motion is introduced first and then broken down (Haibach-Beach et al., 2018; Pastel et al., 2023). The weakness of whole practice is that learners may not immediately perform the movement correctly (Goodway et al., 2021).

Training tennis forehand groundstrokes using the BOTELI method with intervals of 1:1 and 1:3 can improve rally groundstroke forehand skills. The contribution of the BOTELI method training with intervals of 1:1 and 1:3 can be clearly seen with the value (F-count = 129.686 > F-table 4.06). Training using the BOTELI method is simple, effective, time-efficient, cost-efficient, and can be performed in a home yard. Over 16 training sessions, with 300 strokes per day using intervals 1:1 and 1:3, coaches can improve rally groundstroke forehand skills. Interval 1:1 and 1:3 mean that for 1:1, two people use one BOTELI; for 1:3, four people use one BOTELI. The 1:1 interval arrangement means one person practices while one rests; 1:3 means one person practices while three rest. The BOTELI training method encourages open-skill training rather than closed-skill, since tennis requires a high level of open skill. Open skill is essential for racket sports such as tennis (Magill & Anderson, 2017). Every player hitting a ball from an opponent uses all their abilities (Figueiredo et al., 2022), facing unpredictable movements and creating varied motion patterns.

Using the BOTELI method does not require a real tennis court, as a minimum area of 4x10 meters is sufficient to practice with BOTELI. Therefore, to train 48 people in rally groundstroke forehand, only 18 BOTELI units and 2 tennis courts are needed, making it more space-, cost-, and time-efficient. In contrast, the traditional feeding method with 48 players would require 480 balls and at least 2 full courts. This comparison proves the efficiency of the BOTELI training method over the conventional feeding approach.

To improve rally groundstroke forehand skills, the BOTELI training method is more efficient and effective and does not require a feeder. Students who want to improve their rally groundstroke forehand skills need hand grip strength. Hand grip strength is essential when hitting the ball — if the grip is not firm, the ball will not go in the intended direction (Grant et al., 2022). People have different hand characteristics, from wide or narrow palms to large, small, long, or short fingers (Du et al., 2022). Each finger and the palm function for gripping, rotating, holding, grasping, pulling, and pushing (Seo & Lee, 2022). If the grip is too large, players with small hands may find it difficult to control. This study used a handgrip dynamometer to measure hand grip strength and to categorize participants above and below the average. The analyzed results showed that hand grip strength significantly affects the improvement of rally groundstroke forehand skills. The evidence is shown by the value (F-count = 198.793 > F-table 4.06). It is suggested that to improve rally groundstroke forehand skills, athletes should have an average hand grip strength of ±31.17 N.

The analysis of interval and HGS also proved an interaction effect influencing and improving rally groundstroke forehand skills. This is evidenced by the value (F-count = 18.921 > F-table 4.06). In tennis, the most dominant basic technique used is the rally groundstroke forehand. Rally groundstroke forehand can be efficiently and effectively trained using the BOTELI training aid. The results of the interaction analysis are also shown in Figure 1. Training rally groundstroke forehand intervals and hand grip strength with the BOTELI method shows that training intervals affect rally groundstroke forehand skills, and hand grip strength also has an influence on rally groundstroke forehand skills.

CONCLUSION

The purpose of this study was to determine the effect of BOTELI training on interval and hand grip strength to improve tennis rally forehand groundstroke skills. Empirically, training using the BOTELI method proved to be efficient, effective, independent, simple, safe, enjoyable, and efficient in terms of time, space, and training cost. In addition, training using BOTELI develops open skill, as the ball's rebound direction is unpredictable, similar to a real rally with an opponent. The BOTELI training method can improve ball feeling, ball control, and ball adjustment skills for developing reception and direction skills. Ball reception and direction are two crucial skills in tennis. The contribution of BOTELI training intervals 1:1 and 1:3 can improve rally groundstroke forehand skills. Training with the BOTELI method is simple, effective, time-efficient, and cost-efficient, and can be performed even at home. The contribution of hand grip strength in training using BOTELI can also improve ball feeling and ball control. The novelty of this research lies in the effect of hand grip strength on rally groundstroke forehand skills and the interaction between training interval and hand grip strength. Future research is recommended to develop BOTELI training models with variations in the length of the ball-tethering string.

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