

**Kinovea-Based : Tennis Spin Serve Analysis****Ians Aprilo^{1✉}, Moch. Asmawi², James Tangkudung³**Department of Physical Education and Sport, Universitas Negeri Makassar, Indonesia¹Department of Physical Education and Sport, Universitas Negeri Jakarta, Indonesia²³**Article History**

Received March 2022

Accepted June 2022

Published Vol.11 No.(2) 2022

Keywords:

Spin Serve; Kinovea; Tennis

Abstract

The purpose of this research is to describe the mastery level pattern of movement spin service in lawn tennis using kinovea motion analysis tools. Spin serves are chosen to be analyzed because this type of spin service is still difficult for some tennis players. While more and more service masters will have a chance of winning the match. This study used a sample of professional tennis athletes aged 14-16 years and the sampling technique used is purposive sampling. The descriptive method is used in this study and the data analysis technique used is descriptive statistics. The procedure of this research, the sample performs a spin service, and a video is recorded, then analyzed using the kinovea motion analysis application. Analytical guidelines refer to instrument assessment of the movement patterns of the lawn tennis spin service. The results showed that 34% of tennis athletes belonged to the high category, 58% classified as moderate category, and 8% classified as low category, while the mastery rate of each stage of the spin service pattern was obtained low category at the ball toss stage 44%, medium category at coiling stage 54%, back-swing 71%, uncoiling 61%, strike zone 71%, and fall in 83%. The follow-through stage got the highest category of 92%. Based on the results of this study, it can be concluded that the average athlete's spin service is in the medium category, and there is a small part included in the high category.

How to Cite

Aprilo, I., et al. (2022). Kinovea-Based : Tennis Spin Serve Analysis. *Journal of Physical Education, Sport, Health and Recreation*, 11 (2), 79-85.

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p-ISSN 2460-724X

e-ISSN 2252-6773

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INTRODUCTION

The first stroke that signals the start of a match or game in tennis is known as a serve. Serve at first only as of the opening stroke in the game of tennis. At first, the service was not done to get points, if getting a point is an element of luck beyond the potential of the value of the service itself. The development of the era and sports science and technology have changed the service paradigm into a very powerful weapon in determining victory. The serve becomes a lethal weapon to get points early briefly and without a long rally, that which is known as an "ace" where the receiver is unable to reach the opponent's serve (I. Aprilo et al., 2019; Hoskins-Burney, 2014; Keller et al., 2021; Williams et al., 2012; Meffert et al., 2018).

The service will be more important for players who have a relatively higher height will give the angle of the ball tends to be sharper, so it is more likely to in service area, and very sharply slide to the side of the out of the court or into the middle zone of the court (Hornestam et al., 2021; Vaverka & Cernosek, 2013).

The technique of the service stroke pattern can simply be divided into three main parts, namely starting, hitting the ball, and ending. Furthermore, the prefix process, consists of a preparation process for coiling the body clockwise (righthanded), throwing the ball up, and swinging the racket backward. In the process of hitting the ball, consisting of the process of returning the body counterclockwise, and motion of hitting the ball, and the final stage, consisting of a follow-up movement and front foot landing on the court. The stages of the service motion pattern can also be summarized into coiling, ball toss, backswing, uncoiling, strike zone, follow-through, and fall in (Giampaolo & Levey, 2013; Martin et al., 2014).

The process of performing a tennis service stage pattern involves several body segments, and must be by the movement pattern of human body mechanics (biomechanics), including; body rotation, pelvic rotation, an extension of the throwing arm, and hitting arm, body, and hip rotation, flexion the hit forearm, until it is close to the upper arm; extension and pronation of the forearm (Abrams et al., 2014).

The success of the service on the lawn tennis can be influenced by several factors, one of them as height. Previous research has shown that height correlates with service speed in lawn tennis (Vaverka & Cernosek, 2016). The results of previous studies also explained that when preparing for a tennis service, greater knee flexion was

needed to get better service performance (Hornestam et al., 2021). The other previous research too also explain in more detail that servers that have a higher height have the advantage of achieving higher arm angles in producing service ball speed (Martin et al., 2013). All of the basic serving techniques in court tennis, basically are the same. The difference is the ball toss and impact ball and racket (Carboch, 2016; Carboch & Süss, 2015; Giampaolo & Levey, 2013).

