

Article

Relationship between Ball Impact Point, Type of Stroke and Shot Direction in High-Performance Padel

Jesús Ramón-Llín ¹ , Diego Muñoz ² , Iván Martín-Miguel ² , José F. Guzmán ³ , Goran Vučković ⁴,
Rafael Martínez-Gallego ³  and Bernardino Javier Sánchez-Alcaraz ^{5,*} 

- ¹ Department of Teaching of Music, Visual and Corporal Expression, University of Valencia, 46010 Valencia, Spain; jesus.ramon@uv.es
- ² Department of Musical, Plastic and Corporal Expression, Faculty of Sport Sciences, University of Extremadura, 10003 Cáceres, Spain; diegomun@unex.es (D.M.); ivanmartinmiguel97@gmail.com (I.M.-M.)
- ³ Department of Physical Education and Sport, University of Valencia, 46010 Valencia, Spain; jose.f.guzman@uv.es (J.F.G.); rafael.martinez-gallego@uv.es (R.M.-G.)
- ⁴ Faculty of Sports, University of Ljubljana, 1000 Ljubljana, Slovenia; goran.vuckovic@fsp.uni-lj.si
- ⁵ Faculty of Sport Sciences, University of Murcia, 30100 Murcia, Spain
- * Correspondence: bjavier.sanchez@um.es

Abstract: This study aimed to analyze the relationship between ball impact point, type of stroke, and shot direction in high-performance padel. A total of 8363 strokes from nine matches of three national tournaments involving a total of 24 male players were subjected to systematic observation. The variables analyzed were type of stroke, shot direction, and ball impact. A descriptive analysis was conducted for each study variable, with a comparison of the variables performed using Pearson's Chi-Square test, column proportions determined using a Z test according to Bonferroni ($p < 0.05$), an association established by corrected standardized residuals, and an effect size calculated using Crammer's V. The results showed that the most-used stroke types were volleys, serves, groundstrokes, and backwall shots (67.6%). The cross-court direction stood out over down-the-line and inside-out directions. Finally, almost two-thirds of the impact point locations were forward. In addition, the type of stroke determined shot direction and ball impact location. Moreover, the ball's impact location significantly determined shot direction. In conclusion, these results suggest that the ball impact location and the type of stroke provide information from which padel shot direction can be anticipated. Such knowledge may constitute a very important factor affecting performance and success among padel players.

Keywords: racket sports; performance analysis; biomechanics; game actions; paddle tennis



Citation: Ramón-Llín, J.; Muñoz, D.; Martín-Miguel, I.; Guzmán, J.F.; Vučković, G.; Martínez-Gallego, R.; Sánchez-Alcaraz, B.J. Relationship between Ball Impact Point, Type of Stroke and Shot Direction in High-Performance Padel. *Appl. Sci.* **2024**, *14*, 4630. <https://doi.org/10.3390/app14114630>

Academic Editor: Mark King

Received: 2 May 2024

Revised: 21 May 2024

Accepted: 23 May 2024

Published: 28 May 2024



Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Padel is a relatively new sport [1], played on a 20 × 10 m court [2], whose player base has recently increased worldwide [3,4]. Similar studies have been undertaken on this sport, with the main topic being performance indicators [5,6], especially in regard to three fundamental aspects: temporal structure [7–10], players' movements and distance covered on the court [11–13], and game actions, such as technical or tactical parameters [6,14–16]. The main aim of research on this topic has been to try to identify game actions to explain the tactical behavior of players during competitions [10], providing objective information on real game situations [17]. This research information can help coaches and players to enhance performance through effective competition-based training [18]. It enables them to devise strategies for better performance and improve decision-making and feedback based on players' behavior during a match [15].

Performance parameters have been analyzed in relation to padel, providing important information about game patterns and energy requirements during competitions [7,18]. Regarding the characteristics of the game, it has been reported that there are 9–10 strokes

per point in high-level padel [19,20]. The shots with the highest frequency are volleys, smash, serve and groundstrokes [6,11]. In addition, two tactical positions in padel have been described: the net position, where the pair plays close to the net, and the background position, where the pair plays at the baseline of the court [21,22]. Previous studies have confirmed that there is a greater likelihood of winning a point (pertaining to more than 80% of the points), when spending more time in the net position [6,13], using strokes such as bandejas, smashes (12–16%), and forehand and backhand volleys (20–25%) [11,23,24]. However, players in background positions use other types of strokes (with lobs serving as the most frequent type of hit), with the aim of reaching the net position and forcing the opponents to hit the ball away from the net, forcing them to go back to the background position [25].

