



Analysis of competitive wheelchair tennis.

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ABSTRACT

Since wheelchair tennis became a paralympic sport in Barcelona '92, it has developed professionally, and the number of scientific publications on this subject has grown accordingly. This article gathers the information that describes the temporal structure and the physiological demands of wheelchair tennis in order to improve the quality of the current coaching systems.

Key words: Wheelchair tennis, Competition, Playing pattern, Physiological demands.

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INTRODUCTION

Wheelchair tennis is one of the adapted sports that has developed the most in recent years. It is always played to the best of three sets, unlike conventional tennis in which some matches are played to the best of five sets. It is played on all three types of surface (clay, hard and lawn). The main difference with conventional tennis is that the regulations allow for the ball to bounce twice before it is returned (ITF, 2012).

Since it became a paralympic sport in Barcelona '92, it has grown professionally and institutionally, it is played in over 41 countries, with approximately 160 international tournaments in the NEC tour (Bullock & Sanz, 2010). This growth has increased the number of scientific publications in recent years, providing information about different areas such as physiology (Croft et al., 2010; Sindal et al., 2013; Sanz et al., 2005), tactics (Filipic & Filipic, 2009; Sánchez-Pay et al., 2013), or motor control (Reina et al., 2007). However, this article will highlight the most relevant demands in this sport, including temporary structure and physiological demands.

Temporal structure for wheelchair tennis

The wheelchair tennis regulations allow for a maximum of 20 seconds between points and 90 seconds for change overs (ITF, 2012). When the temporal structure of a sport is analysed, the first thing to be considered is the total volume of work that the activity demands (Christmass, et al., 1995; Galiano et al., 1996). Generally speaking, the total playing time for a singles wheelchair tennis match is between 50 and 80 minutes (Croft et al., 2010; Filipic & Filipic, 2009; Roy et al., 2006; Sánchez-Pay et al., 2013; Sanz et al., 2008; Sindal et al., 2013); although the characteristics of the match will be greatly determined by

the level of the participants, the kind of injury, or the playing surface among other things (Filipic & Filipic, 2006, 2009; Sindal et al., 2013; Sánchez-Pay et al., 2013).

Most international tournaments are played on two draws depending on the ranking of each player. This way, highest ranked players will play the Main Draw and the rest will play the Second Draw. Sindal et al. (2013) compared the total length of the main draw in international matches and the second draw in international matches, showing a range of 40.1 to 74.8 minutes per match and found no significant differences between the draws. Filipic and Filipic (2009) measured playing times in 22 simulated amateur matches, with an average length of 54.13 minutes.

Wheelchair tennis is present in all four Grand Slams. A study by Sánchez-Pay et al. (2013) compared the duration of US Open and Roland Garros matches over two consecutive years and found that matches were shorter on fast surfaces (US Open) (68.30 ± 23.32) than on slow surfaces (81.57 ± 29.83). Even though differences are not significant, the trend is the same as in conventional tennis, where the total duration of the match is longer on slower courts than on fast courts (Morante & Brotherhood, 2005; O'Donoghue & Ingram, 2001). Although more research is still necessary on this matter, there seems to be a difference on the data if we compare simulated matches, 54 minutes (Filipic & Filipic, 2006) with official competitions (Croft et al., 2010; Sánchez-Pay et al., 2013; Roy et al., 2006; Sindal et al., 2013) between 68-81 minutes.

Wheelchair tennis is an intermittent sport, within the total time there is a time to work and a time to rest, and this knowledge facilitates specific training. Research shows a real playing time of 15-20% of the total playing time, which equals working /

ratios between 1:1 and 1:4 (Sanz, 2007; Filipic & Filipic, 2009; Roy et al., 2006).

Another important consideration is the duration of the point, like the previous parameter, it will create strategies to specifically improve coaching for competition wheelchair tennis players. There is little research, and research shows that times vary between four and 10 seconds. (Bullock & Pluim, 2003; Filipic & Filipic, 2009) (Table 1). More specifically, Bullock & Pluim (2003), analysed three matches in the Paralympics of Sydney 2000. The authors noted an average time per point of 9.65 seconds, with long intervals between a maximum (11.75 seconds) and a minimum (6.02 seconds). Filipic & Filipic (2009), noted that in 22 simulated recreational matches, the average duration of the point was 4.16 seconds, 70% of which lasted zero-five seconds (Filipic & Filipic, 2009). Although there is little research on the temporal structure of wheelchair tennis, there seems to exist a trend in the sport to becoming faster and faster (Bullock & Sanz, 2010). In this regard, the comparative study between the semifinal and final matches in the Paralympics of Athens and Pekin, proved that the playing times were getting shorter and that the number of players playing after the first bounce was significantly greater in Pekin (2008) than in Athens (2004) (Sanz et al., 2009).



