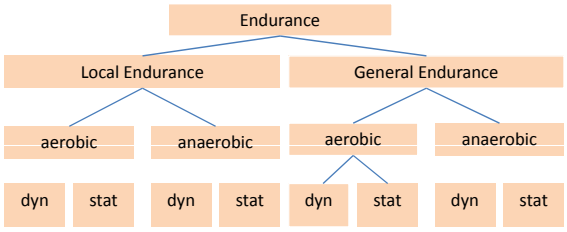
Basic Endurance *versus* Tennis Specific Endurance ?



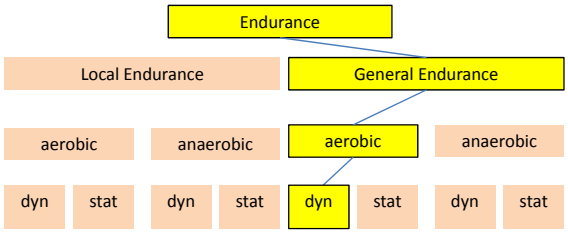
Hollmann and Hettinger 2002

Contents

Basic Endurance *versus* Tennis Specific Endurance ?

Basic Endurance = Tolerance towards extensive aerobic, dynamic work of large skeletal muscles

Activities:
- Running/Jogging
- Walking/Nordic-Walking
- Cycling
- Inline-Skating
- Swimming/Aqua-Jogging
- (Nordic) Scating
- Rowing
- Aerobic/Step-Aerobic
- Indoor Fitness (e.g. Cross Trainer)
- Cardio Tennis

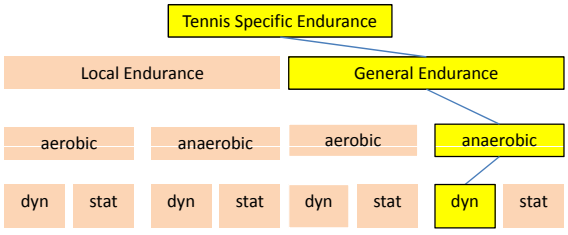


Hollmann and Hettinger 2002

from the official E-learning DVD of the German Tennis Federation
Alexander, Luisa and Fabio Ferrauti
Testing and Training Endurance
with young Tennis Players
Characteristics of the endurance demands in tennis

Tennis Specific Endurance = ?

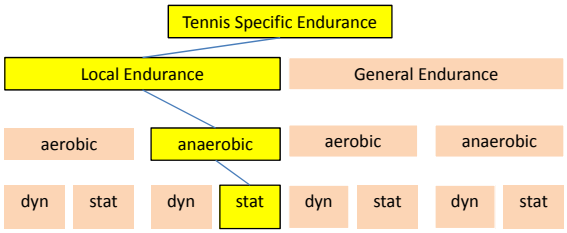
Example 1: Intensive Baseline Drill including sprints.



Hollmann and Hettinger 2002

Tennis Specific Endurance = ?

Example 2: Volley training with high repetitions.



Hollmann and Hettinger 2002

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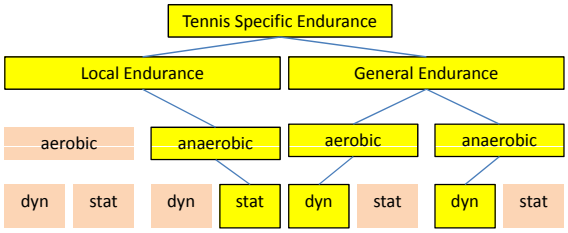
Tennis Specific Endurance =
1. ***During the work***
   Tolerance towards aerobic (and anaerobic), dynamic (and static) work of larger (and smaller) skeletal muscles

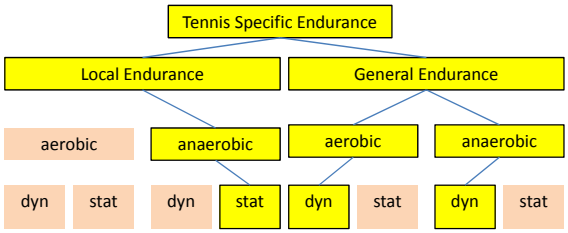


Hollmann and Hettinger 2002

Contents

Tennis Specific Endurance =

1. ***During the work***
   Tolerance towards aerobic (and anaerobic), dynamic (and static) work of larger (and smaller) skeletal muscles
2. ***After the work***
   Quick regeneration between intensiv *rallies (drills) or matches (trainings units)*



