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Analysis of Off-The-Wall Smash Shots in Men's and Women's Professional Padel

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Abstract

Purpose: our aim was to analyze the characteristics of the off-the-wall smash in men´s and women´s padel, and to compare gender differences in the set-dependent frequency of these shots. Study sample: through systematic observation, we analyzed 441 off-the-wall smashes from the Final Master of the 2022 season of the World Padel Tour. Results: showed that the women performed twice as many off-the-wall smashes as the men. This shot was executed most frequently (90%) from the center and right side of the court and from the dominant side, usually providing volley continuity (73%) and sometimes resulting in point winners (21.5%). Furthermore, there were gender differences, depending on the defense zone from which the wall smashes were defended (p = .014) and on the final match result (p = .018). In men's padel, the losing pair performed more off-the-wall smashes, while in women's padel, the winning pair performed more of these smashes. Finally, between both genders, most off-the-wall smashes occurred in the first set and decreased in number in the third set, with the second set containing the fewest off-the wall smashes.

Keywords

smash, game analysis, racquet sports, gender, padel tactics

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Introduction

Padel is a racquet sport played in pairs on a 20 × 10-m court, divided by a central net, with an outer enclosure of a glass or fence wall four meters high at the bottom and four and three meters on the sides, against which the ball can bounce during the game (International Padel Federation, 2023a). Padel has had an exponential growth in recent decades (Courel-Ibáñez et al., 2017), and it is practiced by players of different ages and competitive levels due to the simplicity of its rules and the fact that its physical and technical-tactical demands are adapted to the level of play (Courel-Ibáñez et al., 2018; García-Benítez et al., 2018). The sport is currently practiced in more than 70 countries, which has led in recent years to a significant increase in facilities, commercial agreements, and sports licenses. (International Padel Federation, 2023b; Muñoz, Sánchez-Alcaraz et al., 2016). In this context, the number of scientific studies on padel has also increased in recent years (García-Giménez et al., 2022; Martín-Miguel, Escudero-Tena et al., 2023; Sánchez-Alcaraz, Cánovas et al., 2022), with the most frequently studied padel topic being the analysis of performance in men´s and women´s professional padel (García-Benítez et al., 2018; Lupo et al., 2018; Martín-Miguel, Muñoz et al., 2023; Sánchez-Alcaraz, Pérez-Puche et al., 2020).

Regarding game actions, several authors have analyzed technical-tactical actions and the volume of play in three areas of the court: areas near the net, middle of the court or transition areas, and backcourt areas (Sánchez-Alcaraz, Muñoz, Escudero-Tena et al., 2022). Conde-Ripoll et al. (2021) showed that, in the backcourt, shots using one wall predominate, followed by shots using two walls. As these are the shots with the most errors, the strokes used in this area of the court are more defensive and conservative (Mellado-Arbelo et al., 2019; Ramón-Llín et al., 2020). In the transition and net areas, volleys and smashes are most frequent, with smashes most often resulting in winning points. Thus, strokes in these areas of the court tend to have a more offensive character (Escudero-Tena, Almonacid, et al., 2022; Escudero-Tena, Muñoz, et al., 2022; Sánchez-Alcaraz, Muñoz, Sánchez-Pay et al., 2022). The aim of the player pair who are in the baseline zone is to fight to occupy the net zone, and the aim of the player pair who are in the net zone is to fight to keep the net zone (Courel-Ibáñez, Sánchez-Alcaraz & Cañas, 2017).

From areas at the back of the court, the lob is the most often used, as this is an effective technical-tactical shot in both men´s and women´s professional padel for getting the offensive position in areas near the net. Thus, the lob shot causes an exchange of positions between player pairs (Escudero-Tena et al., 2020; Muñoz, Courel-Ibáñez et al., 2017; Muñoz, Sánchez-Alcaraz et al., 2017). However, the point does not necessarily end with such an exchange, as there are usually more position exchanges during the same point sequence, with the exchanges ending when the pair who has achieved the offensive position wins the point (Escudero-Tena et al., 2020). Authors of a recent systematic review reported that up to 50%

of men's shots are ground shots, and almost 80% of women's shots are lob shots (Martín-Miguel, Escudero-Tena et al., 2023). This means that there are more team position exchanges during the same point sequence in women´s professional padel than in men´s, as was found by Escudero-Tena, Gómez-Ruano, et al. (2023).

In relation to the smashes that take place after a lob, sports researchers have focused on a joint analysis of different smash shots that are performed over the head, classifying them as *bandeja*, flat smash, topspin smash and off the wall smash (Sánchez-Alcaraz, Pérez-Puche et al., 2020), or, following the variables of the validated Observational Analysis of the Smash in Padel (OASP) tool (Escudero-Tena, Antúnez, et al., 2023), classifying them by type of spin (flat, topspin and slice), and final landing point (own court, opponent's court, x3 and x4) (Escudero-Tena, Parraca, et al., 2023). Thus, the flat spin (and topspin in men's padel) and the down the line direction are predominant types of smashes to achieve a winning point in men's and women's professional padel (Escudero-Tena, Parraca, et al., 2023; Sánchez-Alcaraz et al., 2023; Sánchez-Alcaraz, Pérez-Puche et al., 2020), but the proportion of winning points decreases the farther these shots are performed from the net. The slice spin and cross-court direction is the predominant type of smash when errors are committed.

