Analysis of the effectiveness of technical-tactical elements during the serve-receive phase in youth female table tennis athletes

Análisis de la efectividad de los elementos técnico-tácticos durante la fase de servicio-recepción en jóvenes atletas de tenis de mesa

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Abstract

The aim of the current study was to record and compare the technical and tactical elements of the strokes during serve, receive and winning shots between winning and defeated female table tennis athletes, belonging to the cadet leagues and to study their relation with the outcome of the match. The sample for this study was 36 official table tennis matches (2487 rallies) of cadets (14 ± 1.48 years). The technical and tactical analyses was concerned with the type and direction of the serve and receiving the ball, the success rates of the player serving and receiving, as well as the process of winning a point after an offensive shot. In order to record and analyze the matches, the method of video analysis was used and for the statistical treatment of the data the non-parametric X^2 test was implemented. The results revealed that the forehand grip was mainly used for the execution of a serve and the serve of the young female winners was statistically superior to the losers, regarding the score and the rates of successfully receiving the ball. Statistically significant differences were also observed in the first return of the ball after the execution of the serve, where the winners preferred mostly the forehand-push, backhand-topspin and forehand-topspin, making even more winning shots compared to the losers. The findings of the current study could be used by coaches in Cadet Leagues to improve training methods and help them to provide feedback to the athletes during the matches.

Keywords: *serve, receive, winning shots, video analysis.*

Resumen

El objetivo de este estudio fue grabar y comparar los elementos técnicos y tácticos de los golpes en el servicio, la recepción y los golpes ganadores (*winner shots*) entre atletas de tenis de mesa mujeres ganadoras y derrotadas que pertenecen a ligas cadetes, y estudiar su relación con el resultado del partido. La muestra para este estudio fue de 36 partidos oficiales de tenis de mesa (2487 *rallies*) de cadetes (14 ± 1.48 años). Los análisis técnicos y tácticos estaban relacionados con el tipo y dirección del servicio y la recepción, las tasas de éxito de la jugadora al servir y recibir, así como el proceso de ganar un punto luego de un golpe ofensivo. Con el fin de grabar y analizar los partidos, se usó el método de análisis de video y para el tratamiento estadístico de los datos se usó la prueba no paramétrica X^2. Los resultados revelaron que el agarre *forehand* era usado principalmente para la ejecución de un servicio, y el servicio de las mujeres ganadoras jóvenes fue estadísticamente superior al de las perdedoras en cuanto al puntaje y las tasas de recepción exitosa. También se observaron diferencias significativas estadísticamente en la primera devolución de la pelota luego de la ejecución del servicio, cuando las ganadoras prefirieron principalmente el *forehand-push*, el *backhand-topspin* y el *forehand-topspin* lograron más golpes ganadores comparadas con las perdedoras. Los hallazgos del presente estudio pueden ser útiles para los entrenadores en las ligas cadetes para que mejoren sus métodos de entrenamiento y puedan brindar una mejor retroalimentación a las atletas durante los partidos.

Palabras clave: *servicio, recepción, disparo ganador, análisis de video.*

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INTRODUCTION

Table tennis, due to the small dimensions of the court and the high speed of the ball, along with the small size of the racket, requires high level technique quality and accuracy of movements (Fayt et al., 2003).

Match analysis provides coaches and athletes with useful information, which can determine to a considerable extent the result of a match (Wu Xiao, Z., & Escobar, 2007). In racket sports and especially in table tennis, the serve and receiving the ball are the most significant factors affecting the outcome of a match. Learning how to serve requires many hours of practice and is characterized as a special indicator of performance, which is related to technical and tactical parameters (Bahamonde, 2000).

