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Bioenergetic Profile Of Tennis Singles Match Play

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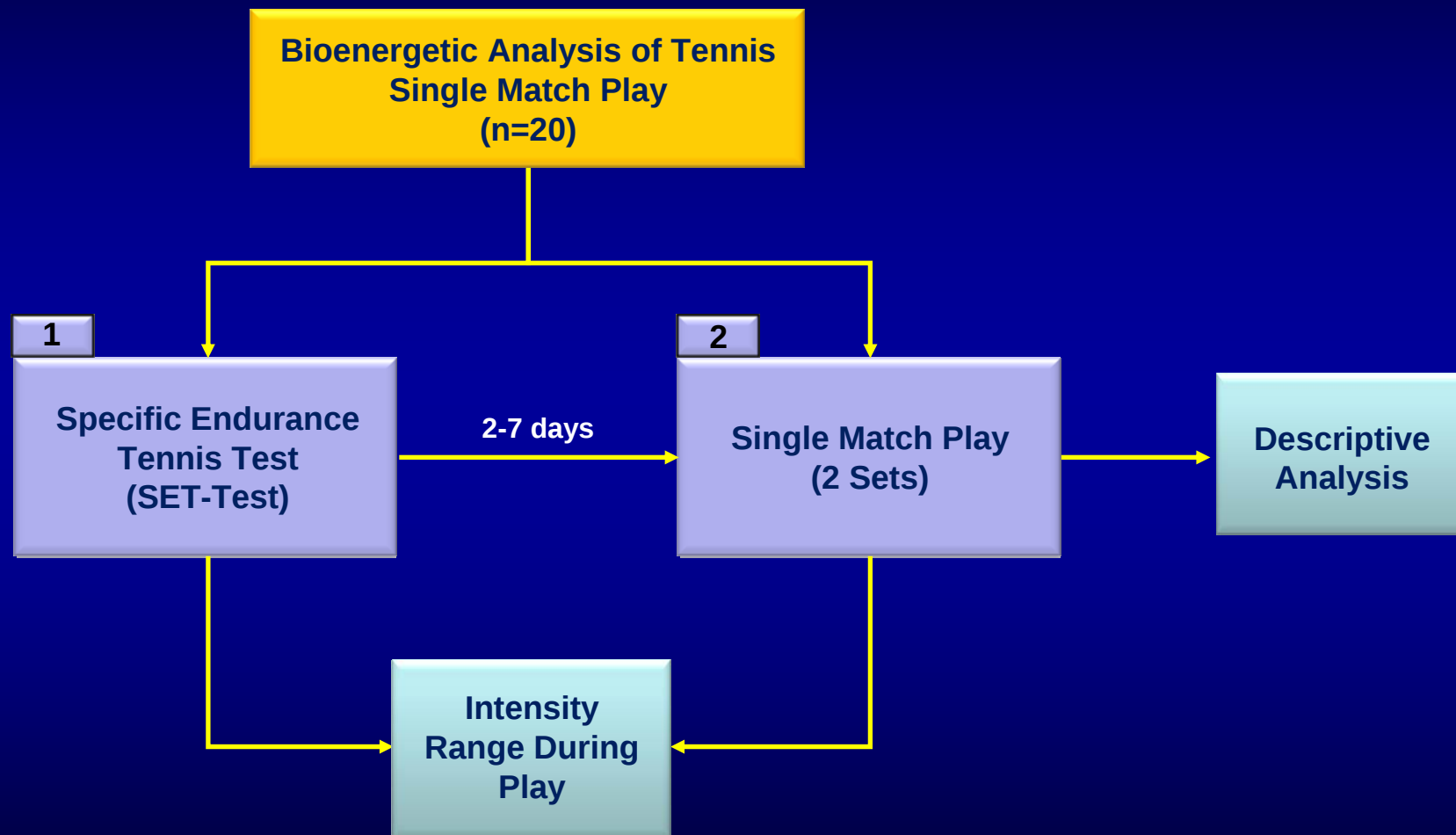


Aim

- To characterize the metabolic response during tennis singles match play
- To establish the bioenergetic profile of male singles tennis competition



