12 (2) (2023) 237 - 243
Journal of Physical Education, Sport, Health and Recreations
http://journal.unnes.ac.id/sju/index.php/peshr

Coiling Exercises Effect On Tennis Spin Serve

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Article History

Received Jun 2023
Accepted Jun 2023
Published Vol.12 No.(2) 2023

Keywords:
Evaluation; Achievement Development: Martial Arts.

Abstract

The biggest problem raised by this study is that the first serve is only counted as a stroke at the start of the game. When it comes to tennis, service is crucial since it is a quick way to score points. One crucial aspect of a tennis spin serve is the ability to coil or rotate the body. This study aimed to analyze the increase in coiling during tennis spin serve exercises. The research method used is a quantitative descriptive research method on subjects of as many as 30 male beginner tennis players from South Sulawesi with an age range of 14-16 years. The study was conducted for 8 weeks on the tennis court at the Faculty of Sports Science and Health, Universitas Negeri Makassar. In the first and last weeks, pre-test and post-test coiling spin serve tennis were analyzed using the Kinovea application. This tennis coiling spin serve exercise is carried out three times a week. The results of the exercises carried out showed an average increase of 1,267. So it can be concluded that coiling exercises can improve tennis spin-serve abilities among novice athletes in South Sulawesi.

How to Cite

Aprilo, I., Hakim, H., Arfanda, P. E., Susilo, & Halim, A. (2023). Coiling Exercises Effect On Tennis Spin Serve. Journal of Physical Education, Sport, Health and Recreation, 12 (2), 237-243.

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p-ISSN 2460-724X
e-ISSN 2252-6773

INTRODUCTION

Tennis is one of the sports competed in the Olympics. Tennis is a very popular sport among different social groups and of all ages and many tournaments are held based on classifications of ability, class, age, and gender. Not only for normal people but tennis tournaments are also intended for people with disabilities who use wheelchairs (Personnel & Obligations, 2013; Sanz & Sánchez, 2017). Tennis can also be played as a recreational event by millions of people and is a popular sport with many spectators around the world. The four famous tennis championships in the world are the Australian Open and the US Open which are played on hard courts, the French Open which is played on clay courts, and the Wimbledon which is played on grass courts. This tennis sport is also a very famous sports game in Indonesia.

Tennis as a competitive game requires a tennis player to practice good techniques and strategies to be successful, especially service skills as a starting weapon in addition to groundstrokes. Along with the development of science, knowledge, and technology in the field of sports, the game of tennis cannot be separated from this. In tennis training, a player must be able to improve his skills and minimize the risk of injury. This is something important, so achieving this goal requires synchronization of interactions between the ball, racket, and players. Which can be measured through the trajectory of the ball and the player, the strength of contact between the ball and the racket, and the speed of hitting and spinning the ball (Yu et al., 2022; Wu, 2021).

Tennis is a sport that requires skill and physical strength together. Tennis skills can only be achieved through routine technical training and per section, but in practice, it is a series of movements that cannot be separated. Various commonly used training techniques such as examples of direct movements or exercises with pictures and videos have been proven to improve the skills of tennis players (Aprilo et al., 2021). The use of technology in training helps coaches train players effectively so that performance can be improved through efficient movement. This helps players perform exercises recommended by a particular coach and monitors the effectiveness of routines based on the adopted training method (Dhinesh et al., 2018). On the other hand, with the development of science and technology in the field of sports, many of the latest scientific discoveries are incorporated into the development of tennis training, which can be used by coaches as a reference for training programs and is useful for players to improve their tennis skills and minimize the risk of injuries to the elbows, wrists, back, hips, knees, ankles, thighs and calves. The mechanism of injury occurs in part due to receiving the ball, hitting the ball, falling, spinning, hitting, jumping, going far, holding the racket, and running (Kaiser et al., 2021).

Several biomechanical studies on increasing the efficiency of body movements when performing movements related to power have become very important research topics to be developed, especially serves. To achieve effective, efficient, and powerful movements, various attempts have been made to develop training models. Because of this, many studies in biomechanics have been developed, specializing in high-performance tennis serves. Many factors influence the results of a good serve, including horizontal racket speed which consists of the backswing preparation process, foot posture, trunk rotation (hips and shoulders), racket rotation, swing style, body alignment, and ball toss are all important factors to consider. According to Elliot B, the next step is forward swing, which is desired for leg drive, maximum external rotation, shoulder and arm alignment, trunk rotation, weight transfer, non-racket arm tuck for trunk rotation, shoulder flexion, elbow extension, shoulder extension, shoulder internal rotation, and wrist flexion; the next step is follow through, which is desired for internal rotation, loading (foot and court position), and racket (strings, impact position)(Aprilo, 2022).