Hollmann and Hettinger 2002

Individual Determinations of Tennis Specific Endurance:

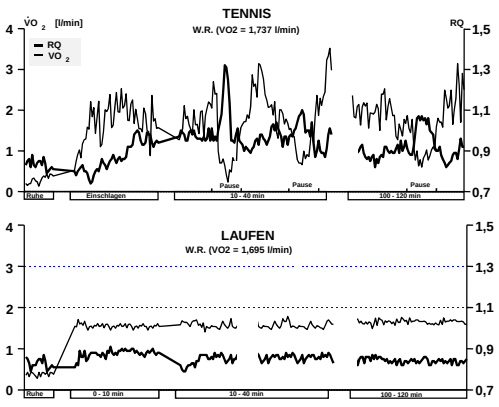
- Stroke energy and stroke economy
- Body weight and reactive force
- Running economy and coordination

Contents

from the official E-learning DVD of the German Tennis Federation
Alexander, Luisa and Fabio Ferrauti
Testing and Training Endurance
with young Tennis Players
Characteristics of the endurance demands in tennis

Energy metabolism and oxygen kinetics differ extremly between running and tennis

Simulation 1
Simulation 2
Simulation 3



Ferrauti et al.
Eur J Appl Physiol 2002

Endurance training for tennis players is based on a sufficient general endurance but has to consider predominantly the tennisspecific endurance !

Contents

Questions and Contradictions?

„Children have a good aerobic capacity “

?

„Children are not made for long distance running“

Selected Citations

„Children have a low anaerobic capacity “

?

„Children love short and intense activities“

Contents

Biochemical profile

Anaerobic markers
- similar resting values for muscle ATP and PCr
- lower glycolytic enzyme activity (e.g. PFK), lower adrenergic stimulation
- smaller glycogen stores, less fast-twitch muscle fibers ?
- lower maximal blood lactate concentrations
- better regulation of blood pH and blood [H^+] Schwankungen

Aerobic markers
- quicker VO_2 response
- higher relative volume of muscle mitochondria and aerobic enzyme activity
- lower RER with better fat utilization

Markers	children
PCr	⟷
PFK, Epi, Glyk	↓
blood [La^-]	↓
blood pH	↑
VO_2-Kinetiks	↑
mitochondria Vol.	↑
RER	↓

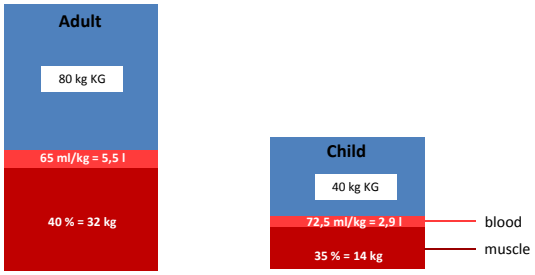
Interpretation
Children seem to have a lower anaerobic and a good aerobic capacity on the first view,
but this has no implications for aerobic and anaerobic fitness and endurance training!

1. The lower anaerobic capacity is adapted to body composition and body mass.
2. The biochemical aerobic capacity is not corresponding to aerobic performance.

Contents

Body composition from children and adults is different
Children have a lower relative (and absolute) muscle volume and a relative higher blood volume.

Consequently blood [La^-] is lower, but this is no indication for a lower anaerobic fitness!



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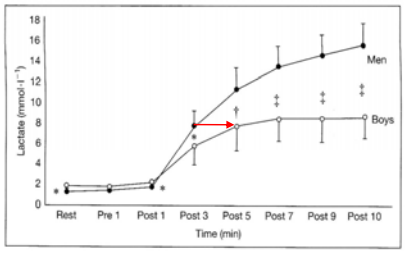
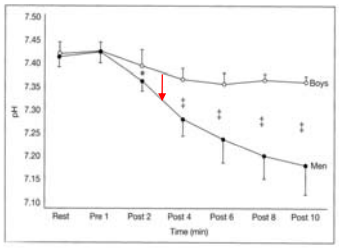
Aspects of childrens exercise physiology

Regulation of blood pH is better in children than in adults
Similar blood [LA^-] correspond to higher blood pH.

Consequently children can better maintain performance during intensive repetitive work!