The winning outcome in table tennis matches is related to successful the serve and receiving the ball activities (Djokic, Malagoli-Lanzoni, Katsikadelis & Straub, 2020). Also, the quality of serve activities is an important differentiator between winners and losers in table tennis (Djokic, Malagoli-Lanzoni, Katsikadelis & Straub, 2020). Winning athletes score more points when serving, in comparison with the defeated athletes (Djokic et al., 2017; Djokic, 2002; Katsikadelis et al., 2013) and according to Yu et al. (2015), when an athlete serves and then attacks earns higher rate of points, compared to the case where he/she attacks after receiving the opponent's serve. As it is noticed by Liu et al. (2015) and Tong & Xiao (2015), rallies are also important and the winners are more accurate. Although Malagoli-Lanzoni et al. (2010), reported that the most common stroke during serving is the Forehand, followed by the Topspin, it varies depending on the type of the racket grip, the direction of the ball, the type of spin and length, and the strategy followed is a determinant factor for the outcome of the match (Drianovski & Otcheva, 2002).

Yet, although the technical and tactical characteristics of top level table tennis athletes have been examined in the past, there is a lack of relevant data regarding young table tennis athletes (Mulloy, Glynn, Rusga, Moore, Hartley, Williams & Irvin, 2014). Due to the fact that, the athletes' technique is developed during the early years of training and is essential for their evolution (Malagoli-Lanzoni et al., 2013), the aim of the current study was to record and compare the technical and tactical elements of the strokes during serve, receiving the ball and winning shots between winning and defeated female table tennis athletes belonging to the cadet leagues and to study their relation with the outcome of the match. In general, research on female table tennis athletes is limited, especially for young female athletes. Also, the technique and tactics of young athletes play a very important role in their subsequent development. It was hypothesized that the winners would be superior in all the technical and tactical elements assessed in the current study.

METHODS

Participants

A total of 36 table tennis matches (2487 stages) of cadet Greek female athletes, were recorded and analyzed. These matches were quarter-finals, semi-finals and final games of the official cadet leagues, but also from the pan-Hellenic championship of the season 2016-17. The participants were 24 young female table tennis players (20 right-handed, 4 left-handed, 19 pimple-in rubber, 5 pimple-out BH-rubber, all of them offensive) with an average age of 14 ± 1.48 years, who belonged to the 26 best athletes of the official ranking list of the Hellenic Table Tennis Federation.

Measuring Instruments

All matches were recorded by the researcher with a Nikon Coolpix B500 camera and a professional tripod. The video was recorded at 120fps, with a resolution 640 x 480. The shooting angle was such that the search variables were clearly visible throughout the matches. In order to achieve the reliability of the research, two very experienced table tennis coaches took part in the recording and analysis of the research data. The researcher then watched the videos and registered the analysis data (point-to-point) in the Spss 20 program where the analyzes were performed.

Process

Video recordings started immediately after athletes' warm-up and ended when the final point was won. The observed parameters regarding the serve and the receiving of the ball were categorized as follows: a) female athlete serving: winner - defeated athlete, b) serve grip: forehand (FH), backhand (BH), c) area where serve was executed: backhand-short, middle-short, forehand-short, back-hand-inside/out, middle-inside/out, forehand-inside/out, backhand-long (BH-Long), middle-long, forehand-long, d) result of the point made by the serving athlete: point won-point lost, e) female athlete receiving: winner-defeated athlete, f) outcome of the serve and the receiving of the ball: successful, unsuccessful, g) way of receive: backhand-push, forehand-push, backhand-flick, forehand-flick, backhand-topspin, forehand-topspin, backhand-drive, h) final shot: successful, missed.

Statistical Analysis

For the statistical treatment of the data the non-parametric chi-square (χ) test was used for each categorical dependent variable to identify statistically significant differences between the classifications within each variable. For selected pairs of the categorical dependent variables chi-square (χ) test of independence was also applied to examine statistically significant relationships between them. The level of significance was set as $p < 0.05$.

RESULTS

Regarding the grip used for the execution of the serve, the chi-square (χ) test of independence revealed that both winning and defeated young female athletes executed more serves using the FH in comparison with the BH grip [$\chi_{(1)}$= 0.009 p= 0.926], without significant differences between them (Table 1).

Table 1.
Racket grips for the execution of a serve.

