



Analysis of serve and first shot sequences in U-12 and U-14 tennis players

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ABSTRACT

Stroke sequence analysis in junior tennis helps identify patterns of play and could help improve the performance of players in formative stages. The purpose of the study was to analyze the sequences of serve and third shot (serve +1) in elite youth tennis, in the men's U-12 and U-14 categories. The direction of the serve, the position of the players when executing the third stroke and the direction in which they send the ball were evaluated. It was found that U-12 players have less effectiveness in second serves. The location of the shots varies depending on the category and the situation of the game. The importance of training service sequences and first shots to improve performance in junior tennis is highlighted.

Key words: notational analysis, junior tennis, stroke sequences, sports performance.

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INTRODUCTION

In tennis, various game situations can be analysed through notational analysis, which has become particularly important for tactical assessment in sport (Gillet et al., 2009). This methodology provides objective and accurate data that is essential for coaches to provide effective feedback to players and improve their performance (Martínez-Gallego, 2015).

Notational analysis provides significant details about tennis dynamics, highlighting that most points are decided in the first point rallies (Carboch et al., 2018; Fitzpatrick et al., 2019; Klaus et al., 2017). These findings underscore the critical importance of a powerful serve and dominating from the first shots. The first serve, due to its high speed, generates a significant advantage, forcing the returner to do it outside the court and creating open spaces for the next shot, as observed (Kovalchik & Reid, 2017; Reid et al., 2016). This results in the percentage of points won on the first serve being significantly higher than those won on the second serve (Gillet et al., 2009).

In the specific case of junior tennis players, previous studies indicate that there are gender differences in the execution of the serve, influenced by age and experience. More experienced players tend to direct their serves towards the corners, while more novices prefer to direct them towards the opponent's body (Hizan et al., 2015). In addition, the probability of winning points on the first serve is significantly higher (55.9%) than on the second serve (42.9%), and it is more common for junior players to make errors on the third shot rather than achieve a winning point (Klaus et al., 2017). These observations reinforce the importance of effectively training the sequence between the serve and the first shots.

In the practice of serve and return, elite junior players find fewer opportunities to execute the third (serve +1) and fourth stroke (return +1) in training (13% and 18%, respectively)

compared to actual matches (60% and 61%, respectively), revealing statistically significant differences (Krause et al., 2019). In addition, it was found that, during training, when players were tasked only with serving, a reduction in the number of serves that fell inside was observed, compared to the situation where a third stroke was added after the return (Krause et al., 2019). This shows the importance of understanding and training these sequences of the serve and first shots during training, which have been shown to be critical aspects that largely define the performance of tennis players.

Evaluation and monitoring of performance in junior tennis is crucial for the effective development of players in training (Kolman et al. 2021). It is critical that training programs are designed to fit the specific needs of each stage of youth development. The differences between junior and professional level are significant and well-documented (Kovalchik & Reid, 2017), underscoring the importance of adapting training methods. Therefore, the main objective of this study was to describe and establish whether there were differences in the sequences of strokes of U-12 and U-14 players in service situations, including the direction of the serve, the position of the players when executing the third shot and the direction in which they send the ball. The results obtained provide valuable information to optimize the preparation of young tennis players for the competition.

METHODS AND PROCEDURES

Sample

The sample consisted of 8 matches in total, 4 men's matches of each category, in which 6 U-12 players and 7 U-14 players participated. A total of 438 points were analysed for the U-14 category and 449 points for the U-12 category, extracted

from the Petit As and Open Super 12 Auray tournaments, respectively. All players evaluated were right-handed and matches were played on indoor hard courts, starting with the quarterfinals.

Procedure

Using the Kinovea program (0.9.5-x64) the court was divided into different zones (see figure 1), which allowed both the position of the players and the bounce of the ball to be recorded. The encoder followed the recommendations described in previous studies (Hizan et al., 2010, 2015), to ensure that the locations of the ball bounce for each of the strokes were coded as accurately as possible.

