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ORIGINAL

INFLUENCE OF LOW-COMPRESSION BALLS IN PADEL INITATION STAGE

INFLUENCIA DE LAS PELOTAS DE BAJA PRESIÓN EN LA INICIACIÓN AL PÁDEL

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ABSTRACT

The aims of this study were to analyze the physical demands in padel initiation stage and to observe the influence of playing with different type of balls. Sixteen padel players at initiation stage (age: 10 ± 0.8 years) participated in this study. Matches were recorded and later analyzed. Players wore a heart rate (HR) monitor. Perceived exertion and satisfaction questionnaire were evaluated at the end of the matches. No differences were found in the match temporal structure. Playing with official balls caused a significant increase in HR ($p < 0.001$) both in average and maximal values (Average HR: 145 bpm, %HRmax: 72.5%) compared with low-compression balls (Average HR: 140 bpm,

%HRmax: 69.9%). In addition, players showed higher satisfaction when using low-compression balls. This information may have implications to determine the use of normal balls or low-compression balls and the design of specific training programmes for young padel players.

KEY WORDS: Raquet sports, equipment, formative, competition.

RESUMEN

Los objetivos de este estudio fueron analizar las demandas físicas en la iniciación al pádel y observar la influencia del uso de diferentes tipos de pelota. Dieciséis jugadores de pádel en etapas de formación (edad: 10 ± 0.8 años) participaron en este estudio. Los partidos fueron grabados y posteriormente analizados. Los jugadores llevaron un monitor de frecuencia cardíaca (FC) durante el partido. Se utilizaron cuestionarios al término de cada partido para evaluar el esfuerzo percibido y la satisfacción. Los resultados no mostraron diferencias estadísticamente significativas en la estructura temporal de los partidos. La FC media y % de $FC_{máx}$ fueron significativamente más altas ($p<0,001$) en los partidos jugados con pelota oficial (145 ppm, 72.5% $FC_{má}$) en comparación el uso de pelotas de baja presión (140 ppm, 69.9% $FC_{máx}$). Además, los jugadores mostraron una mayor satisfacción con el uso de pelotas de baja presión. Estos datos pueden servir de utilidad para determinar el uso de pelotas oficiales o pelotas de baja presión en el diseño de programas de entrenamiento específicos para jóvenes jugadores de pádel.

PALABRAS CLAVE: Deportes de raqueta, equipamiento, formación, competición.

1. INTRODUCCIÓN

Padel (also known as paddle or paddle tennis) is a recently created, doubles racket sport (Sánchez-Alcaraz, 2013). Over the last few years, padel has become very popular due to its easy to play and fun, being accesible for any age or gender (Courel-Ibañez, Sánchez-Alcaraz, García, & Echegaray, 2017). In addition, the number of padel facilities (Muñoz-Marín et al., 2016), and scientific research is increasing in Spain (Sánchez-Alcaraz, Cañas, & Courel-Ibáñez, 2015). The adoption of modern racket sports such as padel within the physical education lessons and school curriculum, emerges as an alternative to traditional sports and a new physical activity for students to practice in their leisure time (Díaz, Cantó, & Soto, 2013).

In padel, several investigations have explored temporal variables such as rally time, recovery time and total match time. In young padel players, rallies lasted 7 seconds in average, with a 9-second resting period between (Courel-Ibáñez, Sánchez-Alcaraz & Cañas, 2017; Sañudo, De Hoyo, & Carrasco, 2008), considering differences resulting from sex, age, the level of practice, the match status and the scoreboard (Courel-Ibáñez & Sánchez-Alcaraz , 2017; Pradas, Castellar, Coll, & Rapún, 2012; Sánchez-Alcaraz, Courel-Ibáñez, Díaz, Grijota

& Muñoz, 2019). In professional senior padel competitions, the rallies last longer (between 10-14 seconds), both in men and women (Almonacid, 2012; Althaus, 2012, Torres-Luque, Ramirez, Cabello-Manrique, Nikolaidis & Alvero-Cruz, 2015).

Based on previous research about the game activity in padel and similar racket sports, one could define padel as an intermittent activity, characterized by alternating short periods of exercise at maximal or near maximal intensity with longer periods of lower intensity (Sánchez-Alcaraz, Courel-Ibáñez, & Cañas, 2018). Regarding the physiological demands, studies showed that the average heart rate (HR) during a padel match is 148 ± 13.7 bpm, which represents the 73.9 ± 4.65% HRmax compared to a laboratory test (Sañudo et al., 2008).