	Forehand grip	Backhand grip
Winning athletes	67.00%	33.00%
Defeated athletes	67.10%	32.90%

Moreover, both winning and defeated young female athletes execute statistically significant more serves in the area of BH-Long [$\chi_{(8)}$= 27.116; p< 0.05], while for both groups, the second choice was the FH-short area (Table 2).

FH-Long	Middle-Long	BH-Long
FH-Inside/Out	Middle-Inside/Out	BH- Inside/Out
FH-Short	Middle-Short	BH-Short

Figure 1. Service areas.
Source: Luini, Fuchs, Djokic, Malagoli-Lanzoni & Munivrana (2021)

As far as the final outcome of the match in relation to the point earned or the point lost after serving is concerned, there was found a statistically significant difference between winning and defeated female athletes [$\chi_{(1)}$= 84.819; p< 0.05]. The winning athletes earned points on two of the three serves they had executed, while, on the contrary, the defeated athletes won less than half of the executed serves (Table 3).

Concerning the first return of the ball after the execution of a serve, it was observed that winning athletes showed statistically significant higher rates of successfull return of the ball [$\chi_{(1)}$ =27.179;p< 0.05], compared to the defeated athletes (Table 4).

Statistically significant differences [$\chi_{(6)}$ = 69.281; for p< 0.05] were also found between winning and defeated female athletes concerning the first return of the ball after the execution of the serve, where both showed greater percentages of the BH-Push, but the winners showed in addition greater values for the FH-push, the BH-Topspin and the FH-Topspin. (Table 5).

Concerning the final ball, the winners showed statistically significant [$\chi_{(1)}$=57,098 p<.05] more successful shots compared to the defeated young female players (Table 6).

DISCUSSION

The results of the present study are very important and rare as most research in performance analysis has to do with top-level male athletes. The findings of the current study revealed significant differences between the winning and defeated female athletes in almost all variables under consideration. The only exception was the grip used for the execution of the serve, where both showed similar rates for the FH grip, which were significantly greater in comparison with the use of the BH grip. Similar with the present research are the findings of Malagoli- Lanzoni, Lobietti & Mermi (2010) according to which the most common service is with FH grip. The same result was found in a study of young male athletes. (Nikolakakis, Mavridis, Gourgoulis & Pilianidis, 2020). Especially in the reception and in the acquisition of a point by service the results were almost the same. In the service grip, the majority of young boys again chose the FH grip but with higher percentages compared to the young girls. egarding the receipt of the ball there is a similarity in the BH-PUSH and FH-Push movements, while differences are spotted in the BH-Flick and FH-Flick movements, where the young female athletes do not perform them so often. Regarding the area where a serve is executed, it was found that not only the winners, but also the defeated young female athletes prefer mainly the BH-Long area. However, as far as their second choice is concerned, despite the fact that both prefer the FH-Short area, the rates observed in this particular area were higher for the winners. Moreover, the winners chose to serve less in the BH-Short and FH-Long spot, compared to the defeated young female athletes. Findings of a similar research on young athletes show that services in the areas near to the net specially in the places Middle and FH shorts belong to the first choices of athletes (Mulloy et al., 2014). From a survey of Luini, Fuchs, Djokic, Malagoli-Lanzoni & Munivrana (2021) in female elite European table tennis players, various results arise in the execution of the service. The elite European athletes perform services mainly in the Middle-Short area while the Greek athletes choose the BH-Long area. However, similarities were observed in the reception as the FH-Push and BH-Push movements are the most common choice of both European elite girls and Greek female table tennis players.

Table 2.
Area where a serve is executed by the winning and defeated female athletes.

Area where a serve is executed	BH-Short	Middle-Short	FH-Short	BH-Inside/Out	Middle-Inside/Out	FH-Inside/Out	BH-Long	Middle-Long	FH-Long
Winning Athletes	8.70%*	7.40%*	23.60%*	2.70%	1.90%	8.60%	36.10%	3.80%	7.30%
Defeated Athletes	12.40%*	5.60%*	18.40%*	4.00%	2.80%	8.80%	35.00%	3.60%	9.30%

Table 3.
Relationship of the point earned or lost when executing a serve with the final outcome of the match.