For this reason, a special training model and evaluation of the spin service are needed so that athletes can master the spin service. In addition, the types of services are also a supporting factor for the success of the service in getting points. In this case, the receiver will find it difficult to predict the direction and character of the service that will be made by the opponent (Tea & Swartz, 2022). Thus, athletes or lawn tennis players should master various types of services in the tennis court, namely flat, slice, spin or some call it to kick service.

This study aims to get an overview of data mastery of the movement patterns of the spin of professional lawn tennis athletes. Furthermore, there will be known weaknesses and find the right solution as an effort to improve in the future. Kinova was chosen as an analytical tool because it suits the needs, is very economical, and is easy to use. There are many other motion analysis applications, but they require very expensive tools and costs and are very complicated to operate. Kinovea has been widely used in various previous studies for example; measuring the angle of the ankle when walking (Hisham, N. A. H. et al., 2017). The reliability of kinovea in measuring the relative angle of the knee in the drop jump movement (Nor Adnan et al., 2018). Measures cervical range of motion in the frontal plane (Nor Adnan et al., 2018), measuring shoulder range of motion (Abd Elrahim et al., 2016), furthermore, the kinovea program has been tested for validity and reliability in obtaining the dimensions of angles and distances (Puig-Diví et al., 2017).

Kinovea has also been used in previous studies to analyze the kinematics of deep serve related to upper extremity movement and the position of throwing the ball up (Hartoto et al., 2021). In this study, kinovea is used to analyze motion to be more accurate, rather than observing directly, especially to assess the movement pattern of spin serves. For service efforts, this research uses a guideline for assessing the spin service motion instrument which is also the result of the kinovea application assistance (I Aprilo et al., 2021). This instrument is specifically for asses-

sing the pattern of spin serve motion in kinovea-based court tennis. Thus, the results of the study will be more accurate in assessing the movement pattern of the spin service on the lawn tennis. The question in this research is how to master the movement pattern of spin serve athletes?.

METHODS

The type of research method used is descriptive quantitative with a sample of 12 professional tennis athletes aged between 14 to 16 years, and purposive sampling is used in the sampling technique of this study, as well as the data analysis technique used is descriptive statistics. The research procedures that have been carried out are as follows; First, diagnosis and analysis are done

referentially about the correct spin service motion pattern, and kinovea motion analysis is used in the process. Third, 3D cameras are used to record athletes when the spin serve is performed three times and records from the front, back, and topsides. Fourth, kinovea is used to analyze data records and an assessment is carried out according to the tennis spin service assessment instrument. Fifth, computer statistical analysis is used to calculate descriptive statistics to provide high, medium, and low categories. The instrument for assessing the motion pattern of the tennis spin service used **Table 1**.

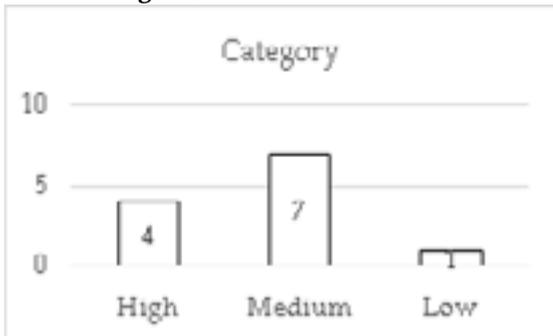
The assessment procedure carried out according to the instrument mentioned above is that each number of indicators is assessed with 1 point, so in the first stage the maximum point.

Table 1. Spin service test instruments (adapted from Aprilo et al., 2019).

Service stage movement	Indicator	Description	
Coiling	Shoulder joint	Both the right and left shoulder joints rotate clockwise (righthanded) and vice versa.	
	Counter twisting motion on the body	Back Angle	Back angle or back arched
		Pelvic Rotation	The waist rotates clockwise (righthanded) and vice versa.
		Feet	Both feet are firmly on the floor, right foot in front and left foot behind (right hand) and vice versa.
Ball toss	Throwing arm joint angle	Straight elbows up to 180 degrees	
	The motion of throwing the ball up	Arm angle when releasing the ball	The arm angle is around 135 degrees
		Throw the target	The goal of throwing the ball on the left is slightly behind the head (righthanded) and vice versa.
Back-swing		The swinging motion of the hitting arm	Circular in front of the body
	Hitting arm motion	Stage One arm angle	The arms form a 90 degrees angle, and the elbows are also 90 degrees
		Stage two elbow joint angle	Close elbow angle
Uncoiling		Angle of both legs	The angle of the knee is bent about
	Twist action on the body	Both shoulder joints	Rotate counterclockwise (righthanded)
		Back angle	Straight
		Hip rotation	Rotate counterclockwise (righthanded), until it faces the net
Strike zone		Arm swing	Reach forward until elbow joint is straight 180 degrees, and forearm pronation Rotate counterclockwise (right hand) straight. Turn counterclockwise (right hand), until it faces the net
	Hitting motion	Ball Impact	On the 7 o'clock side to 2 o'clock on the ball, and the ball spins forward
Follow-through	Follow-up movement after hitting the ball	Hitting arm swing	Circular after impact on the deltoid axis to the left side of the body and meet right and left (righthanded) and vice versa.
		Body position	Body position leaning forward and floating in the air
Fall in	Landing in the court	Position of both feet	The left foot lands on the court until the knee is bent, and the right foot is lifted (righthanded) and vice versa.
		Body position	Body position leaning forward