However, it is important to know the distribution of points and errors in the different strokes because it allows one to characterize players' performance and predict a match's outcome and success in a game [10,17,26]. Regarding scoring strategies, players' locations (i.e., net or baseline, right or left side, etc.) or players' techniques (i.e., hitting the ball at a good location) have been reported to have notable implications in padel [16,27,28]. Thus, it appears that two fundamental tactical principles for achieving success in racket sports are varying the direction of shots and hitting the ball to the corners of the court [25,29,30]. In tennis, hitting the ball earlier or later in a stroke can generate changes in ball direction [31] and serve velocity [32]. Some studies have analyzed impact points and joint angle changes [33]. In this regard, where the ball impacts the racket face (string bed) has a direct effect on racket/arm motion in tennis strokes [33]. The relationship between the location of the ball's impact and shot direction could provide valuable information for developing the ability to anticipate an opponent's shots [33]. This information could help players move more efficiently and productively on the court [31,34,35]. However, there is a concerning lack of research investigating ball impact points in padel. Therefore, the aim of this study was to analyze the relationship between ball impact point, type of stroke, and shot direction in high-performance padel. This information could assist coaches in comprehending players' strategies and their effectiveness in padel games.

2. Materials and Methods

2.1. Sample and Variables

A total of 8363 shots from nine matches (six semi-finals and three finals) across three top national tournaments (First National Category) were analyzed via systematic observation. The matches were performed by 24 male padel players with a mean (SD) age of 31.18 (7.27) years and a height of 181.3 (4.1) centimeters. The matches were conducted in accordance with the established regulations of the game [2]. These players also compete in professional World Padel Tours and Premier Padel circuits, but these tournaments were selected because it is easier to obtain permission to include cameras on the court in these competitions. However, as it was necessary to attach a specific structure on the roof to support the cameras, only 3 tournaments could be included in this research. The study was approved by the ethics board of the local university (ethic code; 154/2020). The following variables were analyzed:

- **Type of stroke:** The strokes analyzed in this study, following the classification proposed by Courel-Ibáñez et al. [6], included the serve (first and second serves), ground strokes, backwall strokes, double-wall strokes, lateral wall shots, lobs, volleys, tray shots, and smashes. All strokes were executed using a player's forehand and backhand, except for the tray shots and smashes, which were performed only on the dominant side.
- **Shot direction:** The court was divided into five areas, and the players' hitting positions and the ball's position on the other side of the court were recorded. Shot directions included inside-out (Figure 1, #1), down the line (Figure 1, #2), and cross-court (Figure 1, #3).
- **Ball impact point:** This term is used to describe the point of impact in relation to the center of mass of the human body. It was calculated with respect to the distance

between the coordinates of the ball and a player's center of gravity. Impact points were classified into forward (in which the impact of the ball is in front of the player's center of gravity) (Figure 2, #1) and backward (wherein the impact of the ball is behind the player's center of gravity) points (Figure 2, #1).

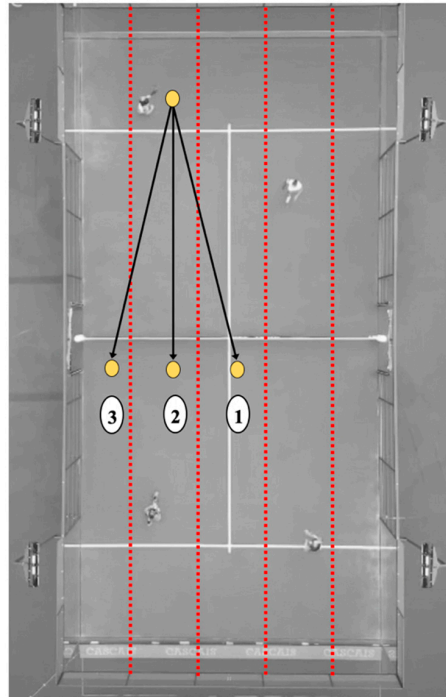


Figure 1. Shot directions: (1) inside-out, (2) down the line, or (3) cross-court.

