

Running speed loads on clay and hard courts in world class tennis

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Abstract

Background

Tennis is a complex sport which is characterised by quick starts and stops as well as the involvement of several muscle groups during the different strokes. At elite level, there is a huge number of tournaments on different surfaces each year. So that the players can master the requirements of the game, they must be prepared physically as well as psychologically optimally for the running speed demands of tennis and to protect themselves against overloading damages and injuries. This study shows some important results about the characteristics of running speed demands in elite level tennis, and the implications for training a player's physical working capacity as well as for preventing injuries.

Methods

For the study thirteen clay court and seven hard court men's singles matches were analysed by means of a systematic criterion catalogue. In the foreground this shows all of the playing situations in which a player prepares his next stroke with a running movement under "time pressure". To categorise the running demand profile, several definitions were identified for different match situations. The results of this analysis were taken from a total of 24 ranking list players (ATP 1-50) aged between 20 and 33 years.

Results and conclusions

On hard courts, a top player at international level must operate at approx. 45% (n=1306), as opposed to 29% on clay courts, in all match situations under time pressure, i.e. under a raised running demand. Also the characteristics of the running demand on both these surfaces differ considerably. The rate of stroke errors differs between both tournaments with regard to the runs to each field side (forehand and backhand) as well as to each stroke (forehand and backhand). In the Australian Open substantially longer running ways are evident under high time pressure than, for example, on clay (5.1 ± 2.7 m versus 4.7 ± 1.6 m). We conclude that a match on a hard court is substantially more incriminating and can be therefore more injury-intensive for the tendons and joints. Therefore, it is necessary to train for these particularly high running demands so that adaptations can result in optimum performance and injury prevention.

Key words: running speed loads, time pressure, court surfaces, injury prevention.

Introduction

Tennis is characterised by diverse performance factors. In competitive tennis there are multiple tournaments on various surfaces every year. For players to be able to handle the huge amount of competitions on various surfaces, they have to be properly prepared, physically as well as mentally, and need to protect themselves from overload damages or chronic injuries. This article highlights the changes of the running speed loads in tennis on different surfaces for an

optimal injury prophylaxis and an efficient training composition.

Methods

The main goal was to gather all the game constellations, where a player was forced to prepare and perform his next stroke under time pressure, whilst in motion. To categorise the physical running load, several definitions were identified for different game situations within the match. The results of

the game analysis came from an overall sample of 24 ATP players, aged between 20 and 33 (age 25.8 ± 2.7 years; height 183.9 ± 5.8 cm; BMI 23.4 ± 1.2 kg/m²) and ranked between 1 and 63. The arithmetic mean and standard deviation of the anthropometric data as well as the ranking position can be seen in Table 1.

With one exception all of the observed players were right-handed. The different tactical orientation of the players ranged from defence-orientated baseliner, to all-round player, to offensive player with dominant serve.¹ According to this test, the standard of the players was representative of world class tennis.

Using systematic video analysis, some up to date findings could be acquired concerning the demands on running speed abilities in world class tennis on clay (C) as well as on hard courts (H). The game analysis contained every rally of 327 (C) and 287 (H) typical service games, as well as eight (C) and three (H) tie-breaks respectively, during the World Team Cup 2004 and the Australian Open 2006. The acquired game situations were sorted into two main categories, “strokes without time pressure” and “strokes under time pressure”, and were further

differentiated.² In a second research section, running distances were measured. This evaluation analysed the running performance of each player under “time pressure”. In each “time pressure” situation within the match, the dislocation of the body focus was recorded while hitting the ball, or immediately after it, and the amount of steps needed to reach the stroke position.³ The data was processed with the programme SIMI SCOUT as well as the spreadsheet analysis programme Excel 2003. There was no statistical analysis of the obtained data because of the different player samples and the varying importance of the different tournaments.

Results and conclusion

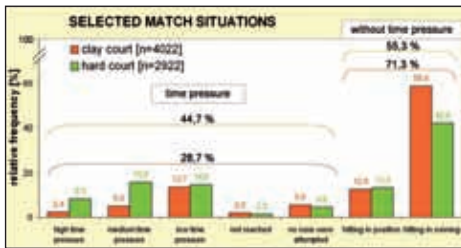
On hard courts, a top player at international level will be forced to operate at approx. 45% (n=1306), as opposed to 29% on clay courts, in all match situations under time pressure, i.e. under a raised running demand. Whilst the count of strokes conducted while hitting in position differ only slightly between hard and clay courts in the category “strokes without time pressure” (H: 13,3% and C: 12,6%), the value on hard courts is more than 28% over the value on clay courts with regard to strokes under medium and high time pressure (Figure 1).