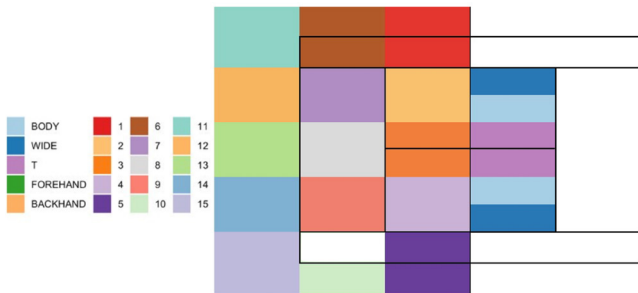


Figure 1. Areas of the court.

The data were recorded in an Excel spreadsheet with the sequentiality of the behaviors. General information related to the data of the players and the score was recorded. In addition, for each point the result of the same and the number of strokes were recorded. To analyze the sequences, information about the serve was recorded, including the type of serve (first and second serve), the side of the court (Equals or Advantage side), the direction of the serve (Open, Body and T), and information about the third stroke (serve +1), including the hitting zone and place of bounce of the ball after the shot.

Statistical analysis

Statistical analysis was performed using RStudio software version 1.3.959 for Mac. Descriptive data is reported through percentages according to category. Using the "TramineR" package, sequence analysis techniques were applied to explore and contrast the sequences employed by the tennis players. This process included three distinct approaches: comparing sequences between categories, identifying common patterns in each category, and analyzing the most frequent states. These analyses were categorized according to the type of serve (first or second) and the side of the court (deuce side or advantage side).

To quantify the differences and similarities between the sequences, dissimilarity analysis was employed, specifically using the Hamming distance. This metric evaluates sequences and records the number of positions in which sequences differ, that is, the number of mismatched elements in sequences. Based on the dissimilarity matrix generated, the discrepancy between the categories was analyzed, determining a statistical significance level of $p \leq 0.05$.

RESULTS

Table 1 shows the descriptive variables of the service and the duration of the points. As can be seen, both categories show similar values both in the number of serves played and in those won with the first serve. However, there is a notable disparity in the percentage of second serves won, particularly evident in the players of the U-12 category, who barely achieve 34% effectiveness in the points played against 56% of the U-14s. In addition, it highlights how short points are the most common in matches in both categories.

Table 1
Descriptive Match Variables.

Variables	U-12	U-14
1st serve in (%)	62%	62%
1st serve won (%)	56%	59%
2nd serve won (%)	34%	56%
Double faults (per match)	6.25	4.25 pm
Points of 4 or fewer strokes (%)	46%	50%

Deuce side analysis

Table 2 shows the most frequent situations for each of the variables in the sequence on the deuce side, for both the first and second serves in both categories.

Table 2

Most frequent situations for each of the variables in the sequence.

Category	Service	Service Direction	3rd Shot	3rd Shot Zone	3rd Shot Bounce
U-12	1	Body T Wide	Forehand	Behind baseline: - Center	Deep: -Backhand -Error
	2	Body T	Forehand Return Error	Behind baseline: -Right -Center	Deep: -Center
U-14	1	T Wide	Forehand Return Error	Behind baseline: -Center Inside the court: -Center	Deep: -Backhand
	2	-Body -Wide -T -Double Fault	Forehand Backhand	Behind baseline: -Right -Center -Left	Deep: -Backhand -Forehand -Center

Most frequent sequences

First Service:

U-12 category: players send their serves in all three possible directions, without having a dominant area, the third shot was primarily a forehand being behind the baseline in the central area, playing deep to the opponent's backhand, or making a mistake (see Figure 2).