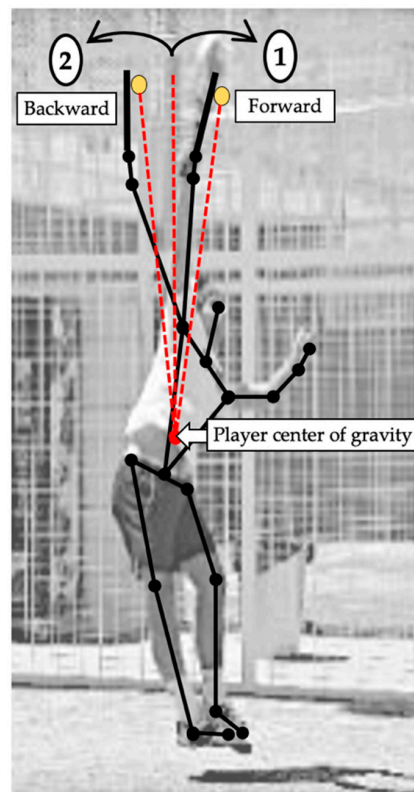


Figure 2. Ball impact points: (1) forward or (2) backward.

2.2. Procedure

Informed consent was requested from tournament organizers and players for the recording of matches. A computerized motion-tracking system (Sagit/Squash) was used to analyze player and ball coordinates, following a procedure used in previous studies [36]. Two Bosch Dinion video cameras were used to record the matches. The cameras were placed in a sagittal direction over the courts, one at a distance of 6 m from the center and the other over the service line. The frame rate was 25 frames per second. This camera and procedure have been used in previous racket studies [37]. Similarly, the reliability of the resulting calculations of player and ball position on the court has been deemed acceptable for analytical purposes [38]. To analyze the matches through systematic observation, two software programs were used. Video analysis was conducted using LINC software v2.1.0. [39], and shot direction was determined by overlaying a visual grid on the images from the video with Kinovea software (V.08.26, www.kinovea.org, Bordeaux, France, accessed on 13 February 2024) (see Figure 1). To analyze the intra-observer and inter-observer reliability, two physical activity and sport sciences graduates, who also have over 10 years of experience as padel coaches, participated in the process. Firstly, a specific training process was employed to identify the study variables. Secondly, at the end of the training process, each observer analyzed the same two sets to calculate inter-observer reliability using the Multirater Kappa Free program [40]. Intra-observer reliability was also evaluated at the end of the observation process, with minimum values of 0.80 obtained to ensure data consistency. The obtained values were above 0.80, indicating a very high degree of agreement [41].

2.3. Data Analysis

Firstly, Microsoft Excel spreadsheets were used for processing the data collected through visual analysis of the nine matches. Here, IBM SPSS 25.0 (IBM Corp: Armonk, NY, USA) was used to perform the statistical analysis of the data collected. To analyze the data, first, a descriptive analysis of the data was carried out to determine the frequency (n) and percentage (%) of each study variable. To determine the normality of the variables, Kolmogorov–Smirnov tests were conducted. Additionally, to assess the homogeneity of variances, Levene’s test was performed. The statistics on the types of strokes were compared based on ball impact point and direction using Pearson’s Chi-Squared test. Column proportions were compared using Z tests, with *p*-values adjusted to *p* < 0.05 according to Bonferroni. Associations among variable categories were analyzed using corrected standardized residuals (CSRs). The effect size was calculated using Crammer’s V [42]. The effect size of Crammer’s V was interpreted as small (*V* < 0.10), medium (0.10 < *V* < 0.30), or large (*V* > 0.30) based on the degrees of freedom [43]. A significance level of *p* < 0.05 was set.

3. Results

A total of 8363 stroke-by-stroke actions were registered regarding type of stroke, ball impact point, and shot direction, distributed as shown in Figure 3. Volleys, serves, groundstrokes, and backwall shots (67.6%) were the most common strokes. Lobs accounted for less than two out of ten strokes. Interestingly, almost two-thirds of the impact point locations were forward. Regarding shot trajectories, the cross-court direction stood out among down-the-line and inside-out directions.

Table 1 shows the distribution of stroke types according to ball impact point. As may be observed, the type of stroke determined the ball impact location ($\chi^2 = 1267.39$; *gl* = 8; *p* = 0.000; *V* = 0.392). The ball impact points in serves, volleys, tray shots, and backwall shots were significantly more likely to be forward impacts. However, ground strokes, lateral-wall shots, and lobs were significantly more likely to have backward impacts. No significant differences were found for smashes and double-wall shots regarding ball impact point.