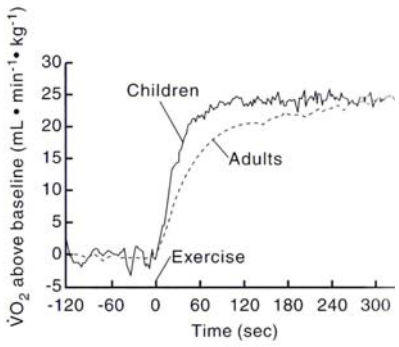


Ratel et al. 2002

Contents

Oxygen kinetic in children is faster than in adults
Adaptation of oxygen uptake is regulated better at the onset of exercise.

Consequently children have a perfect equipment for a variable oxygen uptake !

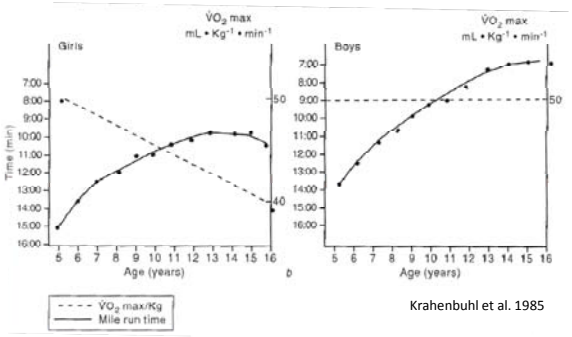


Armon et al. 1991

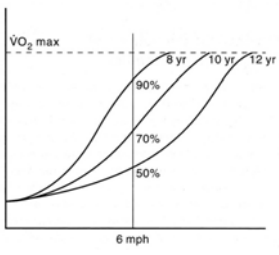
Contents

VO_2max related to body weight has no indication for aerobic performance
Running economy in children is lower (force production, co-contractions).

Inspite of a high biochemical capacity, the aerobic performance has biomechanical limitations!



Krahenbuhl et al. 1985



Rowland 1989

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from the official E-learning DVD of the German Tennis Federation

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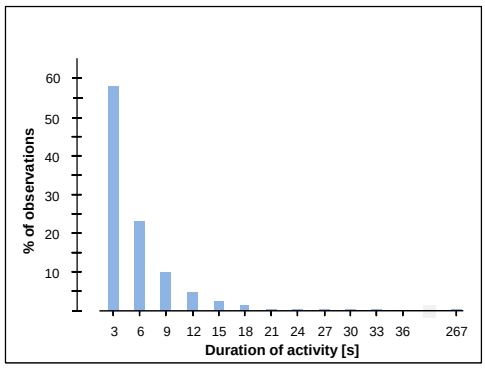
Testing and Training Endurance
with young Tennis Players

Aspects of childrens exercise physiology

Observational techniques show that children prefer short bursts of intense physical activity
The average duration of all activities was 6 s.

Children playing activity is partly anaerobic and aerobic and corresponds to the tennis demands!



Bailey et al. 1995

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from the official E-learning DVD of the German Tennis Federation

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Testing and Training Endurance
with young Tennis Players

Aspects of childrens exercise physiology

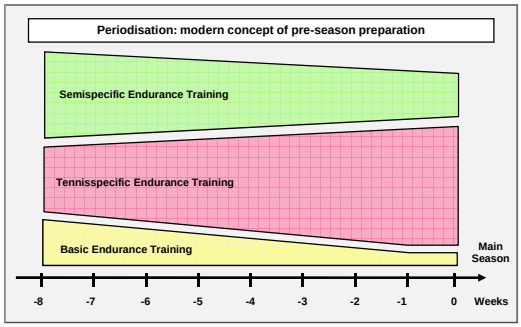
- Children are Metabolic Nonspecialists (aerobic, anaerobic alactacid, anaerobic lactacid)
- Aerobic and anaerobic capacity (engine power) is exactly adapted to body composition (autobody)
- No risk of excessive demands because of a „physiological self restriction“
- The smaller engine has less power but produces less emissions (blood lactate)
- The musculoskeletal system (underbody of the car) is not made for long distances
- Children are perfectly suited for short bursts of intense physical activity (city traffic)

Tennis training and competition as well as a semicpecific endurance training (fartlek) correspond exactly to childrens physiological, biomechanical and psychological specifics

Contents

Endurance training with young tennis players should include three categories:

Basic Endurance | **Semispecific Endurance** | **Tennisspecific Endurance**



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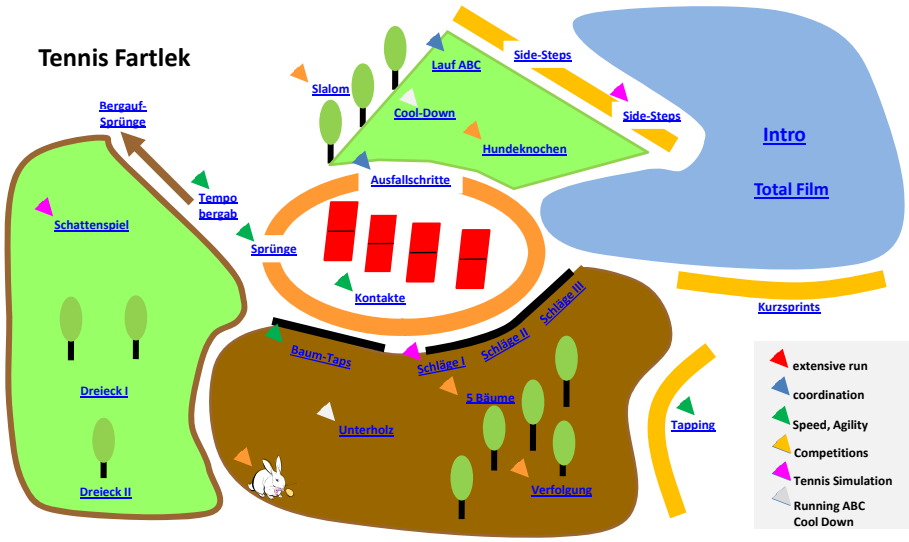


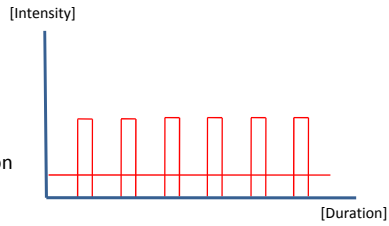
Contents

Tennisspecific Endurance Training

Principles:

- Integration of tennisspecific movement patterns
- Combination of standardized and open rallies
- Integration of competitions
- Integration of speed demands
- Increase of work load intensity and stimulus duration compared to match play

Tennis Match Play



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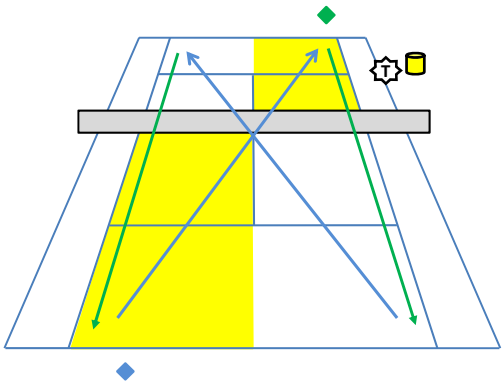
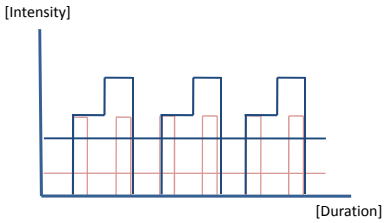


„Ins and Outs“
30 s „braces“
2 points in a row

Dosage:

Braces (Outs)	30 s
2 points (Ins)	30 s
Recovery	30 s



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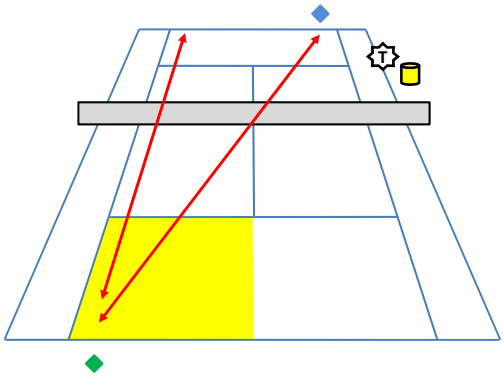
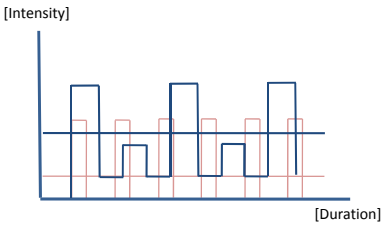


„Under Pressure“
Player green plays alternating into FH and BH.
Player blue hits into the target zone.
Hits and errors are calculated.