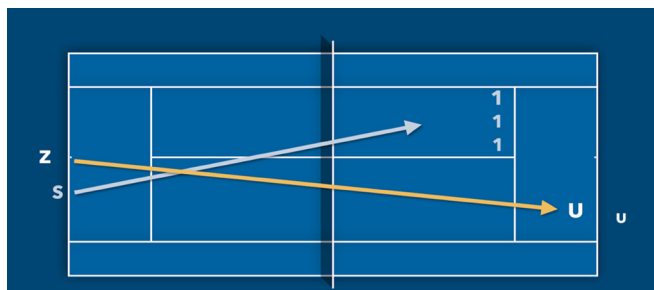


Figure 2. Stroke sequence most commonly used in U-12. The larger the number or letter, the more shots recorded in that area. Note: S=server; 1= Serve placement; Z=Impact zone of 3rd shot; U= 3rd shot placement.

U-14 category: they make serves mostly towards the T, followed by wide serves. In addition, his first shot after serving tends to be a forehand impacted from the central areas of the back of the court, playing the deep shot to the opponent's backhand. Also, there are return mistakes, which causes the completion of the point before the third stroke (see Figure 3).

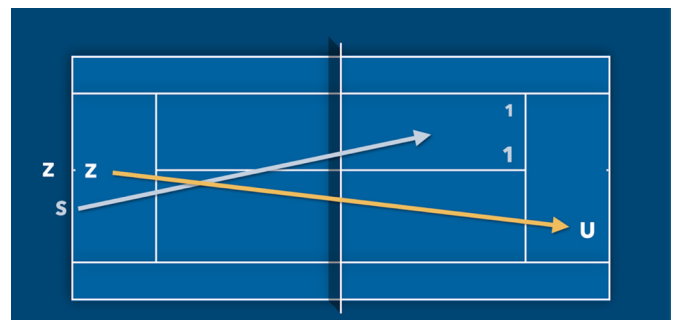


Figure 3. Stroke sequence most commonly used in U-14s. The larger the number or letter, the more shots recorded in that area. Note: S=server; 1= Serve placement; Z=Impact zone of 3rd shot; U= 3rd shot placement.

Second Service:

U-12 category: they mostly execute serves to the Body direction and then to the T, their third shot is a forehand impacted outside the court, in the central or right area, playing deep from the center to the center of the opponent. In addition, there are return mistakes, which causes the point to be completed before the third stroke (see Figure 4).

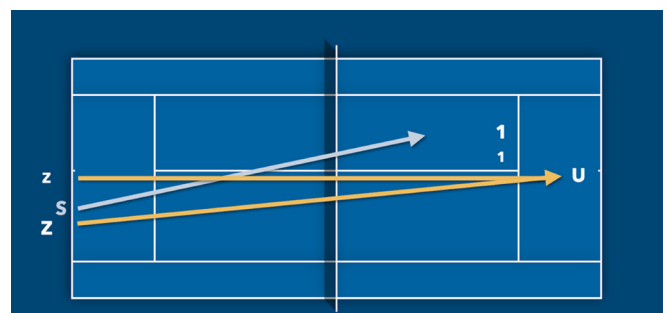


Figure 4. Stroke sequence most commonly used in U-12. The larger the number or letter, the more shots recorded in that area. Note: S=server; 1= Serve placement; Z=Impact zone of 3rd shot; U= 3rd shot placement.

U-14 category: they serve more times to the Body, but also in the other two possible options, the third stroke can be a forehand or backhand, although more forehands are given. Their location at the time of impact is behind the baseline in the right zone primarily, but also in the central zone and less so in the left zone, playing deep balls in all directions (see figure 5).

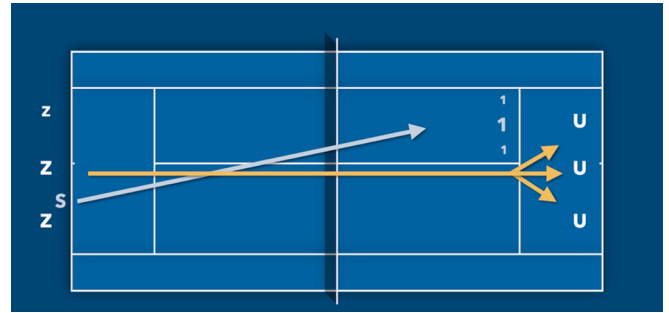


Figure 5. Stroke sequence most commonly used in U-14s. The larger the number or letter, the more shots recorded in that area. Note: S=server; 1= Serve placement; Z=Impact zone of 3rd shot; U= 3rd shot placement.