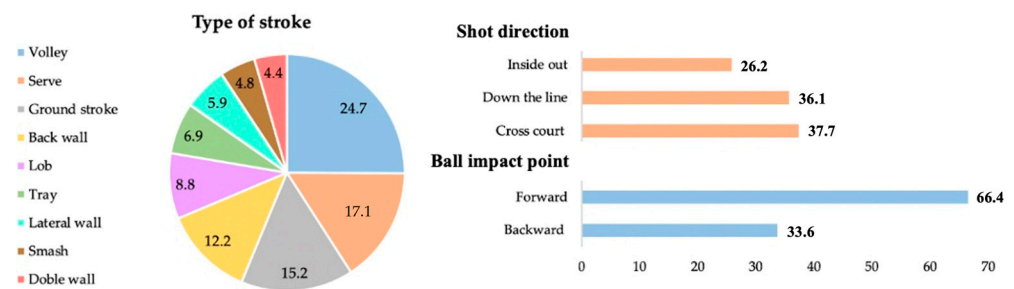


Figure 3. Descriptive analysis of types of strokes, ball impact points, and shot directions.

Table 1. Type of stroke according to ball impact point.

	<i>N</i>	Backward %	Ball Impact Point		Forward %	CSRs	Sig.
			CSRs	<i>N</i>			
Type of stroke							
Serve	537 a	41.4	−6.4	761 b	58.6	6.4	0.000
Ground stroke	680 a	53.3	16.1	595 b	46.7	−16.1	
Volley	256 a	12.4	−23.7	1811 b	87.6	23.7	
Tray shot	18 a	3.1	−16.1	560 b	96.9	16.1	
Smash	135 a	33.8	0.1	264 a	66.2	−0.1	
Backwall shot	307 a	30.0	−2.7	717 b	70.0	2.7	
Lateral-wall shot	394 a	53.4	11.8	344 b	46.6	−11.8	
Lob	321 a	65.0	15.2	173 b	35.0	−15.2	
Double-wall shot	129 a	35.4	0.7	235 a	64.6	−0.7	

Note: N = frequency; % = percentage; CSRs = corrected standardized residuals; a and b = significant differences in the Z tests for the comparison of column proportions, with $p < 0.05$, adjusted according to Bonferroni.

Table 2 shows the descriptive results regarding stroke distribution according to shot direction. As may be observed, the type of stroke determined shot direction ($\chi^2 = 583.54$; $gl = 16$; $p = 0.000$; $V = 0.266$). Down-the-line shots were significantly more frequent than inside-out or cross-court directions for ground strokes, volleys, lobs, and double-wall shots. Cross-court directions were significantly more frequent than down-the-line or inside-out shots for serves, backwall shots, and lateral-wall shots. Finally, inside-out directions were significantly more likely than down-the-line or cross-court shots for tray shots and smashes.

Table 2. Type of stroke according to shot direction.

	Shot Direction									Sig.
	Down the Line			Cross-Court			Inside-Out			
	N	%	CRSs	N	%	CRSs	N	%	CRSs	
Type of stroke										
Serve	402 a	31.0	−5.5	465 b	35.8	−0.2	431 c	33.2	6.3	
Ground stroke	558 a	43.8	4.8	489 a	38.4	1.8	228 b	17.9	−7.3	
Volley	850 a	41.1	3.6	714 b	34.5	−1.7	503 b	24.3	−2.1	
Tray	194 a	33.6	−2.2	112 b	19.4	−8.7	272 c	47.1	11.9	
Smash	85 a	21.3	−7.0	156 b	39.1	1.3	158 c	39.6	6.3	0.000
Backwall	299 a	29.2	−6.0	414 b	40.4	3.1	311 b	30.4	3.3	
Lateral-wall	238 a	32.2	−3.2	323 b	43.8	4.5	177 a	24.0	−1.4	
Lob	324 a	65.7	13.2	161 b	32.7	−1.7	8 c	1.6	−12.8	
Double-wall	160 a	44.0	2.5	141 a	38.7	1.1	63 b	17.3	−3.9	

Note: N = frequency; % = percentage; CSRs = corrected standardized residuals; a, b, and c = significant differences in the Z tests for the comparison of column proportions, with $p < 0.05$, adjusted according to Bonferroni.

Table 3 shows how ball impact location significantly determined shot direction ($\chi^2 = 883.993$; $gl = 2$; $p = 0.000$; $V = 0.328$). As may be observed, when players hit the ball

behind their center of gravity (backward), the shot would be down the line almost 50% of the time. However, when a player hit the ball in front his center of gravity (forward), the direction of the shot was significantly more likely to be cross-court and inside-out than down the line.

Table 3. Shot direction according to ball impact point.

	Ball Impact Point						Sig.
	<i>N</i>	Forward (a) %	CSRs	<i>N</i>	Backward (b) %	CSRs	
Shot direction							
Down-the-line	1533	28.1	−25.4	1578 a	50.7	25.4	0.000
Cross-court	2022 b	37.0	2.4	954	32.1	−2.4	
Inside-out	1905 b	34.9	25.4	246	11.4	−25.4	

Note: *N* = frequency; % = percentage; CSRs = corrected standardized residuals; a and b = significant differences in the Z tests for comparison of column proportions, with $p < 0.05$, adjusted according to Bonferroni.