Decision making is essential in padel due to players are constantly solving problems by cooperating and interacting to perform individual and collective actions focused on disturbing the opponent and defending the own court (Courel-Ibáñez & Sánchez-Alcaraz, 2018). At initiation stages, previous studies highlight the importance of adapting the competition holistically to young players by changing the game rules, equipment and playing spaces, from a comprehensive approach. For instance, in tennis, these kinds of game modifications have improved the teaching-learning process in young players (Sánchez-Alcaraz, 2013c), increasing their participation and enjoyment (Buszard, Reid, Masters, & Farrow, 2016). A smaller court dimension and the use of low-compression balls also seem to favour the accuracy and power of tennis strokes (Larson & Guggenheimer, 2013). In padel, scaling sport equipment for children (low-compression balls and smaller paddles) and playing spaces (smaller courts) improved some technical-tactical actions such us baseline and net game and ending strokes (Lacasa, Orteub, Gabriel, Torrents, & Salas, 2017).

Some research observed that decreasing the net height improved the offensive game and increase winner strokes in tennis (Sánchez-Pay, Sánchez -Alcaraz, & Courel-Ibáñez, 2018). However, this modification may also reduce the duration of the rally because players can't return the ball in good conditions (Limpens, Buszard, Shoemaker, Saverlsbergh, & Reid, 2018). Therefore, it is very important to adapt the net height to the age and the level of the players, due to a low height net may increase unforced errors by a lower ball impact and reduce the baseline game (Timmerman et al., 2014).

The modification of court dimensions or height net in padel is difficult due to this sport is played inside an enclosed synthetic glass and metal court with side and back walls. Then, the easiest adaptation in teaching-learning process at padel training stages may be the use of low-compression balls. The use of balls with 25% less compression balls in tennis increased the duration of the points, the number of winner and total shots, the percentage of serves and reduced the errors when comparing with normal balls (Kachel, Buszard, & Reid, 2014). Also, players felt more satisfied and comfortable when the sport equipment is adapted to their physical characteristics (Farrow & Reid, 2010). Therefore, it seems that using low-compression balls in padel could improve the performance in young players.

However, there is a lack of studies exploring the effect of low-compression balls in competition on technical-tactical action and physiological demands in young padel players. Therefore, the aim of this study was to analyse physical competition demands in padel training stage using low-compression and normal balls.

2. MATERIAL AND METHODS

2.1. Design

This is a quantitative, quasi-experimental, transversal study which combined descriptive and relational analyses.

2.2. Participants

The study sample was made up of 16 young padel players (10 boys and 6 girls) with similar characteristics (age of players = 10 ± 0.8 years; height = 146.0 ± 4.9 cm; weight = 37.4 ± 7.3 kg). Players trained 2 hours per week and they had one year of competition experience. The study was approved by the Ethics Committee of the University of Murcia (Spain).

2.3. Instruments

Matches were recorded using 4 wide-angle video cameras, placed on a tripod each, 2.5 m behind the back wall of the paddle court. The disposition of the camera allowed the total vision of the court and players actions. The Lince software was used for the video analysis of the matches (Gabin, Camerino, Anguera, & Castañer, 2012). This free-use software allows the creation of a registration sheet to analyze the time and occurrence of game actions.

All players were equipped with a Bluetooth-connected tape to a Polar Team 2® telemetry monitor (Polar, Kempele, Finland) where the HR was recorded before warming up. The HR was registered every second from the beginning to the end of the match. Data were analyzed with Polar Team 2® software, indicating the average, minimum and maximum HR values, excluding outliers (HR results of 0 or > 220). The percentage on the maximum HR (% HRmax) for each participant was estimated through the formula 208 - (0.7 x age) proposed by Tanaka, Monahan, & Seals (2001), as it is the formula that best suits this type of population (Machado & Denadai, 2011). This estimate allowed the determination of the intensity for each participant during each activity condition using the intensity ranges marked by the ACSM (2014).