RESULTS AND DISCUSSION

The results show that the value of the seven stages of the spin serves motion pattern from each athlete, the total value obtained is the average value of 13, the standard deviation of 1.08, and the total value of 157. The mastery of athletes at each stage of the service movement pattern is classified as high as many as 7 athletes, moderate as many as 4 athletes, and low by 1 athlete, as shown in **Figures 1**.



Figures 1. Mastery of spin service

Figures 1 was a bar chart of the results of statistical analysis that describes the category of athlete's spin serve ability which was divided into three categories namely; in the high category there were four athletes, the medium category had seven athletes, and the low category had one athlete.

Furthermore, in **Figure 2**, it can be seen in terms of the percentage of athlete's spin service mastery which in the high category is 34%. For the medium category, the score was 58%, and for the low category, the score was 8%. This means that more athletes master the spin serve in the medium category than in the high category.

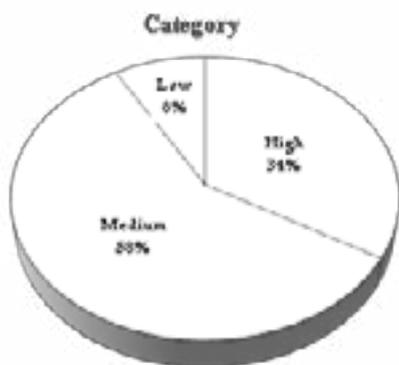


Figure 2. Mastery Of Each Stage Movement

Figure 2 was a statistical calculation that had been generated to describe the spin serve ability category in percent calculation.

In the analysis, it is also known the weakness of tennis athletes when spin serves are performed. This can be seen in **Figure 3**. Successively, for each stage of the motion pattern, the coiling number is 54.11%, ball toss is 44.9%, the backswing is 71.15%, uncoiling is 61.13%, the strike zone is 71, 15%, follow through 92.19%, fall in 83.18%. The highest mastery of the spin service stages is the follow-through. For coiling, uncoiling, backswing, strike zone, and fall in in the medium category, and ball toss is the lowest service stage mastered.

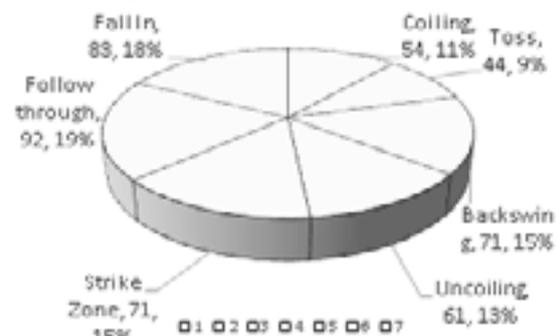


Figure 3. The Seven Stages of Spin

Figure 3 was the result of statistical calculations that had been carried out in the form of a percentage, regarding the ability of the spin service motioned based on each stage of the service motioned which consists of seven stages, namely; coiling, ball toss, backswing, uncoiling, strike zone, follow-through, and fall in.

Thus, based on **Figure 3** above, it could be seen that the stages of service motioned controlled by the high category were follow-through, the medium category was coiling, backswing, uncoiling, and strike zone. For the low category was ball toss. More details could be seen in **Table 2** below;

Table 2. Categories of mastery of spin service

	Category		
	Low	Medium	High
Ball toss		Coiling	Follow-through
		Backswing	
		Uncoiling	
		Strike zone	
		Fall in	

Based on the results **Table 2** of the analysis obtained, athletes have more control over the stages of follow-through motion in the process of performing spin serve. This type of spin service is the same as in other types of tennis services (flat

and slice). Therefore, the highest value is at the spin service pattern stage of the follow-through stage. It does not affect basic Techniques on various types of services. So even though athletes rarely use spin serve, they can still perform the follow-through service stages well, which in this study belongs to the high category. In contrast to other service stage techniques, such as in the medium category (coiling, backswing, uncoiling, strike zone, and fall in), the characteristics are slightly different from other types of service, especially in the spin service. At the coiling and backswing stages, they have similarities with each type of service, it is useful for twisting the body so that it has a spring force to transfer energy from the lower limbs, while at the backswing stage it is the beginning of the arm swing backward before proceeding to the strike zone stage.