A review of padel literature, shows that previous researchers analyzed different types of smashes collectively as a group, without focusing on any one type of smash (Sánchez-Alcaraz, Pérez-Puche et al., 2020). The off-the-wall smash is a unique shot, because it combines offensive and defensive characteristics. It is an overhead shot that often results in winning points (Escudero-Tena, Almonacid, et al., 2022), but it is performed at the back of the court, where defensive shots are typically played due to the high number of errors associated with them (Mellado-Arbelo et al., 2019). Therefore, the off-the-wall smash can provide teams in defensive positions an advantage. In addition, gender differences have been observed in the number of smashes (flat and topspin) and *bandejas* played, as well as in their directions and effectiveness (Sánchez-Alcaraz, Pérez-Puche et al., 2020). These gender differences are likely due to differing anthropometric characteristics of each gender (Sánchez-Muñoz et al., 2020). Comparing playing styles between players of different genders can help coaches and players adapt training sessions and tactics according to gender-specific needs. Finally, it has been observed that the number of winning points from off-the-wall smashes is higher than the number of errors made with these shots in both men's and women's professional padel (Escudero-Tena, Muñoz, et al., 2022). However, to the best of our knowledge, no researchers have analyzed the specific characteristics of off-the-wall smashes in professional padel. Therefore, our aim in this study was to analyze the characteristics of off-the-wall smashes in men's and women's professional padel, while comparing differences between men and women in the frequency of these shots according to the set.

Method

Research Design and Ethical Considerations

This research methodology was quantitative and descriptive, using an arbitrary code to record natural observation during professional padel play. In addition, this investigation was empirical, nomothetic, cross-sectional, and multidimensional (Ato et al., 2013). We conducted the study according to the guidelines of the Declaration of Helsinki (World Medical Association, 2013), and the research protocol was approved in advance by University of Extremadura Ethics Committee (154/2020). As we were observing public play that was intended to be observed, no informed participant consent was necessary.

Participant Sample

We systematically observed and analyzed 441 off-the-wall smashes (150 men's and 291 women's) from 14 matches (seven men's and seven women's) in the Barcelona Final Master tournament of the 2022 season of the official World Padel Tour (WPT) circuit. We selected these tournaments and matches to include observations of the highest-ranked players and ensure that our summary of optimal techniques and tactics was not influenced by the play of lower-level players. This tournament included 32 players, 16 men (*M* age = 30.18, *SD* = 6.23 years; *M* height = 1.81, *SD* = 0.04 m) and 16 women (*M* age: = 32.31, *SD* ± = 5.92 years; *M* height = 1.61, *SD* = 0.04 m). The 16 players of each sex who we observed were those with the best ranking, according to official WPT ranking during the 2022 season.

Observed Variables

Following methods developed by Anguera and Hernández-Mendo (2016), we defined and observed the following variables:

- Gender: We were interested in men´s and women´s performances, because we suspected important differences between them.
- Set: We grouped observational data were grouped according to whether they were recorded in the first, second or third set.
- Playing Situation: We distinguished between observations made when a player pair was a serving or returning Because we suspected tactical relevance to this distinction.
- Side of the Court: According to Sánchez-Alcaraz, Martínez-Gallego et al. (2022), we divided court areas into three zones of 3.33 m (m) each because area of play has had an important connection to game tactics. We also differentiated between shots hit on the left side of the court, those hit on the right side of the court, and those hit in the center of the court for similar reasons (see Figure 1).

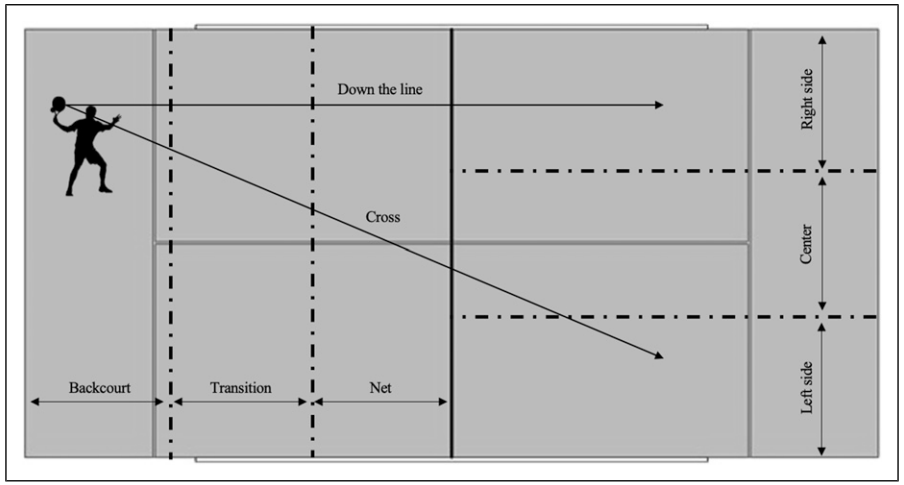

Figure 1. Areas of the Padel Court.

- Player Making the Shot: We distinguished between players on the left side and right side of the court for relevance of this positioning to team tactics.
- Type of Off-the-Wall Smash: We classified types of these smashes according to the hitting side, the dominant side or off-the-wall forehand smashes and non-dominant side or off-the-wall backhand smashes because prior investigators have neglected these distinctions.
- Direction of the Shot: According to previous findings (Escudero-Tena, Parraca, et al., 2023; Sánchez-Pay et al., 2023), we classified shot directions into two trajectories - cross directional (the ball is hit diagonally by the player, to the opposite side of the court from their position) and down-the-line (the ball is hit straight by the player, to the same side of the court from which they are playing) (see Figure 1).
- Effectiveness of the Shot: We differentiated between winning wall smash shots, errors (the point was lost after the off the wall smash) and continuity (the point sequence continued after the off the wall smash) because these results have tactical implications (Courel-Ibáñez et al., 2018).
- Opponents' Playing Zones: We recorded the opponent's position when they received the wall smash we observed, classifying these positions into three zones: backcourt (a 3m zone from the wall to the service line), transition (a 3.5 m zone from the service line to 1/3 of the ocourt area) and the net (a 3.5 m zone from 1/3 of the court area to the net) because these zones have shown tactical player decision-making relevance (Sánchez-Alcaraz, Pérez-Puche et al., 2020) (see Figure 1).