Rate of perceived exertions (RPE) was measured through Borg's 6-20 scale (Borg & Kaijser, 2006). In addition, players completed a satisfaction questionnaire that included three questions: 1) What type of ball did you enjoy more?; 2) What type of ball do you think make the points longer?; 3) With what type of ball did you find an easier and more comfortable play?; all of them with a single response “a) First ball” or “b) Second ball”.

2.4. Procedure

Following the Declaration of Helsinki, the players voluntarily participated in the study, and written informed consent was obtained from and signed by the parents/ guardians of all participants. A total of eight padel sets were played and recorded, with 15 minutes break between. The first four sets were played with official padel balls (Head padel®), and the following four sets with a low-compression ball with 25% less compression (Head green dot balls®). During the matches organization, eight teams with similar level were distributed in four matches. Before the match, players completed a general 5-minute warm-up (joint mobility and jogging) and a specific 5-minute warm-up (ground strokes, net strokes and serves). All matches were recorded, and each player used a HR monitor during the matches. When a set finished, players completed the perceived effort and the satisfaction questionnaire anonymously.

2.5. Statistical analysis

For the viewing of the match and its codification, the systematic observation process of two observers was followed. Firstly, the observers completed a specific training process. One set was coded by each observer and compared with an experienced observer to calculate the intra-observer reliability. After a week, each observer registered the same set again to calculate inter-observer reliability. Cohen's Kappa was used, showing values above > 0.87 in all the variables, considered as very good results (Landis & Koch, 1977).

A spreadsheet (Microsoft Excel) was designed to collect the data and subsequently exported them to the SPSS software v.21.0 for Windows (IBM Corp., Armonk, NY, USA). A descriptive analysis was performed to calculate the mean (M) minimum (Min), maximum (Max) and standard deviation (SD) of each of the variables. Subsequently, the normal distribution of each variable was confirmed and the Student's t-test was used to determine the possible differences of each variable according to the type of ball (official and low compression). In addition, the counting function was used to know the time of participation of each player over the different intensity zones. The Student's t-test was used to determine the possible differences between the times of participation in each intensity zone depending on the type of ball. For the analysis of the questionnaires a count of the answers was made. Significance level was set at $p < 0.05$.

3. RESULTS

Table 1 shows the descriptive values of set duration, number of points and strokes per set with normal and low-compression balls.

Tabla 1. *Descriptive values: minimum (Min), maximum (Max), mean (M), standard deviation (ST), and statistically significant differences (p) per set.*

	Official ball				Low-compression ball				Diff.	*p*
	Min	Max	M	SD	Min	Max	M	SD		
Set duration	15,08	33,57	24,03	8,38	17,51	28,38	23,38	5,06	0,51	0,922
Points per set	31,00	76,00	51,75	20,21	35,00	65,00	48,25	12,55	3,25	0,791
Strokes per set	122,00	343,00	223,25	91,03	168,00	284,00	209,00	52,19	9,75	0,841

Although no statistically significant differences were observed in set duration and number of points and strokes, sets played with normal balls were longer and players completed a higher number of points and shots.

Table 2 shows the descriptive values of number of total strokes, ground strokes and net strokes and point duration. Mean, minimum and maximum values were very similar regardless the padel balls. No statistically significant differences were found in number of total strokes, ground strokes and net strokes and point duration.

Table 2. *Descriptive values: minimum (Min), maximum (Max), mean (M), standard deviation (ST), y statistically significant differences (p) per point.*

	Official ball				Low-compression ball				Diff.	*p*
	Min	Max	M	SD	Min	Max	M	SD		
Strokes per point	1,00	19,00	4,31	2,76	1,00	18,00	4,33	2,61	-0,01	0,948
Ground strokes per point	1,00	13,00	3,81	2,13	1,00	15,00	3,86	2,18	-0,04	0,819
Net strokes per point	1,00	7,00	1,64	1,20	1,00	4,00	1,49	0,83	0,14	0,434
Point duration (s)	1,13	32,49	8,07	4,79	0,93	31,28	7,99	4,63	0,08	0,859

Figure 1 shows the distribution of strokes per point. Around 70% of the points ended with 2-5 strokes. Only 30% of the points had more than 5 strokes.