Advantage side analysis

Table 3 shows the sequences used on the advantage side for both the first and second serves.

Table 3

Sequence of Points Played on the Advantage Side.

Category	Service	Service Direction	3rd Shot	3rd Shot Zone	3rd Shot Bounce
U-12	1	Wide Body T	Forehand Backhand	Behind the baseline: -Center -Left Inside the court: -Center -Left	Deep: -Forehand -Center -Backhand
	2	Body Double Fault	Backhand Forehand Return Error	Behind the baseline: -Left (open)	Deep: -Center
U-14	1	Wide	Forehand Return Error	Inside the court: -Center -Left Behind the baseline: -Center -Left	Deep: -Backhand -Center
	2	Body Wide	Backhand Forehand Return Error	Behind baseline: -Left	Deep: -Center

Most frequent sequences

First Service:

U-12 category: their serves are directed in all three possible directions, the third shot can be forehand or backhand, impacting from the central or left areas inside but especially outside the court, executing a deep shot in all directions, although a higher percentage to the forehand of the opponent (see Figure 6).

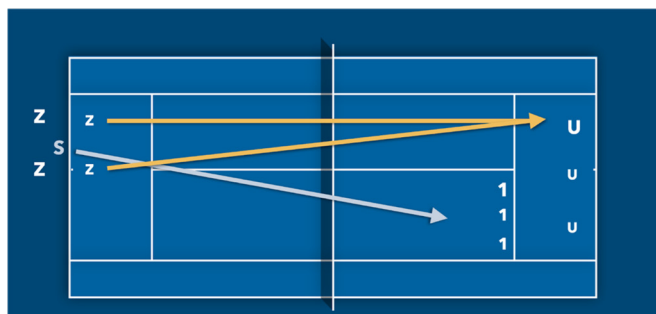


Figure 6. Stroke sequence most commonly used in U-12. The larger the number or letter, the more shots recorded in that area. Note: S=server; 1= Serve placement; Z=Impact zone of 3rd shot; U= 3rd shot placement.

U-14 category: they serve wide, the third shot is a forehand, impacted from the central or left position on the court, playing the deep shot to the opponent's backhand. Also, there are missed returns, so they don't play the third stroke (see Figure 7).

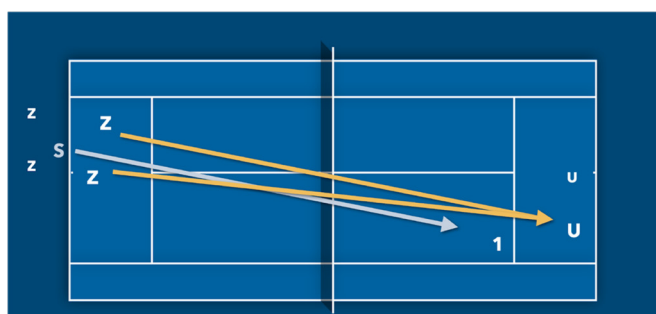


Figure 7. Stroke sequence most commonly used in U-14s. The larger the number or letter, the more shots recorded in that area. Note: S=server; 1= Serve placement; Z=Impact zone of 3rd shot; U= 3rd shot placement.

Second Service:

U-12 category: they serve to the Body direction, their third shot is mostly a backhand, followed by forehand or they do not play it because of the opponent's failed returns, the location of the impact is in open areas on the left side and outside the court, playing with this shot deep balls to the center (see figure 8). In addition, they commit double faults.