– Result of the Match: We differentiated between play that was associated with a player pair either winning or losing the match because of its importance to understanding the result of game tactics.

Procedure

The analyzed matches were streamed and subsequently hosted on the WPT TV website (https://www.worldpadeltourtv.com/), from which we downloaded and saved them for our observations, data collection, and data analyses. For this recording and data collection process, we used the specialized software, LINCE (Gabin et al., 2012), and we designed an ad-hoc instrument to analyze the variables under study. We then used, open-source Kinovea software (V.0.8.15;, www.kinovea.org) to place nine visual grids over the video image of the court area for our data recording. The software's grids differentiated the backcourt, transition, and net areas of the court, as well as the left, center, and right side of the court, enabling objective observation of the playing areas based on the specific measurement of each zone. A PhD student in Sports Sciences who was a certified padel coach with extensive published scientific research related to this study served as our first observer for the matches, recording all study variables. At the end of the collection process, we performed an intra-observer reliability analysis with Cohen's Kappa calculations to ensure the veracity of the data collected. The observer then reanalyzed a random sample of 70 off-the-wall smashes to ensure enough relevant data to represent 10%–20% of the study sample (Igartua, 2006). The mean intra-observer reliability was 0.95, considered almost perfect (Landis & Koch, 1977). A second observer, also holding a PhD in Sports Sciences and a certified padel coach with extensive published scientific research related to the topic of this study, also analyzed the random sample of 70 offthe-wall smashes observed by the first

Table 1. Intra-Observer and Inter-Observer Reliability.

	Intra-Observer	Inter-observer
Study variables	*K*	
Gender	1.00	1.00
Set	1.00	1.00
Playing situation	1.00	0.95
Side of the court	0.82	0.79
Player making the shot	1.00	0.98
Type of off the wall smash	1.00	0.94
Direction of the shot	0.83	0.79
Effectiveness of the shot	1.00	0.92
Playing zone of the opponents	0.87	0.77
Result of the match	1.00	1.00
Total	0.95	0.91

observer to permit calculation of average inter-observer reliability between the two observors. The result was inter-rater reliability of, 0.91 (Landis & Koch, 1977). According to Altman (1990), the kappa values obtained reflected very good strength of agreement (>0.80). Table 1 shows the value of the Cohen's Kappa coefficient (K) used for each of the study variables (Cohen, 1968). Finally, the statistical analyses were carried out and the study was written up.

Statistical Analysis

The recorded variables met criteria for normality of data distributions (Field, 2018), permitting us to use parametric inference statistics for testing our hypotheses. We performed a descriptive analysis of these data for the number of times each categorical study variable occurred (using frequency and percentage). We then conducted an inferential analysis by developing contingency tables, including Pearson´s Chi-square ($\chi 2$) statistical test to understand the association between variables. We calculated the strength of the associations between variables, for which we used Cramer's V coefficient (Vc) (Field, 2018). In interpreting these findings, we followed Crewson's (2006) differentiation of the strength of association according to which the Vc values are considered small (<0.100), low (0.100–0.299), moderate (0.300–0.499) or high (>0.500) associations. In addition, we performed subsequent Z-tests to compare column proportions, adjusting for p values <0.05, according to Bonferroni. Contingency tables allowed the identification of associations between variable categories through corrected standard residuals (CSR). Residuals > |1.96| betrayed cells with more or fewer cases than there should be (Field, 2018). We set statistical significance at $p < .05$, and we performed statistical analyses using the SPSS 27.0 statistical package for Windows.

Results

Table 2 shows a descriptive analysis of observed variables related to the off-the-wall smash in professional padel. The women performed twice as many off-the -smashes as the men; and almost two of three off-the-wall smashes were performed by the serving player pair. Most off-the wall smash shots (80%) were performed from the center and right side of the court (center: 40%; right side: 40%), with only 20% executed from the left side. Players on the right side of the court performed more off-the-wall smashes than players on the left, with over 90% of these shots performed from the dominant side and 63.5% directed down the line. Among these smash shots, 70%led to point continuity but only 20% were winning shots, and less than 10% were errors. For 73.7% of these shots, the rival pair was in areas close to the net. Finally, the winning player pair made 13% more down-the-wall shots than the losing pair.

Table 3 shows the differences between the men and women in their off-the-wall smash shots. There were no significant sex differences in these off-the-wall smashes according to the game situation, the side of the court, the player performing the off-the-wall smash, the types of off-the-wall smashes, the direction of these smashes, the type

Table 2. Descriptive Analysis of Observed Variables Related to the Off-The-Wall Smash.

	N	%
Gender of players		
Men	150	34.0
Women	291	66.0
Game situation		
Serving	283	64.2
Returning	158	35.8
Side of the court		
Left	86	19.5
Center	175	39.7
Right	180	40.8
Player making the shot		
Right side of the court	253	57.8
Left side of the court	186	42.2
Type of off-the-wall smash		
Forehand	402	91.2
Backhand	39	8.8
Direction of the shot		
Down the line	280	63.5
Cross	161	36.5
Hitting efficiency		
Winner	95	21.5
Continuity	312	70.7
Error	34	7.7
Zone of the opponents on the court		
Net	325	73.7
Back	51	11.6
Transition	65	14.7
Result of the match		
Winning pair	249	56.5
Losing pair	192	43.3

Note. N: number; %: percentage.

of point, or the efficiency of the shot. However, significant differences were evident between the men and women in the opponent's zone on the court and the results of the match; with a low association between these variables (0.113–0.139), based on Cramer's V results. With respect to the opponent's zone on court when the off-the-wall smash was performed, the women defended this shot significantly more often from the back of the court ($p = .014$) (CSR = 2.6). On the other hand, with respect to the match outcome, the off-the-wall smash was significantly more match-determinant for women's play ($p = .018$) for whom the winners of the match performed 20% more

Table 3. Gender Differences in Off-The-Wall Smash Shots.