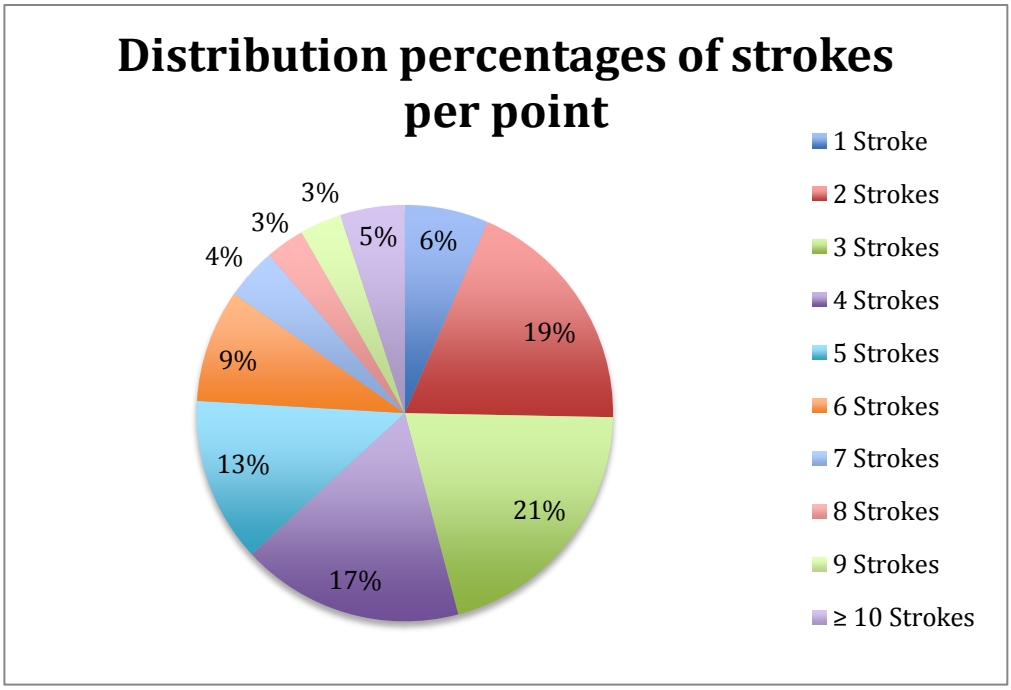

Figure 1. Distribution of strokes per point.

Figure 2 represents the distribution of work and rest time, with less than 30% of working during the padel matches.

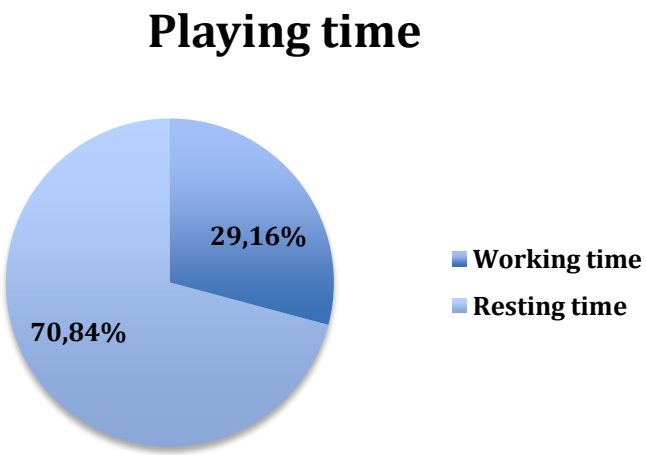

Figure 2. Distribution of working and resting time during the padel match.

Table 3 shows the descriptive values on HR and RPE. Average HR and %HRmax were significantly greater ($p < 0.001$) when playing with official balls (145 bpm, 72.5% HRmax) compared to low-compression balls (140 bpm, 69.9% HRmax). No significant differences were found in RPE.

Table 3. *Descriptive values: minimum (Min), maximum (Max), mean (M), standard deviation (ST), y statistically significant differences (p) on heart rate (HR) and perceived exertion (RPE).*

	Official ball				Low-compression ball					
	Min	Max	M	SD	Min	Max	M	SD	Diff.	p
HR	96,00	206,00	145,43	17,66	97,00	198,00	140,19	17,66	5,24	<0,001
% HRmax	48,10	102,49	72,47	8,75	48,43	98,51	69,85	8,75	2,62	<0,001
RPE	11,00	20,00	13,81	2,46	10,00	19,00	13,75	2,18	0,06	0,940

Figure 3 shows the distribution of participation at different working zones. It can be seen that around 30% of the time, players using a low-compression balls were working at a low level, while the use of official balls reduced the low work at 20%. The percentage of moderate, vigorous and maximum zones with official balls was higher than when using low-compression balls.