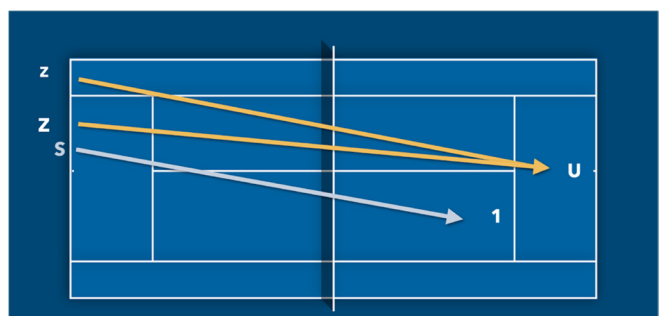


Figure 8. Stroke sequence most commonly used in U-12. The larger the number or letter, the more shots recorded in that area. Note: S=server; 1= Serve placement; Z=Impact zone of 3rd shot; U= 3rd shot placement.

U-14 category: they serve both to side and to the body, the third shot can be a forehand or backhand, although there are more backhands or they do not play it because of the opponent's failed returns, their location at the time of impact is outside the court in the left area, to play deep balls to the center (see figure 9).

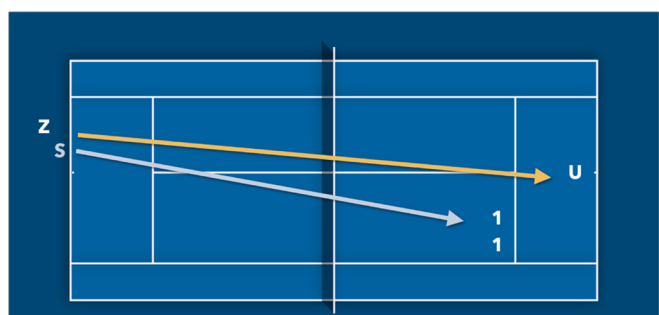


Figure 9. Stroke sequence most commonly used in U-14s. The larger the number or letter, the more shots recorded in that area. Note: S=server; 1= Serve placement; Z=Impact zone of 3rd shot; U= 3rd shot placement.

DISCUSSION

The aim of the study was to describe and establish whether there were differences in the sequences of strokes of U-12 and U-14 players in service situations, including the direction of the serve, the position of the players when executing the third shot and the direction in which they send the ball. The results obtained showed that, depending on the category, the side of the court and the type of serve, different sequences are presented. U-14 players tend to have more defined sequences, especially with the first serve, where they hit the third shot inside the court. While the U-12s with the second serve win very few points, they hit more behind the baseline and more backhands than forehands with the third shot.

The first serves are mostly directed to the T or wide, in both categories and on both sides of the court, however, in the U-14, this pattern is much more marked. These results confirm those obtained in previous studies, which indicate that, as the level of players increases, there is a greater tendency to serve sideways. When comparing junior players with professional players, a preference for serving in the corners of the service box was observed among professional players, while younger players showed a tendency to direct serves to their opponent's body (Hizan et al., 2015).

As far as the second serves are concerned, no such defined patterns were found as with the first. In both categories, the directions are usually varied, depending on the side of the court. Previous studies also observed a marked decrease in service placement near lines (Kovalchik & Reid, 2017), as opposed to professionals. This preference for directing serves towards the body is possibly due to physical limitations associated with their development, specifically, the standard dimensions of the tennis court can make it difficult for younger players to consistently place their serves in the corners of the service box (Hizan et al., 2015). This favors the use of serves aimed at the body as a more effective strategy for these players.

In the case of U-14 players, after the first serves, they tend to mostly execute the third shot with deep forehands aimed at the opponent's backhand side, regardless of which side of the court they are on. This strategy is crucial, as the depth of the shot keeps the opponent out of offensive zones of the court (Martínez-Gallego et al., 2013). In contrast, with the second serve, the sequence of strokes is not as defined, as they can choose to hit with both the backhand and forehand. On the deuce side, the third stroke is executed from outside the court (left, center, right), and depth is sought on the opponent's side (forehand, center, or backhand). Whereas, on the advantage side, the impact is given outside and on the left side of the court, orienting the ball with depth to the center of the opponent's side.