Table 1 Personal data of the tested tennis players regarding participation in each particular tournament (Player data at the time of the particular tournament)

Clay court tournament 2004						
Player data*	Nation	Age [years]	Height [cm]	Weight [kg]	BMI [kg/m ²]	Ranking
Albert Costa	ESP	28	180	78	24,1	25
Gaston Gaudio	ARG	25	175	70	22,9	34
Fernando Gonzalez	CHI	23	183	81	24,2	35
Tommy Haas	GER	26	187	88	25,2	43
Lleyton Hewitt	AUS	23	180	77	23,8	17
Nicolas Kiefer	GER	26	182	80	24,2	58
Feliciano Lopez	ESP	22	187	85	24,3	28
Nicolas Massu	CHI	24	182	80	24,2	12
Jiri Novak	CZE	29	190	86	23,8	13
Mark Philippoussis	AUS	27	195	98	25,8	9
Sjeng Schalken	NED	27	193	82	22,0	18
Rainer Schüttler	GER	28	180	70	21,6	6
Vincent Spadea	USA	29	182	77	23,2	29
Radek Stepanek	CZE	25	185	75	21,9	46
Martin Verkerk	NED	25	195	89	23,4	19
Mariano Zabaleta	ARG	26	182	77	23,2	27
\bar{x}		25,8	184,9	80,8	23,6	26,2
$\pm s$		2,1	5,8	7,2	1,1	14,4
Hard court tournament 2006						
Player data*	Nation	Age [years]	Height [cm]	Weight [kg]	BMI [kg/m ²]	Ranking
Roger Federer	SUI	24	185	80,5	23,5	1
Marcos Baghdatis	ZYP	20	182	80,0	24,2	52
Nicolas Kiefer	GER	28	183	80,5	24,0	24
David Nalbandian	ARG	24	180	79,5	24,5	5
Nikolay Davydenko	RUS	24	180	69,1	21,3	6
Sebastian Grosjean	FRA	27	175	66,8	21,8	28
Fabrice Santoro	FRA	33	178	72,7	23,0	63
Ivan Ljubicic	CRO	26	193	82,7	22,2	9
\bar{x}		25,8	182,0	76,5	23,1	23,5
$\pm s$		3,8	5,4	6,0	1,2	23,2
Total						
\bar{x}		25,79	183,92	79,37	23,4	25,29
$\pm s$		2,72	5,75	7,03	1,2	17,34
maximum		33	175	66,8	21,3	1
minimum		20	195	98	25,8	63

* Player data at the time of that particular tournament

Figure 1 Frequency distribution of all observed criteria under time pressure on clay (orange) and hard courts (green)



The characteristics of the running speed loads also differ substantially according to the two different surfaces. In 1172 game situations on a hard court, an average of 3.83 ± 1.94 m is covered under time pressure, which is a mean of 20 additional centimetres compared to clay (3.65 ± 1.32 m). Except for those under high time pressure, the average running distance in time pressure situations is shorter on hard court than on clay court (Figure 2).

Figure 2 Average values and standard deviations to the running distance in time pressure situations in clay and hard court tennis



The results not only show a dominance in running sideways, but also demonstrate clearly that on average in all time pressure situations especially to the forehand (FH) side, longer distances have to be covered when compared to the backhand (BH) corner. Particularly in the observation category of medium and high time pressure, a mean running distance of four to five metres to the forehand can be determined (Figure 3).

Figure 3 Running distance to the FH and BH sides. Average values and standard deviations to the running distance differentiated for the forehand (FH) and backhand (BH)



The error ratio differs between the two tournaments, concerning runs to the court side as well as to the stroke. In clay court tennis, the error ratio under time pressure (net and out) is higher than one fifth ($n=184$), whilst on hard courts, the amount of faults lies at about 19%. The differentiated analyses regarding the three time pressure situations, as well as the court and stroke side, also show that clay court tennis has a higher error ratio than hard court tennis (Figure 4).