		Men			Women					
Variables	Categories	*N*	%	CSR	*N*	%	CSR	*p*	$\chi 2$	Vc
Game situation	Serving	97	64.7a	0.2	186	63.9a	−0.2	0.876	0.024	0.007
	Returning	53	35.3a	−0.2	105	36.1a	0.2			
Side of the court	Left	28	18.7a	−0.3	58	19.9a	0.3	0.117	4.296	0.099
	Center	51	34.0a	−1.8	124	42.6a	1.8			
	Right	71	47.3a	2.0	109	37.5b	−2.0			
Player making the shot	Right side of the court	91	60.7a	1.0	162	55.7a	−1.0	0.516	1.323	0.055
	Left side of the court	59	38.7a	−1.0	129	44.0a	1.0			
Type of off the wall smash	Forehand	137	91.3a	0.1	265	91.1a	−0.1	0.925	0.009	0.004
	Backhand	13	8.7a	−0.1	26	8.9a	0.1			
Direction of the shot	Down the line	91	60.7a	−0.9	189	64.9a	0.9	0.376	0.783	0.042
	Cross	59	39.3a	0.9	102	35.1a	−0.9			
Hitting efficiency	Winner	35	23.3a	0.7	60	20.6a	−0.7	0.653	0.851	0.044
	Continuity	102	68.0a	−0.9	210	72.2a	0.9			
	Error	13	8.7a	0.5	21	7.2a	−0.5			
Zone of the opponent on the court	Net	113	75.3a	0.6	212	72.9a	−0.6	0.014*	8.548	0.139
	Back	9	6.0a	−2.6	42	14.4b	2.6			
	Transition	28	18.7a	1.7	37	12.7a	−1.7			
Result of the match	Winning pair	73	48.7a	−2.4	176	60.5b	2.4	0.018*	5.620	0.113
	Losing pair	77	51.3a	2.4	115	39.5b	−2.4			

Note. *N*: number; %: percentage; CSR: corrected standard residuals; *p*: *p*-value; $\chi 2$: chi-square; Cramer's Vc: Cramer's V; a, b: indicate significant differences in the Z tests for comparison of column proportions from $p < .05$ adjusted according to Bonferroni.

off-the-wall smash shots than the losers of the match. However, among men, there were approximately the same numbers of off-the-wall shots that resulted in winning and losing the match.

Figure 2 shows the number of off-the-wall smashes as a function of set number, differentiating between women's padel and men's padel. Women made more than twice as many off-the-wall smashes as men in each of the three sets. Moreover, in both men's and women's padel, there were fewer off-the-wall smashes from the first to the second set. There was a slight increase of off-the-wall smash shots in the third set for both men and women.

Discussion

We aimed in this study to analyze the characteristics of off-the-wall smash shots in men's and women's professional padel, and to compare sex differences in

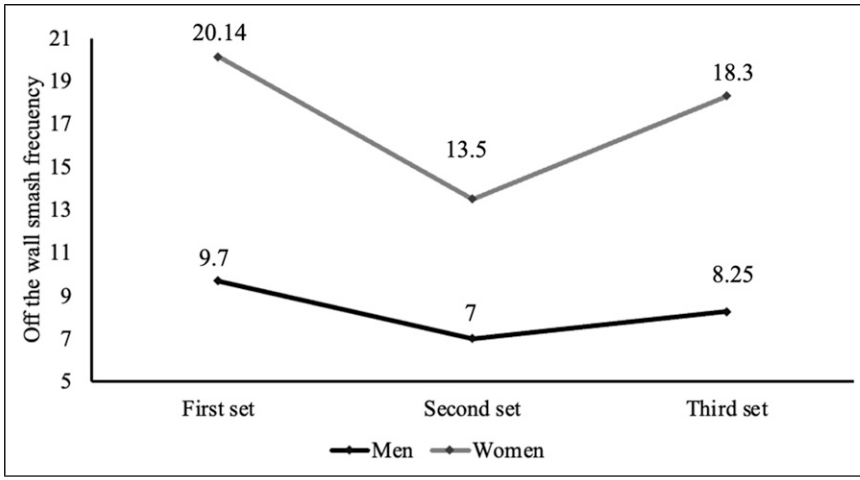

Figure 2. Number of Off-the-Wall Wmashes as a Function of Set.

off-the-wall smash shot frequencies by set. We found that serving players performed a higher percentage of off-the-wall smashes than did returners. Others have shown that, to obtain more chances to get a point and win the match, teams must occupy, for as long as possible, the areas close to the net, where 80 % of points are scored (Courel-Ibáñez, et al., 2015). The serve allows the serving pair to position themselves close to the net at the beginning of the point sequence (Ramón-Llín et al., 2019), and this causes the opposing pair, located in the back areas of the court, to try, from the first moment, to reposition the serving pair, most frequently by using a lob shot (Escudero-Tena et al., 2020; Muñoz, Sánchez-Alcaraz et al., 2017). Thus, when the serving pair loses the net area due to a deep lob from their opponents, they next have an opportunity to perform an off-the-wall smash (an offensive hit from the back of the court). Logically then, the serving pair tends to perform a higher percentage of off-the-wall smashes than returners.