The start of a tennis game is always preceded by a serve, therefore, the serve is considered the most important shot in tennis. Service movement efficiency is the first advantage to get points (Aprilo et al., 2021). Serve in tennis is a weapon to score points quickly at the start of the game. A good service is a service that makes it difficult for the opponent to receive it or even return it, this allows the server to get an ace at the start of the game. Efforts to improve tennis serve are not only determined by the right pattern of training but also require the right assessment tool that can evaluate by showing the weaknesses of the movements performed, as well as solutions and patterns of exercises carried out with existing limitations.

Tennis serving techniques are classified into three categories: prefix, stroke, and follow-through. The coiling, ball toss, and backswing in preparation operations are then separated from the prefix process. When stroking the ball, there is uncoiling and a striking zone. The final phase consists of this follow-through and fall-in. The overall serving movement pattern phase can be summarized as follows: coiling, ball toss, backswing, uncoiling, strike zone, follow-through, and fall-in (Aprilo et al., 2022). To execute a perfect serve in tennis, the accuracy of the ball and the position of the player's body is critical and determine the final result, which can be measured in a variety of ways, including the trajectory of the ball's movement and contact between the ball and the racket, as well as the speed of hitting and spinning the ball (Yu et al., 2022).

This study focuses on the implementation of movement coiling or body rotation which aims to train body rotation patterns while maintaining balance. Before tossing the ball, the server must rotate his or her body. This torso rotation incorporates slightly bent knees and hips, with the rotation of the shoulders being the major emphasis (Aprilo et al., 2019). The process of implementing the spin tennis serve pattern involves many body segments and must adhere to human body mechanics (biomechanics), such as body rotation, hip rotation, throwing arm extension and arm rotation, body and hips, flexion from the forearm to upper arm; forearm extension and pronation. This is the moment to rotate the body so that the spring force can divert energy away from the lower limbs (Aprilo et al., 2022). To find out whether the coiling movement is correct or not, the researchers conducted an analysis using the Kinovea application.

Therefore, this study examines the analysis of tennis serve coiling spin using the Kinovea application for beginner tennis players aged 14-16 in South Sulawesi.

METHODS

The research approach used is the qualitative method. The approach is a naturalistic qualitative approach. The qualitative method is research that intends to understand a phenomenon that occurs both in terms of behavior, perception, comprehensive and holistic with a description using words, and the results of the research are naturally based on findings in the field (Sugiyono, 2010). The process of collecting data in this study researchers used the method of observation, interviews and documentation (Rumini, 2015). This research design used the Stake model through three phases Antecedent, Transaction, and Outcomes. The primary data source in this study was the results of interviews conducted by researchers with administrators, coaches, athletes, and related stakeholders. The data analysis technique used was based on an interactive analysis model developed by (Miles, M. B., humberman, A.M., & Sldana, 2014) data analysis comprised 4 interacting components namely, Data Collection, Data reduction, Data Display and Conclusion. The four components are a continuous cycle.

RESULTS AND DISCUSSION

This study included 30 male beginning tennis players aged 14 to 16 years old from South Sulawesi. The results of the descriptive analysis of physical condition data including trunk rotation and balance as supporting data in the implementation of coiling spin serve tennis are presented in **Table 1.**

Table 1. Descriptive Statistics of Coiling Supporting Body Components

	N	Min	Max	Range	Mean	SD	Var
TR*	30	6.5	12	5.5	8.32	1.52	2.32
DB	30	50	83	33	72.03	8.32	69.14

*TR: trunk rotation
DB: dynamic balance

Table 1 illustrates the trunk rotation conditions with a minimum value of 6.5, a maximum value of 12, a range of 5.5, a mean of 8.32, a standard deviation of 1.52, and a variance of 2.32. For dynamic balance the minimum value is 50, the maximum value is 83, the range is 33, the mean is 72.03, the standard deviation is 8.32 and the variance is 69.14.

For the tennis coiling spin serve data, the statistical descriptive results are obtained in **Table 2.**

Table 2. Descriptive Statistics

	N	Sum	Means	SD	Var
Pretest	30	49.00	1633	.49013	.240
Post-test	30	87.00	2,900	.66176	.438

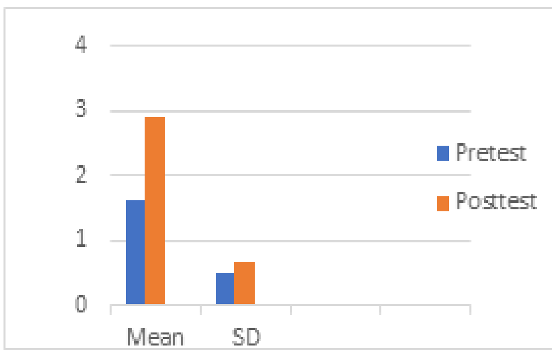

Figure 1. Improved Coiling Tennis Spin Serve

Table 2 and **Figure 1** illustrate that, of the 30 participating subjects, the sum was 49.00 before the coiling training was given and it increased to 87.00 after the coiling training was given. The initial mean was 1.633 increasing to 2.900, and the standard deviation increased from 0.49013 to 0.66176. and the variance increased from 0.240 to 0.438.