Figure 4 Error rate in selected match situations. Progress of the error ratio in selected match situations



It has to be emphasised that the percentile amount of errors on the forehand side as well as the forehand stroke, with the exception of the results under medium time pressure, preponderates. In the match situations under medium time pressure the error ratios of the backhand (28.2% versus 16.3%) and in the backhand corner (27.0% versus 16.8%) in clay court tennis differs substantially compared to those of hard court tennis (Tables 2 and 3). The relative frequency of the runs to the forehand side and to the forehand stroke, however, remains almost the same.

The present game analysis supplies fundamental details of current running speed loads in the elite tennis-specific demand profile. The results not only show the necessity to train this performance-limiting factor, but also describe the characteristics of the running speed loads (e.g. running distances) in world class tennis on different surfaces. Especially realising that the maximum running performance mainly takes place in sideward movements plays an essential role in the injury prevention of the lower extremities.

In connection with the findings and the resulting amount of stopping movements, a competition on a fast surface (hard court) seems to be substantially more incriminating and thus produces more injuries in tendons and joints when compared to clay. It is necessary for injury prevention, as well as for the control and regulation of training, to prepare the player for those high and specific loads. To achieve these goals, strengthening of the concerned muscle areas, as well as technical education of the running technique and co-ordination is essential.

Table 2 Percentile error ratio regarding the three time pressure situations for runs to the forehand (FH) and backhand (BH) sides. Error ratio-runs to the side. Low time pressure. Medium time pressure. High time pressure

ERROR RATIO - RUNS TO SIDE													
Surface		Low time pressure				Medium time pressure				High time pressure			
		Out		In		Out		In		Out		In	
		FH	BH	FH	BH	FH	BH	FH	BH	FH	BH	FH	BH
[n]	Clay court	61	49	202	240	28	20	98	54	16	10	40	29
	Hard court	17	41	107	262	50	38	188	188	32	31	89	90
[%]	Clay court	23,2	17,0	76,8	83,0	22,2	27,0	77,8	73,0	28,6	25,6	71,4	74,4
	Hard court	13,7	13,5	86,3	86,5	21,0	16,8	79,0	83,2	26,4	25,6	73,6	74,4

Table 3 Percentile error ratio regarding the three time pressure situations for runs to the forehand (FH) and backhand (BH) strokes

ERROR RATIO - RUNS TO STROKE													
Surface		Low time pressure				Medium time pressure				High time pressure			
		out		in		out		in		out		in	
		FH	BH	FH	BH	FH	BH	FH	BH	FH	BH	FH	BH
[n]	Clay court	69	41	267	175	28	20	101	51	17	9	40	29
	Hard court	26	32	163	206	54	34	201	175	34	29	92	87
[%]	Clay court	20,5	19,0	79,5	81,0	21,7	28,2	78,3	71,8	29,8	23,7	70,2	76,3
	Hard court	13,8	13,5	86,2	86,5	21,2	16,3	78,8	83,7	27,0	25,0	73,0	75,0

For tournament practice, not only a basic running speed training, but also game situations under time pressure should deliberately be integrated into training, where strokes should be executed in combination with one or more quick changes of direction. The improvement of the tennis-specific quickness should not only result in a minimisation of the amount of time pressure situations - more balls can be reached -, but also in a reduction of the intensity level (low < medium < high time pressure). If the player must hit less balls under time pressure, because he disposes a good running speed and quickness, as well as footwork, the stroke quality (precision and velocity) does not decrease. Thereby the opponent is forced to make more mistakes. The high ratio of direct errors in all situations of time pressure (Figure 4) on clay and hard court in men's tennis confirms the increased importance of running speed. These findings are elementarily for the training practice as well as for the development of valid tennis-specific running tests. The main focus on one hand is to increase the explosive start and acceleration abilities for the first few metres, and on the other hand to optimise the tennis-specific running technique and co-ordination (footwork) immediately before and after the stroke. Start and sprint speed have to be practised for running distances from three to eight metres to the side, especially to the forehand as well as backhand side (Figure 3), with or without subsequently changing direction (including strokes) on the baseline.

To reach an optimal adaptation and performance increase, as well as injury prophylaxis, an accompanying strength training of specific structures is recommended. Speed and agility training must be considered the temporal adaptation process of muscles, tendons and ligaments. 🏓

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