The intermittent nature mentioned above, makes tennis players have short periods of work followed by rest intervals during a match. This has been largely studied in conventional tennis (Fernandez- Fernandez et al., 2009; Kovacs, 2007). In wheelchair tennis related research, the variables that have received most attention to control the intensity of a match are heart rate and/or lactate concentration in blood ([Lac]) (Bernardi et al., 2010; Sindal et al., 2013).

In wheelchair tennis heart rate ranges between 120-140 beats per min⁻¹, which means an intensity of 65-75% on the maximum heart rate with an approx VO₂max of 50-68% considering it a moderate/ high intensity sport (Barfield et al., 2009; Bernardy et al., 2010; Coutts, 1988; Croft et al., 2010; Roy et al., 2006; Sindal et al., 2013). According to the documents analyzed, these values do not show differences if competitive level is analyzed (amateur or profesional) (Sindal et al., 2013). [Lac] Bernardi et al. (2010) analysed four players in simulated matches, showing average values at the end of the match of 3.75 ± 0.76 mmol·L⁻¹. Table 2 shows the most relevant studies on this matter.

Author	Sample	Matches	TT (min)	RT (min)	DP (s)
Bullock & Pluim (2003)	top 10 male players	3 matches Sydney parlympic games	-	-	9.65
Roy et al. (2010)	6 players considered elite	international tournament	70.9	-	-
Filipic & Filipic (2009)	15 male players (10 with no ITF ranking)	22 simulated matches in Green Set	54.13	10.32 19.68%	4.16 ± 0.60
Roy et al. (2006)	6 male recreational players	6 simulated matches	70.2±14.4	10.5±1.3 15.15±1.4%	-
Sánchez-Pay et al. (2013)	54 top 10 players with ITF ranking	27 Grand Slam matches	81.57±29.83 68.30±23.32 Green Set	-	-
Sindal et al. (2013)	14 male players (n7 ≤25 ITF; y n7 ≥350 ITF)	competition matches	52.0±9.1	-	-

Table 1. Most important research related to the structure of WCT.
TT= Total time of the match; RT= Real time of the match; DP= Duration of the point.

Physiological requirements for wheelchair tennis

The aim of knowing the physiological profile of a player is to determine the physiological and contextual demands that impact performance, so as to organise training sessions and optimise the player’s profile (Sanz et al., 2009).

Author	Sample	Matches	Medium HR (Lat•min ⁻¹)	Max HR (%)	VO ₂ max (%)
Barfield et al. (2009).	11 male recreational players	90 minutes of simulated matches	121±14	68.17±0.17	-
Bernardy et al. (2010).	4 players	simulated matches	137±17.9	77.6±2.90	73.0±1.91
Coutts et al. (1988).	3 players	simulated matches	128±4.1	-	-
Croft et al. (2010).	6 players considered elite	competition	146±16	75.3±7.8	68.3±11.8
Roy et al. (2006).	6 male recreational players	6 simulated matches	121.7±9.6	69.4±8.9	49.9±14.5
Sindal et al. (2013).	14 male players (n7 ≤25 ITF; y n7 ≥350 ITF)	competition matches	134±14	-	-

Table 2. Most important research related to WCT physiological requirements Medium HR = Medium heart rate; max HR = maximum heart rate.

CONCLUSIONS

The increase in the number of scientific publications in the last years provides great knowledge on the issue of wheelchair tennis, so coaches can improve the quality of their training sessions. Having reviewed the data, it is possible to state that this sport of an intermittent nature, lasts between 50 and 80 minutes per match, out of which the players will be hitting the ball between 15% and 20% of the time. Due to the intermittent nature of this sport, the average point lasts between four and 10 seconds, with a rest of 20 seconds between points. The work/rest relationship makes the player heart rate range between 120 and 140 beats per minute for the duration of the match long, so it can be considered a moderate/high intensity sport. Anyway, further research is still necessary, since, depending on the type of injury, the playing surface, or the level of the players, there is a wide variety of values recorded.

Even though more research is still necessary on this matter, the kind of injury, the playing surface or the level of the players present a disparity in the values, some guidelines for the coach and/ or trainer when planning sessions could be: a) in 'accumulation' periods, high volume work and low intensity, b) in 'transformation' periods, increase intensity and decrease volume, with a work/rest ratio of 1:1; and c) in 'realisation' periods, between six and eight seconds of high intensity with 20 seconds rest between repetitions simulating the work in the competition.

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