Secondly, our data showed that most off-the-wall smashes were performed from the center and right side of the court. This finding is consistent with those of other studies that found a higher percentage of shots from the back of the court in these two areas (Sánchez-Alcaraz, Muñoz, Escudero-Tena et al., 2022), and this finding is likely due to a greater use of the lob shot by the players who stand on the right side of the court, where effectiveness of the smash is higher. Likewise, we found that 90% of the off the wall smashes were made on the right. Escudero-Tena, Almonacid, et al. (2022) showed that losing players committed more errors than winners when making backhand shots; accordingly, players chose to hit more conservative technical-tactical shots than a backhand off-the-wall smash to minimize errors. In this context, coaches might assume two strategies. First, they should create training drills that involve a high number volume of off the wall smashes in the center and right areas of the court and that use another shot in the left area of the court.

Second, they should prepare players to anticipate an opponent team's off the wall smash from the center or right side and use another shot (e.g. a lob) from the left side of the court.

Taking into account the direction and effectiveness of the off-the-wall smash shot, we found that two of every three off-the-wall smash shots were down the line. Previous studies reported a greater use of crossed trajectories in padel compared to down the line shots (Mellado-Arbelo et al., 2019; Ramón-Llín et al., 2020), since directing the ball towards lateral areas increases the difficulty of returning the ball and causes an increase in the opponent team's errors (Courel-Ibáñez et al., 2019; Sánchez-Alcaraz et al., 2021); but in the case of winning smashes, down the line trajectories are predominant (Escudero-Tena, Parraca, et al., 2023). In the specific case of the off-the-wall smash, since the opposing pair is usually at the net, performing a down the line off-the-wall smash decreases the opponent's reaction time and increases the chances of a point winning shot. Yet, due to the opponent team's predominant net proximal position, the vast majority off-the-wall smashes led to continuity in the game (Sánchez-Alcaraz, Pérez-Puche et al., 2020). While the off-the-wall smash shot serves as a counterattack, the percentage of winners is higher compared to another type of smash, such as the *bandeja* (Sánchez-Alcaraz, Pérez-Puche et al., 2020). Consequently, data from our study enable players and coaches to anticipate the play in competition. The two team members that make the off-the-wall smash will typically press with a second shot to try to finish the point, as the smash shot usually generates continuity. On the other hand, the opposing pair will likely swing, closing the gaps in the court towards the player who intends to hit the off-the-wall smash, and this can leave the cross court less well defended if the wall shots are down the line.

Regarding sex differences in the off-the-wall smash, our results showed that the women performed it more often than men. Results from previous studies of professional play corroborate these data (Escudero-Tena, Almonacid, et al., 2022), and they reveal a greater use of the lob shot by women (Sánchez-Alcaraz, Ramón-Llin et al., 2022) and suggest that gender-related anthropometric characteristics of female players (Muñoz et al., 2022; Pradas et al., 2015, 2021; Sánchez-Muñoz et al., 2020), cause them to hit a ball more often from the back zone after the ball bounces on the ground rather than hitting from the transition zone into a more unfavorable position. Thus, coaches who train women should give more importance and training frequency to the off-the-wall smash stroke than do coaches of men.

On the other hand, with respect to the position of the opposing players at the time the off-the-wall smash, we observed that, although on most occasions players of both sexes tended to defend the off-the-wall smash in the net proximal zone, while women tended to defend it in the defense zone more often than men. Although no investigators to date have analyzed this type of data, it is likely that there is a greater tendency for men to perform more shots in areas close to the net and for women to perform more shots from the middle or back of the court (Lupo et al., 2018; Torres-Luque et al., 2015). Our results differentiated between a more offensive type of play by men who tended to occupy offensive positions after launching the lob, and a more defensive style by women who more often opted to defend in the backcourt areas. Furthermore, these

findings suggest that players adjust the intensity and height of their off-the-wall smash shots so that, if the opponents defend this shot at the backcourt, smash shot makers can afford to play with more margin, reducing their intensity and passing the ball further away from the net to take fewer risks.

Considering match results, we found that, in men's padel, the losing pair performed more off-the-wall smashes than the winning pair, concurring with Courel-Ibáñez et al.'s (2019) finding that the pair that played more shots from the back of the court tended to lose the match. On the other hand, in women's padel, we found that the winning pair tended to perform this shot more often than the losing pair, consistent with other findings that women play with fewer winning shots, fewer powerful smashes with topspin, and more shots from defensive zones (Escudero-Tena et al., 2021; Sánchez-Alcaraz, Jiménez et al., 2022; Sánchez-Alcaraz, Pérez-Puche et al., 2020). Thus, women tended to use the off-the-wall smash more as a shot as a defensive tactic that allowed them to win the match. These data suggest that men may benefit from using a lob shot behind the wall or a *bandeja* to avoid losing the net and to increase their chances of winning the match., while women may find it advantageous to hit an off-the-wall smash instead of a poorly positioned overhead shot, as this tactic increased their chances of winning the match. Thus, coaches should create gender-specific drills and tactical situations to increase or decrease the use of the off-the-wall smash.

Finally, with respect to the number of off-the-wall smashes in relation to set number, we observed that women played more than twice as many off-the-wall smashes as men in each of the three sets. In both men's and women's padel, there was a decrease in the number of off-the-wall smashes from the first to the second set, and in the third set there appeared to be a slight increase in the number of off-the-wall smashes in both groups. First, the higher number of these smashes in the first set may be due to less accumulated fatigue early in the match, compared to the following sets (Cádiz-Gallardo et al., 2023), allowing for more effective lobs and a higher number of shots per point sequence (Muñoz, García-Fernández et al., 2016). On the other hand, the decrease in the frequency of these smashes in the second set may be due to less accuracy in the lob and a greater use of other types of smashes to keep the net (Martín-Miguel, Escudero-Tena et al., 2023). Another increase of these smashes in the third set could be due to the accumulated fatigue that hinders hitting in a proper position. Coaches, especially those of women, should encourage increasing the number of off-the-wall smashes at the end of the training sessions to help immunize players against this accumulated fatigue.