4. Discussion

This study aimed to analyze the relationship between ball impact point, type of stroke, and shot direction in high-performance padel. The results showed that the most-used strokes in padel were volleys (24.7%), serves (15.5%), groundstrokes (15.2%), and backwall shots (12.2%). Previous studies have reported similar results when quantifying the distribution of padel strokes [6,19,27]. Therefore, the distribution of strokes is the decisive parameter in this regard. It appears that this factor may be directly related to alterations in the depth and width of the court space [6,44]. A recent study's data show that the winning pair used more smashes and volley shots, while the losing pair used more ground strokes (wall strokes and lobs) [27]. The data presented in this study also show a high percentage of serves (15%). These data seem consistent due to the point at which this shot is made; thus, coaches may consider including exercises with a serve–volley sequence. This is important because the serving pair has a significant advantage in rallies, which typically last until the 7th shot in women's matches and the 12th shot in men's matches [16].

Regarding shot trajectories, recent research has shown that the cross-court direction is more significant than the down-the-line and inside-out directions. The winning pair tends to use cross-court trajectories more often than the losing pair [27]. Therefore, it is important to emphasize the significance of cross-court trajectories in professional padel [27,29]. The utilization of cross-court shots can direct the ball towards the court's side, leading to a rebound off the metal fence, side wall, or the corner between the back wall and the side wall. This can increase the opponent's uncertainty and the likelihood that they will make mistakes [27]. Moreover, the cross-court direction seems to be more effective in positions close to the net, especially in the central area of the court, since the angle for striking is greater [6]. A novel contribution of this study is its description of the inside-out direction in padel. This concept has been widely used in tennis [45,46]. Our results show that the inside-out directions were significantly more frequent than down-the-line and cross-court shots for tray shots and smashes. This could be due to the fact that a higher percentage of left-handed players made these shots [44], so coaches and players could use this information to adapt strategies and tactics in competitions when playing against left-handed players.

This study's main contribution is its analysis of the impact location of the ball in high-performance padel and its relationship with hitting directions. Interestingly, our results showed that almost two-thirds of the impact point locations were in front of the players' center of gravity. Regarding type of shot, forward impact locations were more frequently observed in serves, volleys, tray shots, and backwall shots. However, ground strokes, lateral-wall shots, and lobs were significantly more associated with backward impacts. Considering that ball impact points in tennis are predominantly forward [31], these differences could be produced by the singular characteristics of padel courts, with the use of lateral and back walls, which could affect impacts points. Thus, the comparison

between ball impacts and shot direction showed that the shot was down the line almost 50% of the time when a player hit the ball behind his center of gravity (backward). However, when a player hit the ball in front his center of gravity (forward), the direction of the shot was significantly more likely to be cross-court and inside-out than down the line. These results enable the optimization of players' performance by allowing them to anticipate their opponent's shots [34], enabling more efficient and productive actions or movements on the court [31,34,35].

The present study provides new insights into the expanding field of padel training and assessment. It includes an analysis of ball impact point and its correlation with stroke type and shot direction, which may have significant implications for improving the quality and precision of training drills based on specific match activity and technical–tactical demands. However, it is important to note some limitations of this study. Firstly, we did not take into account the height of the ball in players' impacts. This parameter could be very interesting with respect to knowing a shot's effectiveness or the speed of a smash. Secondly, the zone of the court where the players hit the ball was not analyzed. Some studies have shown how the distance to the net could affect shot effectiveness and direction [26,27,47]. Winning pairs execute more attacking actions for 85% of the points they score, spend more time in net zones, and perform more smashes. As future lines of research, it would be of interest to conduct a similar study with professional players in order to gain insight into these dynamics among higher-level players. Furthermore, it would be beneficial to analyze these variables in women's padel, as the analysis of ball impact point and trajectories for women would allow for individualization based on their characteristics, as well as for a comparison between both genders. Finally, future research should address the aforementioned limitations. In addition, an analysis of the player's hitting zone should be conducted, with the effectiveness of the stroke being taken into account. This may explain the tactical component of some strokes and their effectiveness.