Design

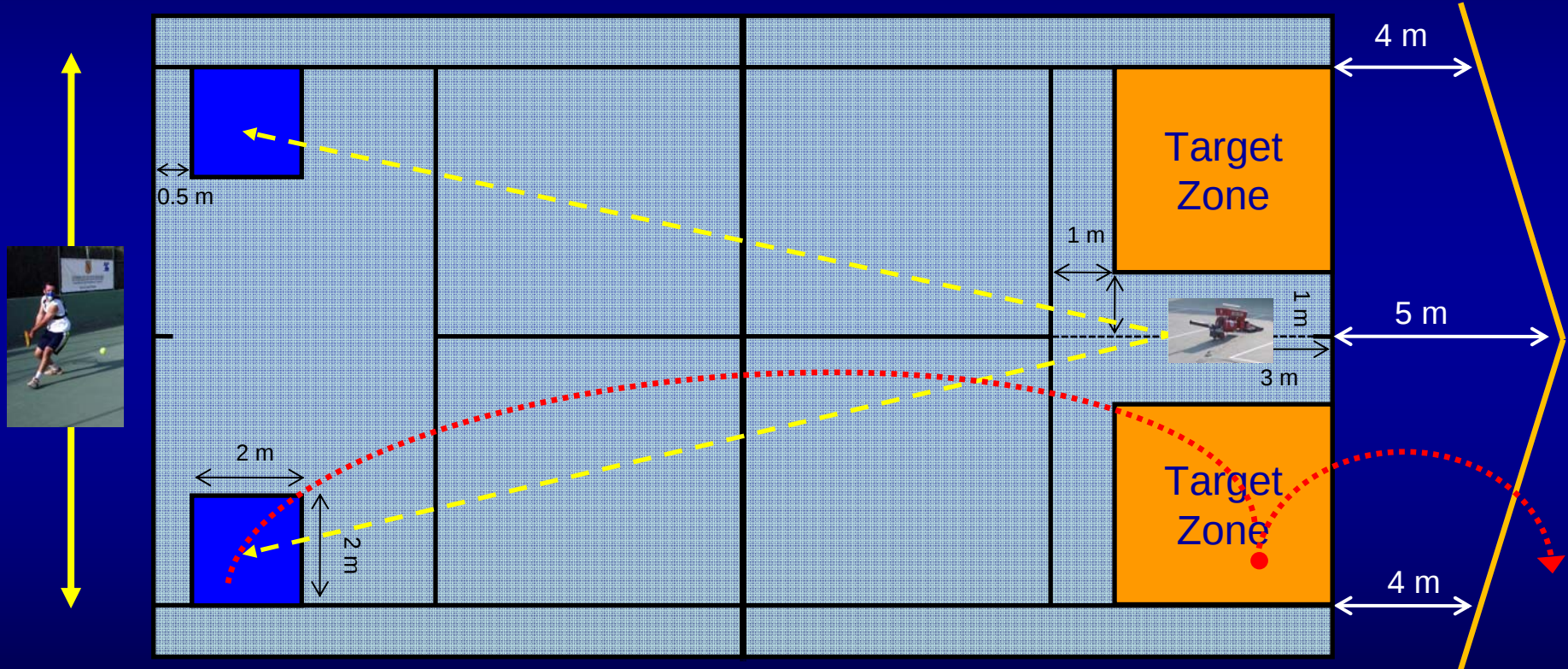




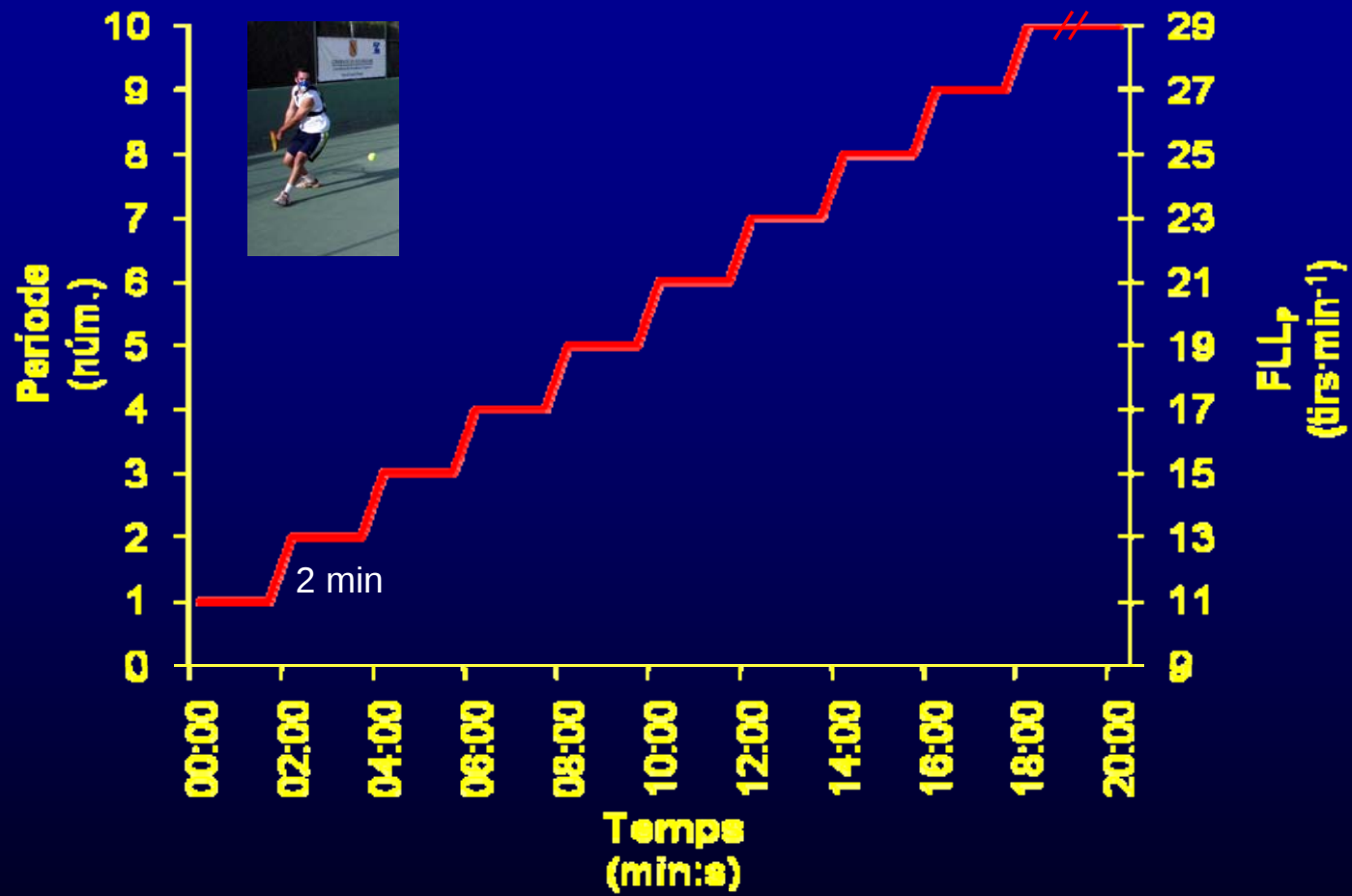
n = 20

	Age y	Height cm	Weight kg	BMI kg/m ²	Competitive Level	Training volume h/wk	
						Technical	Physical
Mean	18.2	180.1	72.7	22.3	4 ATP	3.7	1.5
SD	1.3	7.9	8.6	1.4	16 ITN 1-4	0.5	0.4

SET-Test



SET-Test Protocol



SET-Test



The Specific Endurance Tennis Test (SET-Test): Design, Reliability and Validity

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Introduction

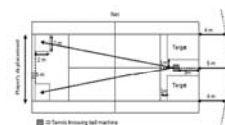
Although tennis is characterized by short efforts of intensive exercise based on a series of acyclic intermittent movements of an explosive and reactive nature, the player needs to maintain all these abilities for a prolonged time. A new procedure to assess tennis specific endurance was evaluated as to its application for testing and research purposes.

Objectives

To propose a specific endurance field test for tennis that would take into account specific technical and functional aspects of the sport, as well as evaluating their validity and reliability, and to ascertain the main indicators of tennis performance among the physiological, load and technical effectiveness parameters measured by the test.

Methods

38 trained male tennis players performed a maximal, incremental field test (SET-Test) conducted by a tennis ball throwing machine. 12 players performed the test three times, one with a portable gas analyzer (Coesmed K4b2). The test dynamics and reference parameters were adapted from the test used by Smekal et al. (2000). It is a maximal continuous stepped protocol, with loads imposed by a tennis ball throwing machine (Pop-Lob Airmatic 104). The players stood at the end of the court and hit the ball alternatively from right to left and left to right of the court with forehand and backhand volleys and moving laterally from one side to the other.