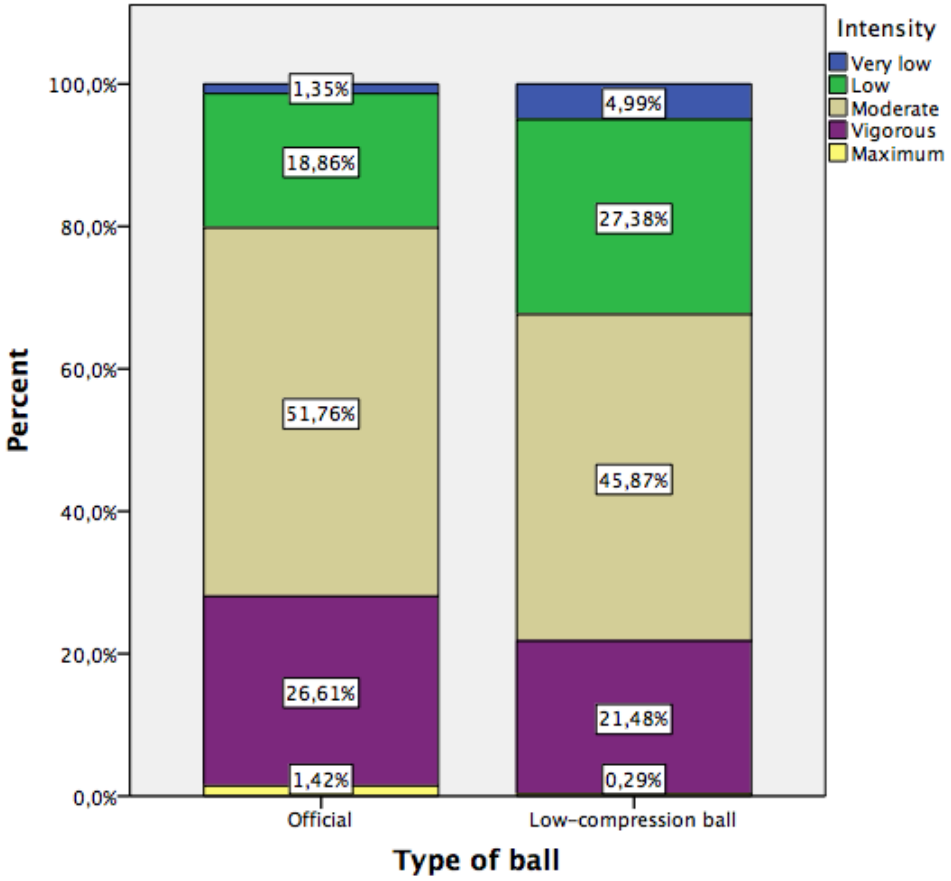

Figure 3. Distribution of participation at different working zones during the padel match.

Table 4 shows the minutes player at a given %HRmax working zones. No significant differences were found in minutes played in different work zones according to the two padel balls. The highest difference was observed in the moderate zone (65-76% HRmax), where players spent 12.82 minutes with the official ball, and 10.94 minutes with the low-compression ball.

Table 4. *Differences in activity time (minutes) regarding different work zones*

	Total		Official ball		Low-compression ball			
% HRmax	M	SD	M	SD	M	SD	Diff.	*p*
Very low (≤57%)	0,76	1,64	0,33	0,59	1,19	2,20	-0,856	0,143
Low (58-64%)	5,60	5,61	4,67	4,78	6,53	6,35	-1,861	0,357
Moderate (65-76%)	11,88	5,18	12,82	4,82	10,94	5,51	1,873	0,314
Vigorous (77-95%)	5,86	7,65	6,59	8,15	5,12	7,31	1,465	0,596
Maximum (≥90%)	0,21	1,00	0,35	1,41	0,07	0,28	0,282	0,438

%HRmax value ranges according to the ACSM (2014)

Figure 4 shows the percentage of players' answers according to the perceived satisfaction when playing with official or low-compression balls. It can be observed how players' satisfaction is higher during sets played with a low-compression ball. Over 60% of the players have better perception of enjoyment, point duration and game comfort when playing with a low-compression ball.