5. Conclusions

This study provides new contributions to game analysis indicators in national-level padel. The most common stroke types were volleys, serves, groundstrokes, and backwall shots. The results showed different ball impact points regarding the type and direction of strokes. In this regard, serves, volleys, tray shots, and backwall shots were significantly more likely to have forward impacts, and ground strokes, lateral-wall shots, and lobbs were significantly more likely to have backward impacts. In addition, when players hit the ball backward, the shot would be down the line almost 50% of the time. However, when players hit the ball forward, the direction of the shot was significantly more likely to be cross-court or inside-out than down the line. The findings of this study will allow padel coaches to design anticipation and movement exercises in relation to type of stroke and ball impact point. For instance, given the high frequency of use of specific strokes, coaches should plan training sessions with an emphasis on these strokes, given their high frequency of use in competitions. Additionally, knowing the impact position and direction of the ball facilitates a more comprehensive understanding of the tactical characteristics of these strokes. For instance, the results indicate that groundstrokes are predominantly executed with backward impacts. Consequently, positioning oneself too far away from the glass may increase the probability of an error being made. Similarly, it will permit a more accurate anticipation of the opponent's next move, given the predominant direction of a specific hit. Consequently, the high practical applicability of these findings makes it of interest to other racket sport competitors to be aware of the characteristics of the specific strokes of each sport in order to be able to plan strategies in competitions and training sessions from a tactical and technical point of view.

Author Contributions: Conceptualization, J.R.-L., D.M., J.F.G. and R.M.-G.; Methodology, J.R.-L., D.M. and B.J.S.-A.; Software, J.R.-L. and G.V.; Validation, J.R.-L. and G.V.; Formal analysis, J.R.-L. and G.V.; Investigation, R.M.-G.; Resources, I.M.-M.; Data curation, I.M.-M. and R.M.-G.; Writing—original