Limitations and Directions for Further Research

Among the limitations that should be considered when interpreting these results, our study's sample size, while large by comparison to past studies, was still problematic for broad generalizations to other populations. Future researchers might analyze a greater number of shots by expanding the number of tournaments and players studied. Also, we only analyzed the off-the-wall smash shot, without considering previous or subsequent

shots, and these further considerations might help us better understand the full context of this shot.

Conclusion

The information we obtained through this study will allow professional padel coaches to design sex specific training tasks for their players' technical and tactical improvements, with a particular focus on both offensive and defensive approaches to the off-the wall smash shot for men and women, respectively. Likewise, these data will allow further testing of new hypotheses about competitive padel play to provide specific feedback on the key aspects of the off-the-wall smash shot, to increase its effectiveness and optimize padel player performance. Our specific findings were:

In women's padel, twice as many off-the-wall smashes were performed as in men's padel, with greater use of this shot in the first set in both genders, followed by the third set and finally the second set.

- Serving players played almost two out of three off-the-wall smashes, both in men's and women's professional padel.
- Both men and women performed most of the off-the-wall smashes from the right (dominant) side or from the center of the court, with more than 90% being down the right.
- The predominant direction for off-the-wall smash sots was down the line versus cross court, in both men's and women's professional padel.
- The off-the-wall smash shot produced continuity in the point sequence in more than 70% of its occurrences in men's and women's padel, while about 20% of these shots were winning shots and errors occurred in 10% of them.
- The opposing player pair in men's padel tended to defend this shot at the net; but women players tended to defend it more often in the back court.
- In men's padel, the losing pair played more off-the-wall smashes; in women's padel, the winning pair played more off-the-wall smashes.

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References

Altman, D. G. (1990). *Practical statistics for medical research*. Chapman and Hall/CRC. https://doi.org/10.1201/9780429258589

Anguera, M. T., & Hernández-Mendo, A. (2016). Advances in observational studies in sport science from mixed methods. *Sport Psychology Notebooks*, *16*(1), 17–30.

Ato, M., López-García, J. J., & Benavente, A. (2013). A classification system for research designs in psychology. *Annals of Psychology*, *29*(3), 1038–1059. https://doi.org/10.6018/analesps.29.3.178511.

Cádiz-Gallardo, M. P., Pradas, F., Moreno-Azze, A., & Carrasco-Páez, L. (2023). Physiological demands of racket sports: A systematic review. *Frontiers in Psychology*, *14*, 1149295. https://doi.org/10.3389/fpsyg.2023.1149295.

Cohen, J. (1968). Weighted kappa: Nominal scale agreement provision for scaled disagreement or partial credit. *Psychological Bulletin*, *70*(4), 213. https://doi.org/10.1037/h0026256

Conde-Ripoll, R., Llanos-García, M. B., García-Sánchez, J. M., & Sánchez-Alcaraz, B. J. (2021). Analysis of wall strokes in professional padel. *Sports Training Journal*, *35*(2), 3–11.

Courel-Ibáñez, J., Sánchez-Alcaraz, B. J., & Cañas, J. (2017). Game performance and length of rally in professional padel players. *Journal of Human Kinetics*, *55*(1), 161–169. https://doi.org/10.1515/hukin-2016-0045

Courel-Ibáñez, J., Sánchez-Alcaraz, B. J., García-Benítez, S., & Echegaray, M. (2017). Evolution of padel in Spain according to practitioners´gender and age. *Culture, Science and Sport*, *12*(34), 39–46. https://doi.org/10.12800/ccd.v12i34.830.

Courel-Ibáñez, J., Sánchez-Alcaraz, B. J., & Muñoz, D. (2019). Exploring game dynamics in padel: Implications for assessment and training. *Journal of Strength and Conditioning Research*, *33*(7), 1971–1977. https://doi.org/10.1519/JSC.0000000000002126

Courel-Ibáñez, J., Sánchez-Alcaraz, B. J., Muñoz, D., Pérez, F. J. G., Herrera, R. C., & García, J. D. (2018). Gender reasons for practicing paddle tennis. *Notes: Physical Education and Sports*, *133*(3), 116–125. https://doi.org/10.5672/apunts.2014-0983.es.(2018/3).133.08.

Courel-Ibáñez, J., Sánchez-Alcaraz, J. B., & Cañas, J. (2015). Effectiveness at the net as a predictor of final match outcome in professional padel players. *International Journal of Performance Analysis in Sport*, *15*(2), 632–640. https://doi.org/10.1080/24748668.2015.11868820

Crewson, P. (2006). Applied statistics handbook. In *AcaStat Software: Leesburg, Virginia* (Vol. 1, pp. 103–123).