After serving first serves, U-12 players tend to mostly hit the third shot with forehands, aiming for the center and sides of the court when they are on the deuce side, and from center and left areas on and off the court when serving from the advantage side. These shots are directed towards deep areas of the opponent's side, specifically to the backhand area when they play on the deuce side and to the forehand zone when they are on the advantage side. As for the third shot after the second serve, there is a preference for hitting more with forehands from the deuce side and with backhands from the advantage side. These shots are aimed sideways and out of the court, with the aim of sending deep balls into the opponent's court. In addition, it is common to see that many points are concluded after a mistake in the return by the opponent.

Regarding the third shot (serve +1), most of the points are hit in the central areas of the court, this may be due to the fact that the returners sought to put the ball in play, although in our study the return was not evaluated, it has been shown through descriptive analysis that a high percentage of returns are directed to the center of the court regardless of the age group, the location of the serve and the side of the court (Hizan et al., 2014).

In junior tennis, fewer direct service points are earned when compared to professionals (Kovalchik & Reid, 2017). Both U-14 and U-12 players win close to 60% of first-serve points, similar percentages have been found in previous studies for U-12 and U-16 junior players (Hizan et al., 2011). While for the second serve there are lower percentages, especially in the U-12 category, where they win only 34% of the points played with this serve. This percentage increases to 56% for U-14 players. The data of U-12 players are similar to those found by Hizan et al. (2011), where the percentage was 34% of points won with this service. These data show that, in elite junior players, the second serve is an ineffective tool and that it should be emphasized in training to improve this variable or be used when returning.

Another important aspect to consider is the number of strokes that were played per point, where most were short, in the range of 1 to 4 strokes. The importance of short-point focused training is evidenced by the fact that most points in junior tennis end with less than 4 strokes, usually due to a mistake rather than a winning shot (Klaus et al., 2017). Therefore, it is essential to work on service +1 and return +1 situations. In addition, previous studies showed that when the serve was trained with the possibility of playing a third shot, players demonstrated greater accuracy in their serve compared to an isolated approach (Krause et al., 2019).

Whereas all points in tennis start with a serve and return, and that these two strokes have been identified as the most critical in the sport (Gillet et al., 2009; O'Donoghue & Ingram, 2001; Reid et al., 2010), it stands to reason that they should receive priority attention in the training content of players. However, these strokes are worked in isolation and with low percentages of time (Krause et al., 2019). The data provided by this study can be useful for coaches to include more specific training content in the preparation of U-12 and U-14 players, focused on the work of the service situation through proposals with a high application to the real competitive game.

This study presents a novel approach with high practical implications, however, it is not without some limitations. The main one is the sample size which, although we think is adequate for the analysis carried out, the generalizability of these findings to a wider population could be limited. To address this limitation in future research, it is recommended to carry out a more thorough analysis that includes a larger sample of parties, as well as women's parties, which will allow for more robust and generalizable conclusions, as well as knowing the differences between the sexes.

CONCLUSIONS

Shot sequence analysis in junior tennis is fundamental for the development and improvement of players at this formative stage. This technique could identify patterns of play, strengths and weaknesses in strokes technique, as well as tactical effectiveness in different game situations. These findings can help us understand how strokes are executed and combined. With this, coaches can design age-appropriate training programs, addressing specific areas of improvement and maximizing the potential of each player.

PRACTICAL APPLICATIONS

It is possible to develop specific training for the serve that goes beyond the mere isolated exercise, integrating situations that allow the server to execute a third shot, preferably from the forehand. It is particularly important to focus on second serve with players under the age of 12. At this age, since the stroke is not yet fully developed, serves tend to be directed towards the opponent's body and executed at a slower speed, which often benefits the returner by allowing him to take the initiative. Therefore, it is essential to train specific patterns for the second serve, emphasizing the execution of forehands, a predominant technique among players. In addition, it is essential to practice serving in contexts that simulate real match conditions, which helps players exercise under pressure and develop tactical and strategic skills applicable in authentic game situations.

CONFLICTS OF INTEREST AND FUNDING

The authors declare that they have no conflict of interest, nor have they received any funding related to the development of this study.

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