Point earned when serving	Point Won	Point Lost
Winning athletes	66%*	34%*
Defeated athletes	47.7%*	52.3%*

Table 4.
Relationship between the success of the first return of the ball, after the execution of a serve receive, with the final outcome of the match.

Receive of a serve	Successful Return	Failure to Return
Winning athletes	82%*	18%*
Defeated athletes	73.2%*	26.8%*

Table 5.
Relationship of the way a serve is received among winning and defeated

Way of receiving a serve	BH-Push FH-Push	BH-Flick	FH-Flick	BH-Topspin	FH-Topspin	BH-Drive
Winning athletes	37,90% 30,60%*	1,10%	2,10%	8,00%*	16,90%*	11,60%*
Defeated athletes	36,20% 24,00%*	1,30%	2,00%	1,70%*	10,00%*	16,30%*

female athletes.

Table 6.
Relationship between the success of the final ball and the final outcome of the match.

Final shot	Successful	Missed
Winning athletes	64,2%*	46,8%*
Defeated athletes	35,8%*	53,2%*

Due to the fact that serving and receiving the ball offer a considerable advantage that could lead to win, the winning table tennis athletes become more effective when serving, in relation to the defeated athletes. The current findings highlight that the winners earned more points when serving themselves, in comparison with the defeated athletes. The results of the research of Yu et al. (2015) were similar, who claimed that the winners gain an advantage when they serve as they earn a point directly from the service or gain an advantage in the third ball. Concerning the rates of success in receiving the ball it showed that winning athletes successfully received the ball more frequently, contrary to the defeated athletes, who made more errors. All the aforementioned results are in line with a relevant survey conducted by Djokic et al. (2017), who claimed that winning athletes obtain an advantage when serving by immediately winning points or winning an advantage in the third ball. Consequently, this means that winning athletes present The quality of receiving the ball also plays when executing a serve or receiving. As Ma et al. (2015) stated, the first three strokes of a game are considered as an important factor that could directly affect the outcome of the game.

The quality of the receives execution also plays a major role in the outcome of the match. Regarding the receipt of the ball and more specifically the strokes used to receive it, it was found that winning young female athletes use technically more complex and offensive strokes, compared to defeated athletes, a fact that offers them an advantage in the acquisition of the point. Both winning and defeated female athletes used the Backhand-push as their first choice, followed by the Forehand-push. There are statistically significant differences in Backhand-topspin and Forehand-top-spin, which are mainly executed by winning athletes. Coaches and athletes should therefore, integrate to a greater extend the elements of serve and receive in their training, in order to achieve an effective improvement of their technique, as well as optimized outcomes during games.

Concerning the final hits, statistically significant differences were found between winners and defeated female table tennis players. The winners executed more successful winning shots compared to the defeated players, and consequently earned more points. It was impressive that slightly over half of the winning shots executed by the defeated athletes were missed, pointing out the low level of these athletes. Apart from the hits that lead to win a direct point, avoiding errors is also or more important (Wenninger & Lames, 2015).

Although the aforementioned findings could help table tennis players and coaches to increase the efficiency of their serves and receives, they were restricted to cadet leagues and should be generalized with caution. Future studies could examine in detail the technical and tactical features in other categories and apart from serve, receive and winning shots, could also focus on other parameters, for instance leg movements. A detailed study of the technical and tactical parameters could provide valuable information to table tennis coaches to improve their athletes' performance and to develop a stable background especially for the young table tennis players.

CONCLUSION

The current study showed that both the winners and the defeated female athletes used mainly the forehand grip for serving, and their first choice for the area where the serve was executed was the same, corresponding to the BH-Long area. However, their second and third choices were different. Moreover, winning female athletes earned more points immediately after their own serve and they win also more points directly from their serve (ace). Last but not least, crucial differences were observed regarding the receiving of an opponent's serve and the wining shots. Winning female athletes performed receives with better-quality and more successfully, making fewer errors compared to defeated athletes.

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