Schematic set-up for the SET-Test

Results

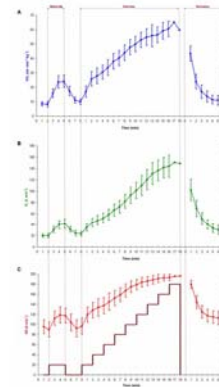
Test duration was $13:39 \pm 01:34$ min:s (6.61 ± 0.82 stages); $\dot{V}O_{2\max}$ was 57.0 ± 6.0 mL.kg⁻¹.min⁻¹; technical effectiveness (TE) was 63.1 ± 9.1 % of successful shots. A TE deflection point (TEDP) was observed at stage 5.2 ± 1.1 (79.6 ± 14.6 % of final stage). A heart rate deflection point (HRDP) was observed in 92% of the subjects at an average of 178.6 ± 8.7 beats.min⁻¹ (92.2 ± 2.7 % of HRmax). HRDP significantly correlated with the second ventilatory threshold (VT2) ($r = 0.87$, $p < 0.001$). Low to moderate significant correlations ($0.35 < r < 0.55$, $p < 0.05$) were found between test results and the competitive level of the players.

TE together with VT2 and

$\dot{V}O_{2\max}$, respectively, explained 56% and 53% of competitive level. Physiological and load parameters showed good

consistency (HRmax: ICC: 0.91, CV 1.4%; HRDP: 0.87, 2.5%; final stage: 0.85, 2.0%), somewhat higher than

TE parameters (TE: 0.72, 4.7%; TEDP: 0.59, 6.1%). No differences in performance were found when using the portable gas analyzer.



Oxygen uptake ($\dot{V}O_2$), minute ventilation (VE), heart rate (HR), and stage (S) during the SET-Test ($n = 38$). Mean and SD are depicted. Values are 15-s averages.

Conclusions

- The SET-Test is an objective, valid, and reliable field test for the assessment of load, physiological, and technical efficiency parameters, allowing estimations of the VT2 in tennis players.
- Performance predictive capacity is moderate according to the multifactorial character of the game.