draft, I.M.-M., J.F.G. and B.J.S.-A.; Supervision, D.M. and J.F.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of University of Extremadura (154/2020).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Sánchez-Alcaraz, B.J. History of padel. *Mater. Para La Hist. Del Deporte* **2013**, *11*, 57–60.
2. International Padel Federation. *Rules of Padel*; FIP: Lausanne, Switzerland, 2020.
3. Courel-Ibáñez, J.; Sánchez-Alcaraz, B.J.; García, S.; Echegaray, M. Evolution of padel in Spain according to practitioners' gender and age. *Cult. Cienc. Y Deporte* **2017**, *12*, 39–46. [\[CrossRef\]](#)
4. International Padel Federation. *List of IPF Associated Countries*; International Padel Federation: Lausanne, Switzerland, 2020.
5. Sánchez-Alcaraz, B.J.; Martínez, J.C.; Pay, A.S.; Muñoz, D. Investigación en pádel. Revisión sistemática. *Padel Sci. J.* **2023**, *1*, 71–105. [\[CrossRef\]](#)
6. Courel-Ibáñez, J.; Sánchez-Alcaraz, B.J.; Muñoz, D. Exploring game dynamics in padel: Implications for assessment and training. *J. Strength Cond. Res.* **2019**, *33*, 1971–1977. [\[CrossRef\]](#)
7. García-Benítez, S.; Courel-Ibáñez, J.; Pérez-Bilbao, T.; Felipe, J.L. Game responses during young padel match play. *J. Strength Cond. Res.* **2018**, *32*, 1144–1149. [\[CrossRef\]](#)
8. Sañudo, B.; De Hoyo, M.; Carrasco, L. Structural characteristics and physiological demands of the paddle competition. *Apunts* **2008**, *94*, 23–28.
9. Courel-Ibáñez, J.; Sánchez-Alcaraz, B.J. Effect of situational variables on points in elite padel players. *Apunts* **2017**, *127*, 68–74.
10. Courel-Ibáñez, J.; Sánchez-Alcaraz, B.J.; Cañas, J. Game performance and length of rally in professional padel players. *J. Hum. Kinet.* **2017**, *55*, 161–169. [\[CrossRef\]](#)
11. Priego-Quesada, J.I.; Olasso-Melis, J.; Llana-Belloch, S.; Pérez-Soriano, P.; González-García, J.C.; Sanchís-Almenara, M. Padel: A quantitative study of the shots and movements in the high-performance. *J. Hum. Sport Exerc.* **2013**, *8*, 925–931. [\[CrossRef\]](#)
12. Ramón-Llín, J.; Guzmán, J.; Llana, S.; Vuckovic, G.; Muñoz, D.; Sánchez-Alcaraz Martínez, B.J. Analysis of distance covered in padel based on level of play and number of points per match. *Retos* **2020**, *39*, 205–209. [\[CrossRef\]](#)
13. Ramón-Llín, J.; Guzmán, J.; Llana, S.; Vučković, G.; James, N. Comparison of distance covered in paddle in the serve team according to performance level. *J. Hum. Sport Exerc.* **2013**, *8*, S738–S742. [\[CrossRef\]](#)
14. Muñoz, D.; Sánchez-Alcaraz, B.J.; Courel-Ibáñez, J.; Díaz, J.; Julian, A.; Munoz, J. Differences in winning the net zone in padel between professional and advance players. *J. Sport Health Res.* **2017**, *9*, 223–231.
15. Courel-Ibáñez, J.; Sánchez-Alcaraz, B.J.; Cañas, J. Effectiveness at the net as a predictor of final match outcome in professional padel players. *Int. J. Perform. Anal. Sport* **2015**, *15*, 632–640. [\[CrossRef\]](#)
16. Sánchez-Alcaraz, B.J.; Muñoz, D.; Pradas, F.; Ramón-Llín, J.; Cañas, J.; Sánchez-Pay, A. Analysis of serve and serve-return strategies in elite male and female padel. *Appl. Sci.* **2020**, *10*, 6693. [\[CrossRef\]](#)
17. McGarry, T.; O'Donoghue, P.; Sampaio, J. *Routledge Handbook of Sports Performance Analysis*; Routledge: London, UK, 2013.
18. Sánchez-Alcaraz, B.J.; Courel-Ibáñez, J.; Cañas, J. Temporal structure, court movements and game actions in padel: A systematic review. *Retos* **2018**, *33*, 221–225.
19. Torres-Luque, G.; Ramirez, A.; Cabello-Manrique, D.; Nikolaidis, T.P.; Alvero-Cruz, J.R. Match analysis of elite players during paddle tennis competition. *Int. J. Perform. Anal. Sport* **2015**, *15*, 1135–1144. [\[CrossRef\]](#)
20. Sánchez-Alcaraz, B.J. Game actions and temporal structure differences between male and female professional paddle players. *Acción Motriz* **2014**, *12*, 17–22.
21. Ramón-Llín, J.; Guzmán, J.F.; Llana, S.; James, N.; Vučković, G. Analysis of padel rally characteristics for three competitive levels. *Kinesiol. Slov.* **2017**, *23*, 39–49.
22. Sánchez-Alcaraz, B.J. Padel tactic in initiation stage. *Trances Rev. De Transm. Del Conoc. Educ. Y De La Salud* **2013**, *5*, 109–116.
23. Carrasco, L.; Romero, S.; Sañudo, B.; de Hoyo, M. Game analysis and energy requirements of paddle tennis competition. *Sci. Sports* **2011**, *26*, 338–344. [\[CrossRef\]](#)
24. García-Benítez, S.; Pérez-Bilbao, T.; Echegaray, M.; Felipe, J.L. The influence of gender on temporal structure and match activity patterns of professional padel tournaments. *Cult. Cienc. Deporte* **2016**, *11*, 241–247. [\[CrossRef\]](#)
25. Muñoz, D.; Courel-Ibáñez, J.; Sánchez-Alcaraz, B.J.; Díaz, J.; Grijsota, F.J.; Munoz, J. Analysis of the use and effectiveness of lobs to recover the net in the context of padel. *Retos* **2017**, *31*, 19–22.