Escudero-Tena, A., Almonacid, B., Martínez, J., Martínez-Gallego, R., Sánchez-Alcaraz, B. J., & Muñoz, D. (2022). Analysis of finishing actions in men's and women's professional padel. *International Journal of Sports Science & Coaching*. in press.https://doi.org/10.1177/17479541221139970

Escudero-Tena, A., Antúnez, A., García-Rubio, J., & Ibáñez, S. J. (2023). Analysis of the characteristics of the smash in padel: Validation of the OASP instrument. *International Journal of Medicine and Physical Activity and Sport Sciences*, *23*(90), 64–84. https://doi.org/10.15366/rimcafd2023.90.006

Escudero-Tena, A., Courel-Ibáñez, J., García-Rubio, J., & Ibáñez, S. J. (2021). Sex differences in professional padel players: Analysis across four seasons. *International Journal of*

Performance Analysis in Sport, *21*(5), 651–662. https://doi.org/10.1080/24748668.2021.1930363

Escudero-Tena, A., Fernández-Cortes, J., García-Rubio, J., & Ibáñez, S. J. (2020). Use and efficacy of the lob to achieve the offensive position in women's professional padel. Analysis of the 2018 WPT Finals. *International Journal of Environmental Research and Public Health*, *17*(11), 4061. https://doi.org/10.3390/ijerph17114061

Escudero-Tena, A., Gómez-Ruano, M. Á., Ibáñez, S. J., Sánchez-Alcaraz, B. J., & Muñoz, D. (2023). Importance of maintaining net position in men's and women's professional padel. *Perceptual and Motor Skills*, *130*(5), 2210–2225. https://doi.org/10.1177/00315125231194402

Escudero-Tena, A., Muñoz, D., Sánchez-Alcaraz, B. J., García-Rubio, J., & Ibáñez, S. J. (2022). Analysis of errors and winners in men's and women's professional padel. *Applied Sciences*, *12*(16), 8125. https://doi.org/10.3390/app12168125

Escudero-Tena, A., Parraca, J. A., Sánchez-Alcaraz, B. J., Muñoz, D., Sánchez-Pay, A., García-Rubio, J., & Ibáñez, S. J. (2023). Analysis of the final shots in professional padel. *E-handball com*, *19*(2), 117–126. https://doi.org/10.17398/1885-7019.19.117

Field, A. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.): Sage Publications Ltd.

Gabin, B., Camerino, O., Anguera, M. T., & Castañer, M. (2012). Lince: Multiplatform sport analysis software. *Procedia - Social and Behavioral Sciences*, *46*, 4692–4694. https://doi.org/10.1016/j.sbspro.2012.06.320.

García-Benítez, S., Courel-Ibáñez, J., Pérez-Bilbao, T., & Felipe, J. L. (2018). Game responses during young padel match play: Age and sex comparisons. *Journal of Strength and Conditioning Research*, *32*(4), 1144–1149. https://doi.org/10.1519/JSC.0000000000001951

García-Giménez, A., Pradas, F., Castellar-Otín, C., & Carrasco-Páez, L. (2022). Performance outcome measures in padel: A scoping review. *International Journal of Environmental Research and Public Health*, *19*(7), 4395. https://doi.org/10.3390/ijerph19074395

Igartua, J. J. P. (2006). *Quantitative methods of communication research*. Bosh.

International Padel Federation. (2023a). *Rules of the game in padel*: IFJ. https://www.padelfip.com/es/

International Padel Federation. (2023b). *List of countries associated with the international padel federation*. https://www.padelfip.com/es/

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159–174. https://doi.org/10.2307/2529310.

Lupo, C., Condello, G., Courel-Ibáñez, J., Gallo, C., Conte, D., & Tessitore, A. (2018). Effect of gender and match outcome on professional padel competition. *RICYDE. International Journal of Sport Science*, *14*(51), 29–41. https://doi.org/10.5232/ricyde2018.05103

Martín-Miguel, I., Escudero-Tena, A., Muñoz, D., & Sánchez-Alcaraz, B. J. (2023). Performance analysis in padel: A systematic review. *Journal of Human Kinetics*, *89*, 213–230. https://doi.org/10.5114/jhk/168640.

Martín-Miguel, I., Muñoz, D., Escudero-Tena, A., Toro-Román, V., & Sánchez-Alcaraz, B. J. (2023). Differences in performance parameters between winning and losing pairs in men's and women's professional padel. *International Journal of Sports Science & Coaching*, *0*(0), 17479541231213544. https://doi.org/10.1177/17479541231213544.

Mellado-Arbelo, Óscar-Baiget, E., & Vivès-Usón, M. (2019). Analysis of the game actions in professional men's padel. *Culture, Science and Sport*, *14*(42), 191–201. https://doi.org/10.12800/ccd.v14i42.1332

Muñoz, D., Courel Ibáñez, J., Sánchez-Alcaraz, B. J., Díaz García, J., Grijota Pérez, F. J., & Muñoz Jiménez, J. (2017). Analysis of the use and effectiveness of the lob to achieve the net depending on the context of the game in padel. *Challenges, New Trends in Physical Education, Sport and Recreation*, (31), 19–22. https://doi.org/10.47197/retos.v0i31.48988.

Muñoz, D., García-Fernández, A., Grijota-Pérez, F. J., Díaz-García, J., Bartolome-Sánchez, I., & Muñoz-Jiménez, J. (2016). Influence of set duration on temporal variables of game in padel. *Notes: Physical Education and Sports*, (123), 69–75. https://doi.org/10.5672/apunts.2014-0983.es.(2016/1).123.08.

Muñoz, D., Sánchez-Alcaraz, B. J., Courel-Ibáñez, J., Díaz, J., Julián, A., & Muñoz, J. (2017). Differences between professional and advanced players in padel net-raising actions. *Journal of Sport and Health Research*, *9*(2), 223–232.

Muñoz, D., Toro-Román, V., Courel-Ibáñez, J., Sánchez-Pay, A., & Sánchez-Alcaraz, B. J. (2022). Height as a performance factor in professional padel: Gender differences. *Motor-action*(29), 93–103.