The purpose of this research is to explain the exact kinematics of the coiling spin tennis serve on the first serve and to get the maximum speed of the ball passing through the net and entering the opponent's court so that the opponent finds it difficult to return it. This is because correct service skills and maximum speed are important so that players get points and can win easily (Doewes & Nuryadin, 2022). Tennis is a sport that requires the ability of complex physical components such as linear sprints and changes in speed, agility, muscle strength, and cardiovascular fitness to achieve high levels of performance (Fernandez-Fernandez et al., 2021; Fernandez-Fernandez et al., 2018).

Serves are a quick way to earn points quickly, so they must be done accurately and precisely. Serve plays an important role in the outcome of a tennis match, allowing players to win points outright with an ace or dominate a rally from the start. Serves must be made with an eye on ball sharpness and high precision, full power, and biomechanics compatibility (Fernandez-Fernandez et al., 2021; Hoskins-Burney & Carrington, 2014; Vaverka & Cernosek, 2013). A fast serve will affect your opponent's reaction time and can outwit the return of the ball (Hornestam et al., 2021; Hayes et al., 2021). Serving from a higher position can increase the target area's viewing area and increase target opportunities, increasing the chances of hitting faster and passing the ball better (Dossena et al., 2018). The success of the serve is also determined by the variation in the serve (eg using a different spin) and its placement in the service box (F. Vaverka & Cernosek, 2016; Sakurai et al., 2013).

Serves are perfect for scoring points easily because they have a high probability of going over the net and bouncing the ball well outside the attacking area (Aprilo et al., 2019). Previous studies have shown that the average tennis spin serve rose from 40.12% to 70.83%. The increased results were analyzed biomechanically and it was found that movements that emphasized leg flexion, hip rotation, body rotation, and effective arm rotation and shoulder rotation contributed greatly to the increase (Aprilo et al., 2021). The results of other studies also explain that when preparing for a tennis serve, more dominant knee flexion is needed to get better serving results (Hornestam et al., 2021). The tennis serve is the only tennis stroke without counter-influence that allows the player more control over the entire movement pattern and requires precise coordination throughout the kinetic chain to achieve serve speed (Palmer et al., 2018; Martin et al., 2014).

Coiling or turning the body is the first step before serving. The server must make sure to make a twist before throwing the ball into the air. These rotations include knee and hip movements, but the most important are shoulder rotations (Aprilo et al., 2019). The most important thing in coiling is getting your body in sync with the movement. The results of previous studies proved that the results of coiling exercises increased from 54.11% to 72.50% (Aprilo et al., 2021). In the implementation of lower extremity coiling is the basis of the kinetic chain of tennis service. Therefore, lower limb movement becomes important to start channeling energy to the trunk, upper extremities, and rackets. Knee flexion greatly affects the greater rate of knee extension during the preparation phase of the serve, due to the application of acceleration over a longer period. This knee flexion results in efficient locomotion of the lower limbs due to the large amount of mechanical energy in the body. So there is a positive correlation between maximum knee flexion and racket impact height with the ball at service speed and racket height (Sgro et al., 2013).

In sports and motion science, we always talk about kinematic chains. The kinematic chain describes the proximal-distal motion produced by the body segments; In a tennis serve, the kinematic chain starts with plantar flexion of the foot and ends up with the racket. An important performance result related to chain kinematics is the principle of speed change. Several studies have used kinematic analysis of tennis serves in 2D and 3D dimensions. In most of the previous studies, analysis of motion kinematics has been associated with specific performance outcomes (eg, pile firing velocity, performance time, impact height). Tennis coaches and sports scientists agree that an effective serve depends on the height of the stroke and the speed after contact of the ball with the racket (Sgro et al., 2013).

This study shows that the trunk rotation of South Sulawesi beginner tennis athletes is in a good category. Trunk rotation is related to performance and risk of injury in dynamic sports movements. In this context, body movement refers to the movement of the segment that connects the chest and abdomen to the pelvis. The trunk has a very important role in maintaining the stability of the human body because it consists of large muscle groups which are responsible for the movement of the upper and lower limbs. Trunk rotation is very helpful when releasing the ball while throwing the ball up. Trunk rotation during dynamic sports movements is critical to increasing our understanding of the role of physical exercise in sports performance as well as sports injuries.