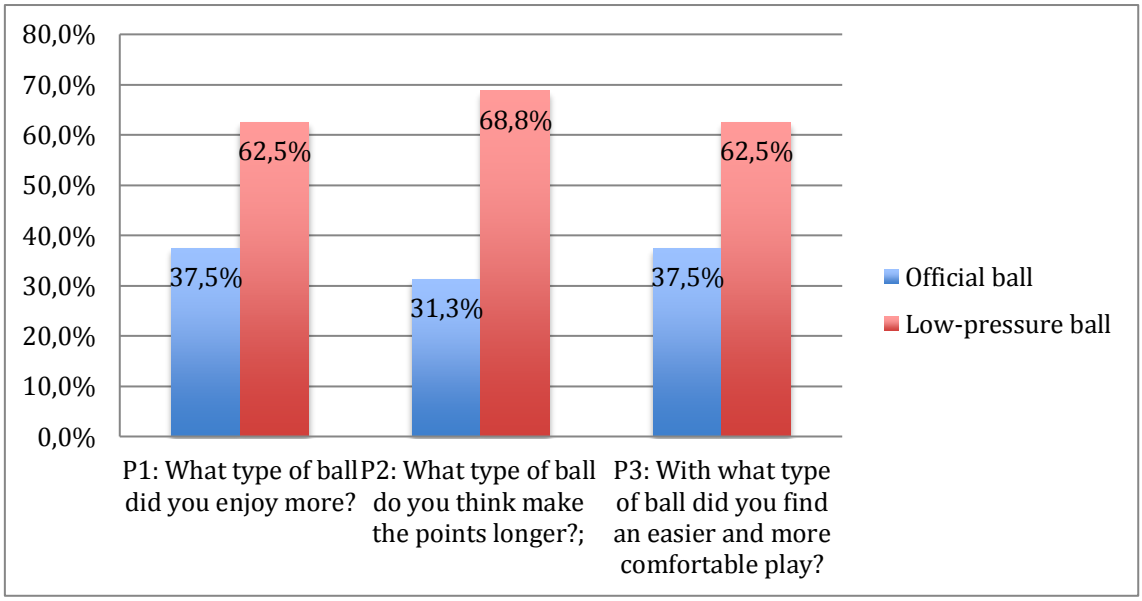

Figure 4. Players' satisfaction with normal and low-compression balls.

4. DISCUSION

A better understanding of the match temporal structure and physical demands in young padel competitions will help coaches and practitioners to make decision according to representative parameters. The aim of this study was to analyse the alterations on temporal structure and competition demands in a padel match when playing with official or low-compression balls.

Temporal Structure

The results of this study show a mean set duration of 24.03 minutes with official balls, and 23.38 minutes with low-compression balls (table 1). These lengths are shorter than the 32 minutes found in professional players (Almonacid, 2012) or the 30 minutes in regional level matches of teenage players (Sánchez-Alcaraz, 2014a).

The average duration of a point played with official or low-compression balls was around 8 seconds (table 2). These values are lower than those obtained in professional players (Althaus, 2012) or official regional level matches (Sánchez-Alcaraz, 2014a), but similar to teenagers players of a national category (Sañudo et al., 2008). Hence, it seems that point duration is affected by the level of play and age. In turn, and in contrast to what observed in tennis (Kachel et al., 2014), the use of low-compression balls did not alter the duration of the point in padel at formative stages.

Points were ended after 4.3 strokes in average both when using an official or low-compression ball (table 2). These values are lower than the 6.7 hits per point obtained in young players of regional level (Sánchez-Alcaraz, 2014a). Likewise, a higher number of strokes were found in professional male and female players, with an average of 9.4 and 9.1 hits per point respectively (Sánchez-Alcaraz, 2014b). In this sense, professional players have greater technical ability and physical condition that allows them to hit and return a high number of strokes resulting in longer rallies compared to non-professional or youth categories (Sánchez-Alcaraz, 2013b; Sánchez-Alcaraz, Orozco, Courel-Ibañez and Sánchez-Pay, 2018). Regarding the number of hits after a bounce, there were no notable differences when using an official or low-compression ball. Interestingly, young padel players performed direct strokes without bounce the 16% of time, which is importantly lower compared to professional players (Courel-Ibañez, Sánchez-Alcaraz, and Muñoz, 2017). These results may suggest that initiation level players would play most of the time in the baseline, far from the net; however, we cannot provide data to confirm this hypothesis. Results revealed that the working time represents less than the 30% of the total time in young amateur padel players (figure 2). These results are inferior to those obtained by Almonacid (2012) and Pradas et al. (2012) in senior male and female padel players, but higher than tennis, which varies between 20% and 26% of the total playing time (Christmass, Richmond, Cable and Hartmann, 1995; Christmass, Richmond, Cable, Arthur, and Harmann, 1998; Ferrauti, Weber and Wright, 2003; Kovacs, 2004; Morante and Brotherhood, 2005; Smekal, Von Duvillard, Rihacek, et al., 2001). In consistency with the aforementioned results, the lower values found in this study may be due to the level of play of the participants, which limit them a hit and return continuity far from 5 strokes.