Muñoz, D., Sánchez-Alcaraz, B. J., Courel-Ibáñez, J., Romero-Pastelero, E., Grijota-Pérez, F. J., & Díaz-García, J. (2016). Study on the profile and distribution of padel courts in the Autonomous Community of Extremadura. *E-handball com*, *12*(3), 223–230.

Pradas, F., Cachón-Zagalaz, J., Otín-Benedí, D., Quintas-Hijós, A., Arraco-Castellar, S. I., & Castellar-Otín, C. (2015). Anthropometric, physiological and temporal analysis in elite female padel players. *Challenges, New Trends in Physical Education, Sport and Recreation*, (25), 107–112. https://doi.org/10.47197/retos.v0i25.34491.

Pradas, F., Sánchez-Pay, A., Muñoz, D., & Sánchez-Alcaraz, B. J. (2021). Gender differences in physical fitness characteristics in professional padel players. *International Journal of Environmental Research and Public Health*, *18*(11), 5967. https://doi.org/10.3390/ijerph18115967.

Ramón-Llin, J., Guzmán, J., Martínez-Gallego, R., Muñoz, D., Sánchez-Pay, A., & Sánchez-Alcaraz, B. J. (2020). Stroke analysis in padel according to match outcome and game side on court. *International Journal of Environmental Research and Public Health*, *17*(21), 7838. https://doi.org/10.3390/ijerph17217838.

Ramón-Llin, J., Guzmán, J. F., Llana, S., Martínez-Gallego, R., James, N., & Vučković, G. (2019). The effect of the return of serve on the server pair's movement parameters and rally outcome in padel using cluster analysis. *Frontiers in Psychology*, *10*, 1194. https://doi.org/10.3389/fpsyg.2019.01194.

Sánchez-Alcaraz, B. J., Cánovas, J., Sánchez-Pay, A., & Muñoz, D. (2022). Research in padel. Systematic review. *Padel Scientific Journal*, *1*(1), 71–105. https://doi.org/10.17398/2952-2218.1.71

Sánchez-Alcaraz, B. J., Ferrer, F., Zurano, A., Muñoz, D., & Ramón-Llin, J. (2021). Analysis of the double open wall stroke in professional padel. Differences between genders. *Motor-action*, *25*, 113–122.

Sánchez-Alcaraz, B. J., Jiménez, V., Muñoz, D., & Ramón-Llin, J. (2022). Efficiency and distribution of the final attacking strokes in professional padel. *International Journal of Medicine and Physical Activity and Sport Sciences*, *22*(87), 635–648. https://doi.org/10.15366/rimcafd2022.87.013

Sánchez-Alcaraz, B. J., Martínez-Gallego, R., Ramón-Llin Mas, J., Crespo, M., Muñoz, D., López Martínez, J. M., & Sánchez-Pay, A. (2022). Professional padel: Characteristics and effectiveness of the shots played to the fence. *International Journal of Sports Science & Coaching*, *0*(0 174795412210937). https://doi.org/10.1177/17479541221093765.

Sánchez-Alcaraz, B. J., Muñoz, D., Escudero-Tena, A., Martín-Miguel, I., & García, J. M. (2022). Analysis of hitting zones in professional padel. *Kronos*, *21*(2), 1–9.

Sánchez-Alcaraz, B. J., Muñoz, D., Ramón- Llín, J., Martínez-Gallego, R., Conde-Ripoll, R., & Sánchez-Pay, A. (2023). Research in performance analysis in padel. *Motor-action*, *31*, 118–132.

Sánchez-Alcaraz, B. J., Muñoz, D., Sánchez-Pay, A., Martín-Miguel, I., Piedra, D., & Barriocanal, I. (2022). Analysis of winning strokes and errors in professional padel. *Iberoamerican Journal of Physical Activity and Sport Sciences*, *11*(3), 85–97. https://doi.org/10.24310/riccafd.2022.v11i3.15474

Sánchez-Alcaraz, B. J., Pérez-Puche, D. T., Pradas, F., Ramón-Llín, J., Sánchez-Pay, A., & Muñoz, D. (2020). Analysis of performance parameters of the smash in male and female professional padel. *International Journal of Environmental Research and Public Health*, *17*(19), 7027. https://doi.org/10.3390/ijerph17197027.

Sánchez-Alcaraz, B. J., Ramón-Llin, J., González, R., Martínez-Gallego, R., & Sánchez-Pay, A. (2022). Analysis of the lob in male and female professional padel: A pilot study. *Padel Scientific Journal*, *1*(1), 39–54. https://doi.org/10.17398/2952-2218.1.39

Sánchez-Muñoz, C., Muros, J. J., Cañas, J., Courel-Ibáñez, J., Sánchez-Alcaraz, B. J., & Zabala, M. (2020). Anthropometric and physical fitness profiles of world-class pale padel players. *International Journal of Environmental Research and Public Health*, *17*(2), 508. https://doi.org/10.3390/ijerph17020508.

Sánchez-Pay, A., Sánchez-Jiménez, J., Escudero-Tena, A., Muñoz, D., Martín-Miguel, I., & Sánchez-Alcaraz, B. J. (2023). Analysis of the smash in junior men's and women's padel. *Culture, Science and Sport*, *18*(57), 37–55. https://doi.org/10.12800/ccd.v18i57.2012

Torres-Luque, G., Ramírez, A., Cabello-Manrique, D., Nikolaidis, T. P., & Alvero-Cruz, J. R. (2015). Match analysis of elite players during paddle tennis competition. *International Journal of Performance Analysis in Sport*, *15*(3), 1135–1144. https://doi.org/10.1080/24748668.2015.11868857

World Medical Association. (2013). World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *Jama*, *310*(20), 2191–2194. https://doi.org/10.1001/jama.2013.281053.

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