References

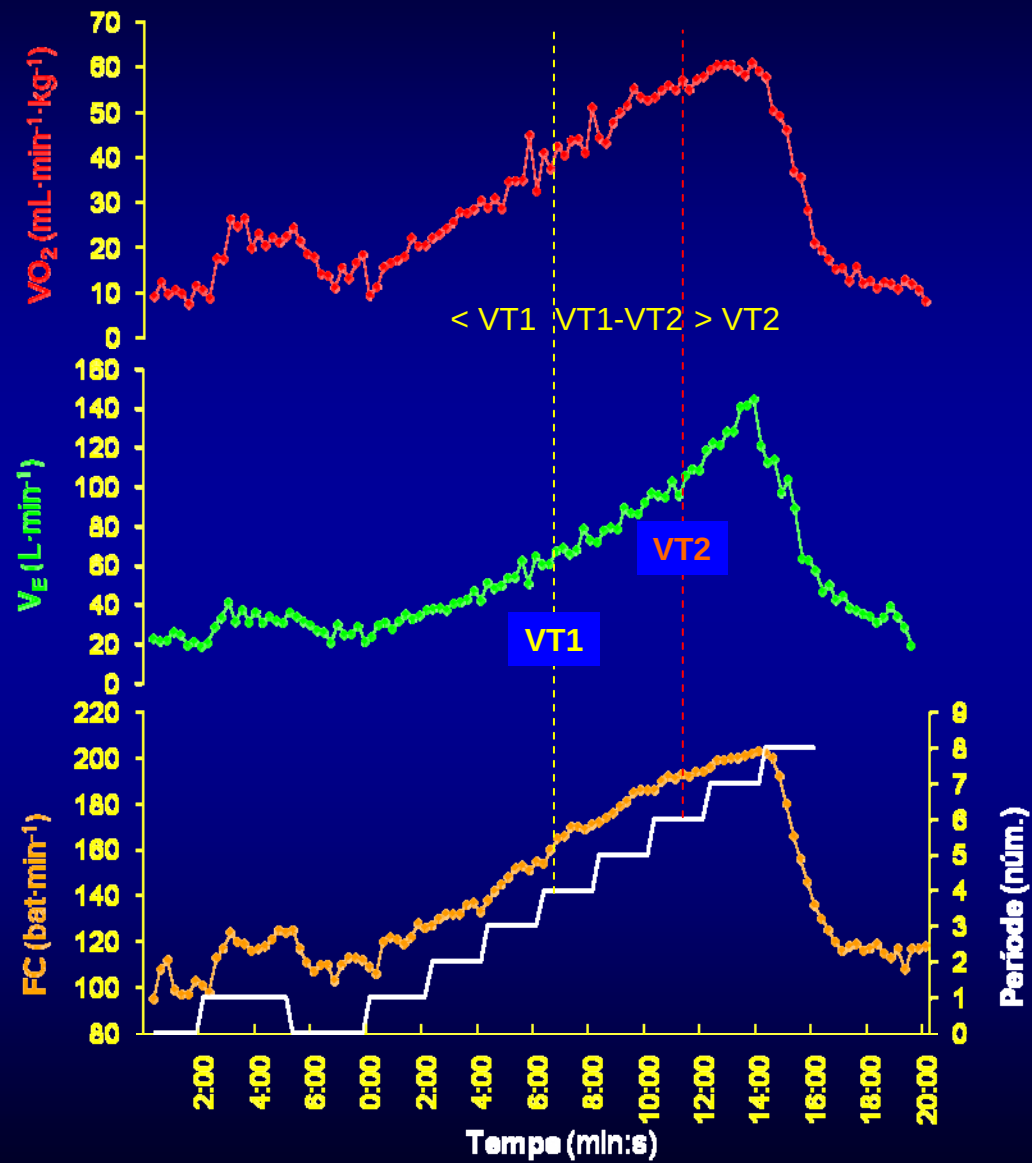
- Baiget E. Doctoral dissertation. Barcelona: Universitat de Barcelona; 2008.
- Smekal G et al. Int J Sports Med 2000;21(4):242-9.

Material

- Playing surface: Green Set®
- Tennis ball throwing machine (Pop - Lob Airmatic 104. France)
- Portable gas analyzer (Cosmed K4b², Italy)
- Heart rate monitors (Polar S-810 & S-610, Finland)
- Digital anemometer
- Tennis balls (Babolat Team. Japan)