At this stage of the strike zone, there was little difference between this type of spin service and the others. To maximize the rotation of the ball during the strike zone, there was a rotation of the shoulder joint so that pronation occurs in the forearm. When the impact of the racket with the ball occurs right at the side slightly behind the side of the head, it would have the advantage of longer friction between the ball and the racket. It was different for the flat typed of service, during the strike zone the arm swing could immediately straighten the elbow joint and ends with a pronation movement of the forearm, at the time of impact the flat typed ball did not require high rotation but had high ball speed characteristics to produced gliding bounced. The typed of slice service also had differences at the strike zone stage. This type of service requires a fastball rotation so that the ball bounces off the court (righthanded). For this reason, when impacting the ball with the racket, it must be swiped on the right side of the ball. The difference with the typed spin service lay in the direction of the ball rotation, the typed spin service rotates the ball towards the diagonal front, while the slice service typed had a sideways rotation of the ball.

At the uncoiling stage, this was the basic technique used for all types of services, both flat, slice, and spin (Giampaolo & Levey, 2013). The uncoiling stage which was turning the body backed counterclockwise and this was a compensation due to the coiling motioned stage, at the beginning of gathering momentum from the lowered leg. This was also the process of transferring energy to the hitting arm area (Talaat et al., 2015). Fell in was the final step off the stage of each type of service. At this stage, the front foot (left foot for righthanded) lands right within

the baseline, or in the court area, and was followed by the backed foot, which at this stage results from the release of maximum energy during the strike zone of the body there was an upward spring force so that occurs hovering in the air, and landing right in the court (fall in). The lowest service stage mastered in this study was the ball thrown. The stage of the motioned pattern was a distinguishing feature and was a characteristic of each type of service. Thus, athletes who rarely used spin serve could still perform these motioned stages even though they were not perfect, and in this study were classified in the moderate category. The results of the analysis of the stages of service motioned that were the lowest mastered in this study were ball tossed. The results of the analysis of the stages of service motioned that were the lowest mastered in this study were ball tossed. A ball tossed was a ball tossed up that was made at the time of service at the same time as the start of the backswing movement each typed of service had a different throwing angle (Carboch, 2016). This typed of spin service had the direction of throwing the ball slightly to the left behind the head (righthanded). This was also a characteristic that distinguishes spin services from flat and slice services. Therefore, for those who were not used to or even practiced seriously, it had been difficult to display the pattern of the stages of a ball-tossed spin motioned in tennis. If you did not do the ball tossed stage perfectly, then the ball with the racket would not be perfect at the time of impact, producing a fast spin. This was what characterizes the typed of spin service, which was that it had a high bouncing power and was directed out of the field (righthanded) (Sakurai et al., 2014).

The results of this study explained that athletes rarely used spin services, on average they used flat and slice services. This was also supported by a service training pattern that only emphasizes the severity of the serve. Hard serve was only produced on the flat serve typed, so they prefer to practice monotonously. Flat serve practiced rather than spin serve or even slice typed. There were several disadvantages if the player only had one type of service. Opponents would more easily read your services and even easily broke your serve. In contrast to players who had or master all three types of service, the opponent would have difficulty anticipating what type of service he would receive, because each typed of service had its character of the ball's bouncing power (Kolbinger & Lames, 2013). Another reason for the infrequent use of this type of service, apart from having a slow speed characteristic,

was that it was difficult to perform this type of service. Spin typed serve was more in the use of energy and besides that, the athlete must have spinal flexibility and good balance. This was also the supporting driving forced in producing a whip on the forearm when pronation and leading to the impact racket sliding the ball forward.

CONCLUSION

Based on the results of this study, it can be concluded that the average athlete's spin service is in the medium category, and there is a small part included in the high category. This can be because the spin service is not mastered so it is rarely used and never even uses. For this reason, it needs to be reactivated to be able to master all types of services, whether flat, spin, or slice. To get perfect results, use kinovea motion analysis as a tool to evaluate weaknesses and to get the right solution.

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