26. Sánchez-Alcaraz, B.J.; Courel-Ibáñez, J.; Muñoz, D.; Infantes, P.; Sáez de Zaramán, F.; Sánchez-Pay, A. Analysis of the attack actions in professional padel. *Apunts* **2020**, *142*, 29–34. [\[CrossRef\]](#)
27. Ramón-Llin, J.; Guzmán, J.; Martínez-Gallego, R.; Muñoz, D.; Sánchez-Pay, A.; Sánchez-Alcaraz, B.J. Stroke analysis in padel according to match outcome and game side on court. *Int. J. Environ. Res. Public Health* **2020**, *17*, 7838. [\[CrossRef\]](#)
28. Sánchez-Alcaraz, B.J.; Perez-Puche, D.T.; Pradas, F.; Ramón-Llin, J.; Sánchez-Pay, A.; Muñoz, D. Analysis of Performance Parameters of the Smash in Male and Female Professional Padel. *Int. J. Environ. Res. Public Health* **2020**, *17*, 7027. [\[CrossRef\]](#)
29. Escudero-Tena, A.; Fernández-Cortes, J.; García-Rubio, J.; Ibáñez, S.J. Use and efficacy of the lob to achieve the offensive position in women's professional padel. Analysis of the 2018 wpt finals. *Int. J. Environ. Res. Public Health* **2020**, *17*, 4061. [\[CrossRef\]](#)
30. Ramón-Llin, J.; Guzmán, J.F.; Llana, S.; Martínez-Gallego, R.; James, N.; Vučković, G. The effect of the return of serve on the server pair's movement parameters and rally outcome in padel using cluster analysis. *Front. Psychol.* **2019**, *10*, 1194. [\[CrossRef\]](#)
31. Shim, J.; Carlton, L.G.; Kwon, Y.H. Perception of Kinematic Characteristics of Tennis Strokes for Anticipating Stroke Type and Direction. *Res. Q. Exerc. Sport* **2006**, *77*, 326–339. [\[CrossRef\]](#)
32. Baiget, E.; Corbi, F.; López, J.L. Influence of anthropometric, ball impact and landing location parameters on serve velocity in elite tennis competition. *Biol. Sport* **2022**, *40*, 273–281. [\[CrossRef\]](#)
33. King, M.A.; Kentel, B.B.; Mitchell, S.R. The effects of ball impact location and grip tightness on the arm, racquet and ball for one-handed tennis backhand groundstrokes. *J. Biomech.* **2012**, *45*, 1048–1052. [\[CrossRef\]](#)
34. Abernethy, B.; Gill, D.P.; Parks, S.L.; Packer, S.T. Expertise and the perception of kinematic and situational probability information. *Perception* **2001**, *30*, 233–252. [\[CrossRef\]](#) [\[PubMed\]](#)
35. Shim, J.; Carlton, L.G.; Chow, J.W.; Chae, W. The use of anticipatory visual cues by highly skilled tennis players. *J. Mot. Behav.* **2005**, *37*, 164–175. [\[CrossRef\]](#)
36. Sánchez-Alcaraz, B.J.; Martínez-Gallego, R.; Llana, S.; Vučković, G.; Muñoz, D.; Courel-Ibáñez, J.; Sánchez-Pay, A.; Ramón-Llin, J. Ball Impact Position in Recreational Male Padel Players: Implications for Training and Injury Management. *Int. J. Environ. Res. Public Health* **2021**, *18*, 435. [\[CrossRef\]](#)
37. Vučković, G.; Perš, J.; James, N.; Hughes, M. Tactical use of the T area in Squash by players of differing standard. *J. Sports Sci.* **2009**, *27*, 863–871. [\[CrossRef\]](#)
38. Vučković, G.; Perš, J.; James, N.; Hughes, M. Measurement error associated with the Sagit/squash computer tracking software. *Eur. J. Sport Sci.* **2010**, *10*, 129–140. [\[CrossRef\]](#)
39. Soto, A.; Camerino, O.; Anguera, M.T.; Iglesias, X.; Castañer, M. LINCE PLUS Software for Systematic Observation Studies of Sports and Health. *Behav. Res. Methods* **2022**, *54*, 1263–1271. [\[CrossRef\]](#)
40. Randolph, J.J. *Free-Marginal Multirater Kappa: An Alternative to Fleiss' Fixed-Marginal Multirater Kappa*; Joensuu Learning and Instruction Symposium: Joensuu, Finland, 2005.
41. Altman, D.G. *Practical Statistics for Medical Research*; Chapman and Hall: London, UK, 1991.
42. Cohen, J. Statistical Power Analysis for the Behavioural Science. In *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed.; Hillsdale: Lawrence Erlbaum, 1988.
43. Cohen, J. Quantitative methods in psychology: A power primer. *Psychol. Bull.* **1992**, *112*, 155–159. [\[CrossRef\]](#)
44. Courel-Ibáñez, J.; Sánchez-Alcaraz, B.J. The role of hand dominance in padel: Performance profiles of professional players. *Motricidade* **2018**, *14*, 33–41. [\[CrossRef\]](#)
45. Martín-Lorente, E.; Campos, J.; Crespo, M. The inside out forehand as a tactical pattern in men's professional tennis. *Int. J. Perform. Anal. Sport* **2017**, *17*, 429–441. [\[CrossRef\]](#)
46. Martín, E.; Campos, J.; Crespo, M. The inside out stroke in men's tennis: Strategies and tactics. *ITF Coach. Sport Sci. Rev.* **2018**, *74*, 20–23.
47. Sánchez-Alcaraz, B.J.; Jiménez, V.; Muñoz, D.; Ramón-Llin, J. Effectiveness and distribution of attack strokes to finish the point in professional padel. *Rev. Int. Med. Cienc. Act. Fis. Deporte* **2022**, *22*, 635–648.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.