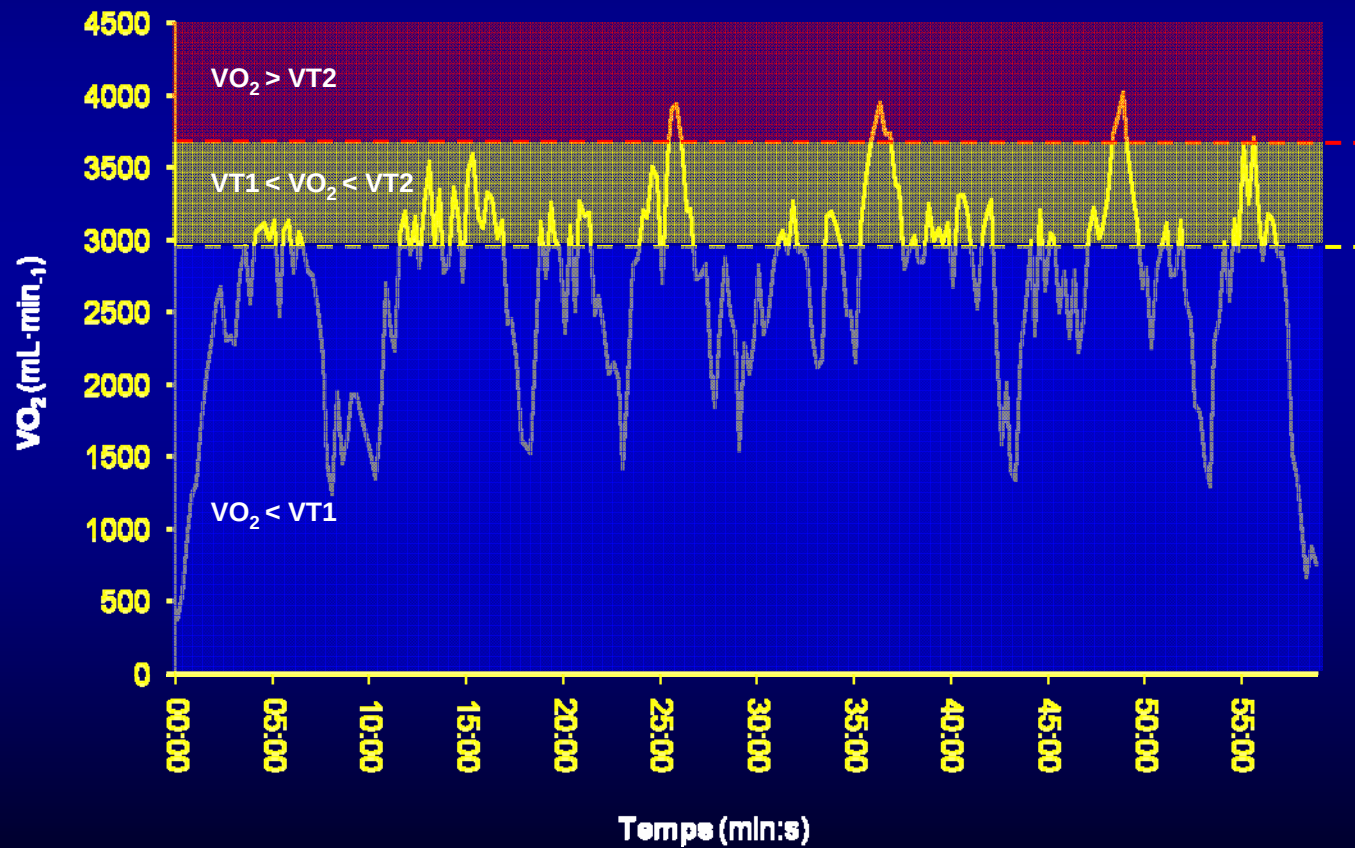


VT Detection



Intensity Zones

Intensity Zones During One Set





Results

Maximal Values During The SET-Test

	Mean $\pm$ SD	Range
Time (min:s)	13:39 $\pm$ 01:34	10:30 – 18:00
Last Stage (#)	6.61 $\pm$ 0.82	5 – 9
Heart Rate (b $\cdot$ min ⁻¹)	193.7 $\pm$ 7.6	179 – 206
VO ₂ (mL $\cdot$ kg ⁻¹ $\cdot$ min ⁻¹)	57.0 $\pm$ 6.0	70.6 – 43.5



Results

VO_2 & Heart Rate at Ventilatory Thresholds

	VT1	% maximal	VT2	% maximal
VO_2 ($\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$)	36.8 ± 4.2	64.5 ± 4.5	48.2 ± 5.4	84.6 ± 3.3
HR ($\text{b}\cdot\text{min}^{-1}$)	153.3 ± 11.4	79.1 ± 4.5	177.0 ± 9.1	91.8 ± 2.6
R	0.87 ± 0.1	78.4 ± 6.8	0.98 ± 0.12	87.4 ± 8.1

Match Playing Data

Sets Played 20 (170 games)

Duration 31 ± 11 min (15 to 60 min)

Results 60% Ties (1-1)