A study conducted by Brouwer stated that all female and male participants' centers of gravity rotated during the loading stage, as did all joint angles (shoulder, elbow, knee), the center of mass displacements, and rotations. From loading to completion, there are several stages. During the ball contact stage, articular moments (mid-trunk, upper-trunk, shoulder, elbow, and wrist) and segmental contributions (pelvis linear, pelvic rotation, trunk, shoulder, elbow, and wrist) moved in synchronization (Brouwer et al., 2021). In short, it can be explained that propulsion starting from the feet until the rotation of the body occurs is very important for the momentum of the movement starting from the feet to the upper limbs, until the ball collides with the racket. This trunk rotation measurement assumes that there are still many samples in which the participants maintain a static position during the measurement, which can be considered a limitation of the study.

The trunk, also known as the core, consists of the rectus abdominous, transverse abdominous, internal and external obliques, and erector spinal muscles and contributes approximately 50% of the total generated kinetic energy. Ellenbecker and Roetert discovered a significant positive relationship between trunk rotation and flexion strength, as well as groundstroke velocity. Athletes are usually portrayed in an arched position (lateral flexion and back extension when the ball is released from their ball toss hand) during the preparatory phase coiling of the serve. Eccentric activation of the anterior trunk is required to prevent excessive back extension, but it also helps to maintain dynamic balance, which is supplemented by flexing the knees and ankles. For example, by the end of the coiling phase, right-handed respondents left external obliques showed a significant level of activity. Professional athletes have larger trunk angular momentum than their amateur counterparts, resulting in faster serving speeds (Williams, 2021). Angle accuracy in doing trunk rotation also affects the speed of service performed (Brocherie & Dinu, 2022). A similar study was also conducted to determine the relationship between upper extremity and trunk movement in tennis spin serves (Murata & Fujii, 2022).

Tennis asymmetric trunk muscular activity can result in asymmetries in rotational muscle strength and endurance from side to side. Rotational power in the trunk, on the other hand, is a better predictor of athletic performance. Given that tennis players of different weights have significantly higher trunk rotational power on the dominant side than the non-dominant side, and that there are no significant side-to-side differences in a control group of fit individuals, this parameter may be attributed to their asymmetric loading during trunk rotations (Zemkova et al., 2019). Because load transmission occurs synchronously via the muscular chains that contribute to the development of the gesture, a good serve begins at the base of support. During the serve, support features such as foot pressure force, power, and center of gravity might lead to a better understanding of the technical gesture (Alfonso-Mora et al., 2019; Abrams et al., 2014).

In dynamic sports, every body movement that is carried out cannot be separated from the risk of injury, especially injuries to the lower limbs, upper limbs, and spine. Dynamic sports body movements have traditionally been measured using optical motion capture. But now several tools or applications have been developed that can measure body movements in dynamic sports (Brouwer et al., 2021; Saini et al., 2020).

To be able to perform an effective and efficient tennis spin serve, players need agility, flexibility, and good balance as well as good body coordination. Agility training including trunk rotation and balance allows players to move more quickly across the court and change direction quickly while maintaining body control. Bashir et al (2019) have conducted research that aims to determine the effect of trunk training programs on dynamic balance and mobility. The result is that there is a significant difference between the results before and after the test.

In tennis spin serve balance exercises must be done continuously, to train control of the lower extremities and upper extremities separately. Therefore, gaining a better understanding of how balance and end-effector control can properly interact with each other is essential to support training development. This balance training must be done for sports that are dynamic and complex, such as spin-serve tennis. This is based on the speed of movement of the whole body which is carried out simultaneously with the shifting of the footholds and the acceleration of motion which affects balance, especially in the torso and upper extremities (Jamkrajang et al., 2020).

This study states that coiling exercises which are carried out three times a week can improve coiling spin serve tennis skills which are supported by trunk rotation and dynamic balance skills. The results of this coiling movement were analyzed using the Kinovea application.

CONCLUSION

From the results of the study it can be concluded that with regular training three times a week, the ability to coil tennis spin serve of beginner tennis athletes aged 14-16 years in South Sulawesi can be improved properly. Therefore coiling exercises can be used as an alternative exercise to improve tennis spin serve for beginner tennis athletes.

This study still uses a very small sample, so the results of the study can only be applied to research subjects with the same characteristics as the sample in this study, namely beginner tennis athletes aged 14-16 years. Likewise, when measuring body rotation, it is assumed that there are still many samples that maintain a static position during the measurement. This is a research limitation in this study, which encourages researchers to continue further research by analyzing movement patterns, supporting movements, and with a larger and wider sample, both gender and in terms of age.

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