Physical activity levels.

The average HR during the padel game increased when using an official ball (145 ppm, 72.5%HRmax) and decreased with the use of a low-compression ball (140 ppm, 69.9%HRmax) in young players (table 3). These results are slightly

lower than those observed in one previous study examining physical demands in young padel players, finding an average HR of 148 bpm and 74.0% HRmax (Sañudo et al., 2008). The RPE scores showed average values of 13.8 both when using an official or a low-compression ball (table 3). These values can be interpreted as "somewhat hard" on the Borg 6-20 scale. These results are very similar to those found in padel matches (Amieba and Salinero, 2013) and tennis (Fernández-Fernández, Méndez-Villanueva, Fernández-García, and Terrados, 2007). The intensity range (figure 3) as well as the time in minutes that players use in the different zones (table 4) did not show significant differences according to the type of ball used. However, it was observed that the use of an official ball increased the players' time at moderate and vigorous intensities up to 78%, whilst the use of a low-compression ball achieved the 67%. These differences are in line to those already observed suggesting that low-compression ball might reduce the intensity of the padel game. Nevertheless, the levels of physical activity shown by children during a padel game could considered sufficient according to the recommendations of the ACSM (2014), which emphasized the recommendations of practicing padel as a healthy cardiovascular physical activity (Muñoz-Marín et al., 2019).

Young padel players showed a more favourable predisposition to play with a low-compression ball than with official balls (figure 4). The use of low-compression balls gives children more fun and a comfort to play padel. These data suggest the use of low-compression balls to reduce overloads during initiation stages and thus reduce injuries and discomfort that may lead to discontinue the padel practice (Sánchez-Alcaraz, Courel-Ibáñez, Díaz-García and Muñoz-Marín, 2019). In addition, children perceived longer points during the match when using low-compression balls. Although there are studies indicating a greater satisfaction playing padel when the number of hits and returns increases (Sánchez-Alcaraz, Sánchez-Pay, Gómez-Mármol, Bazaco-Belmonte, and Molina-Saorín, 2017), in our case, the greatest enjoyment may be due to aspects related to the sensation of hitting, the better control of the ball, or the simple novelty of playing with a different ball.

This study has some limitations that must be mentioned. On the one hand, the players' youth and inexperience could influence the reliability of the data obtained. In addition, the players were accustomed to use an official ball, so it would have been interesting to include an analysis of the game after previously continued practice with each type of ball. Future studies should replicate this experiment with a greater number of children. In addition, it would be of interest to confirm whereas the manipulation of other rules such as reducing the court size may produce similar effects on physical demands, game dynamics and enjoyment in young padel players at initiation stages.

5. CONCLUSIONS

In the light of the results obtained, it may be concluded that:

- The set duration in young padel players is approximately 24 minutes, with a number of 50 points and more than 200 strokes per set.

- Players perform around 4 strokes per point, with a higher number or groundstrokes than net strokes; the point duration is around 8 seconds.

- Working time represents 30% of the total time of the padel match.

- Players have an average HR of 140-145 bpm, which represents 67-69% of the HRmax. Perceived exertion values are close to 13 points on a 6-20 Borg Scale.

- There are not differences in temporal structure of a padel match regarding the ball used. In turn, a match played with low-compression balls appears to reduce the game intensity.

- Physical activity levels during a padel match at initiation stage can be considered as a healthy cardiovascular activity.

- Young padel players have better perception of enjoyment, longer point duration and higher game comfort when playing with low-compression ball.

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