70% Wins Player Without K4b²



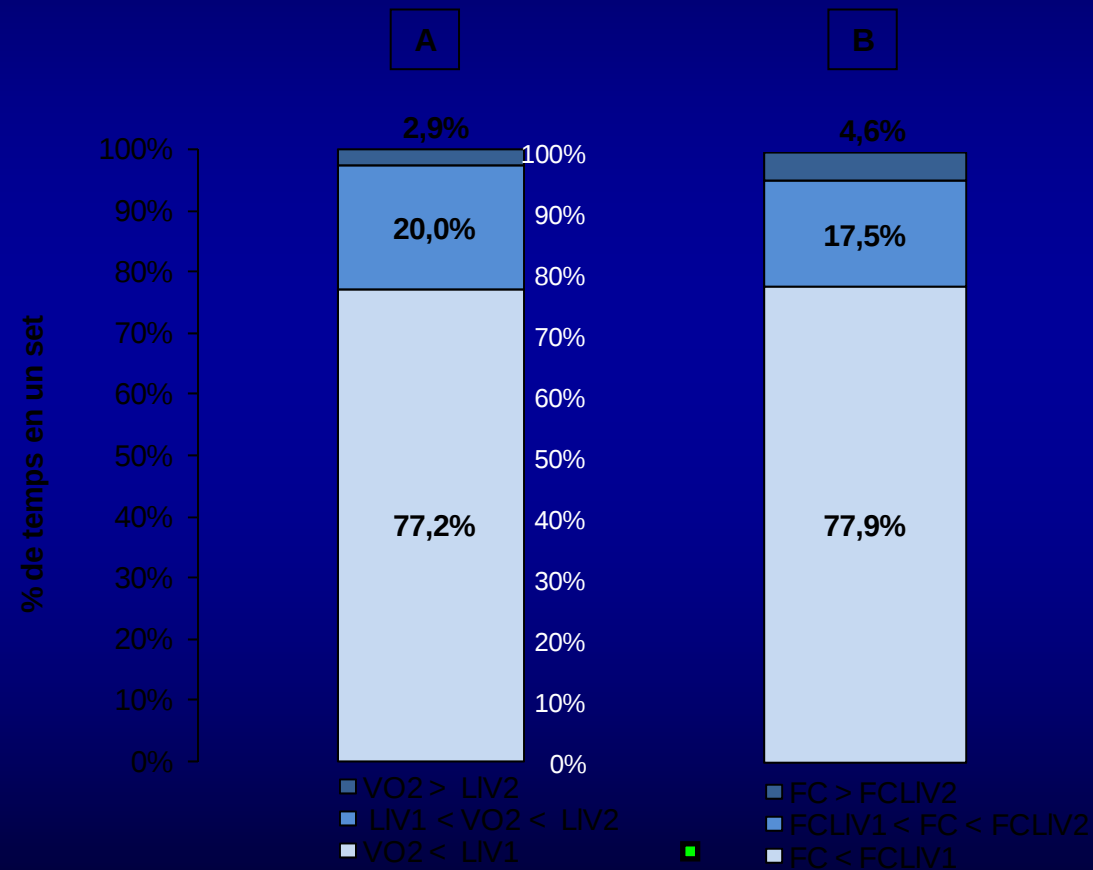
Results

Absolute And Relative Values During Match Play

	Mean	% $\text{VO}_{2\text{max}}$	% VT1	% VT2
VO_2 ($\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$)	29.9 ± 3.7	51.6 ± 8.6	80.7 ± 15.2	60.7 ± 11.3
Heart Rate ($\text{b}\cdot\text{min}^{-1}$)	138.1 ± 14.5	71.5 ± 6.5	89.7 ± 12.5	76.9 ± 9.8
R	0.94 ± 0.03	82.8 ± 7.9	104.3 ± 7.2	95.0 ± 7.5

Results

Time Played At Intensity Ranges





Discussion

VO₂ During Tennis Match Play

	Age y	n	VO ₂ mL·kg ⁻¹ ·min ⁻¹	% VO _{2max}	% VT2
Ferrauti et al. (2001)	47.0 ± 5.4	6	25.6 ± 2.8	54.0	-
Smekal et al. (2003)	26.0 ± 3.7	12	29.1 ± 5.6	51.1 ± 10.9	64.8 ± 13.3
Fernández et al. (2005)	23.9 ± 2.5	6	26.6 ± 3.3	46.4 ± 7.2	-
Murias et al. (2007)	16.9 ± 2.3	4	27.5 ± 2.5	49.5 ± 4.8	-
Present Study	18.0 ± 1.2	20	29.9 ± 3.7	51.6 ± 8.6	60.7 ± 11.3



Discussion

- 77% of time was played at **low-moderate intensity** (below VT2) mostly due to the rest periods between games
- **Most actions** during actual playing corresponded to the **transition zone** intensity (between VT1 and VT2)
- Playing intensity **over VT2** was minimal (<3%) although it may take place during decisive periods of the game



Discussion

- Low average VO_2 values (ca. $30 \text{ mL} \cdot \text{Kg}^{-1} \cdot \text{min}^{-1}$, 52% of $\text{VO}_{2\text{max}}$) and 77% of playing time below VT2 suggest that the oxygen transport system is not a limiting factor in tennis
- Considering the submaximal intensity of playing **specific endurance training programs** should be undertaken beyond competition itself

Thank you for your kind attention