Dosage:

intensive (blue)	30 s
moderate (green)	30 s
change of ends	15 s



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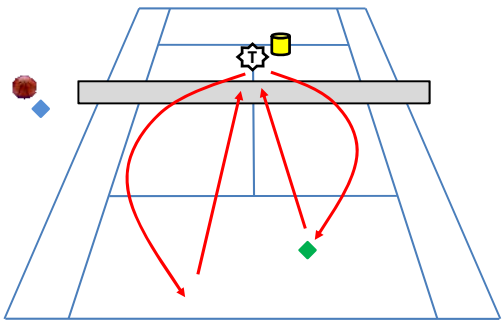
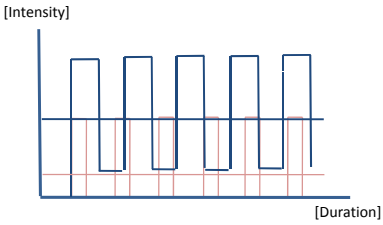


„Bruguera“
The player is only allowed to play forhand and has to attack the Coach with maximum power.
Coach plays soft and high bouncing volleys.

Dosage:

intensiv (green)	30 s
activ recovery (blau)	30 s



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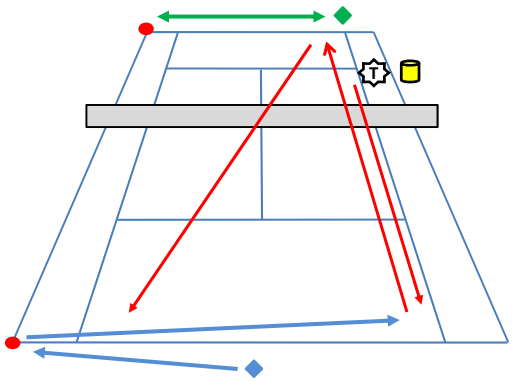


„Baseliner after sprint“

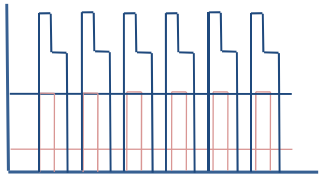
Players green and blue have to sprint after a signal .

The Coach feeds the ball which opens a rally between both.

Dosage:

Sprint	3 s
Rally	5-15 s
recovery	15 s

[Intensity]



[Duration]

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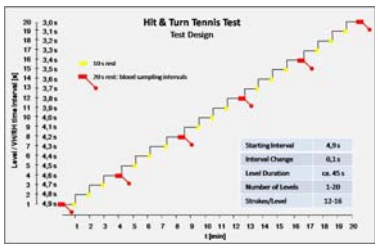
Endurance Testing: „The Hit&Turn Tennis Test“

Hit & Turn Tennis Test (HTT)

- Translation of the multistage 20 m shuttle run test (Léger 1988) on tennis demands.
- The Hit and Turn Tennis test is an acoustically controlled and progressive Fitness Test.
- The test can be easily carried out with a racket on a tennis court by one or more players at the same time.
- The object of the test is to follow as long as possible the audible signals and to hold up the required footwork.
- The player has to run along the base line and to hit a forehand or backhand shot in the respective corners just in time with the signals.
- The maximum achieved test level is assessed and can be used to estimate the maximum oxygen uptake.



developed by Ruhr-University Bochum (2008) under support of ITF and DTB

contact: alexander.ferrauti@rub.de

Contents

HTT test materials

HTT ball pendulum

Ifty Patel
Tennismate
2 Claremont Rd
Dewsbury
West Yorks WF13 4LF
Tel: 00441924 459581 or 00447961 961443
E-mail: iftypatel@hotmail.com
Price: $59.00

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HTT Norm values (male tennis players)

VO_{2max} [ml/min/kg]		Strokes															Category
Level	Intervall [s]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	4,9																	
2	4,8																	
3	4,7																	
4	4,6																	
5	4,5																	bad
6	4,4																	
7	4,3																	
8	4,2																	
9	4,1	46,0	46,0	46,1	46,2	46,3	46,4	46,6	46,8	47,0	47,2	47,4	47,6	47,8	**48,0**			
10	4,0	48,0	48,0	48,1	48,2	48,3	48,4	48,6	48,8	49,0	49,2	49,4	49,6	49,8	**50,0**			
11	3,9	50,0	50,0	50,1	50,2	50,3	50,4	50,6	50,8	51,0	51,2	51,4	51,6	51,8	**52,0**			mittel
12	3,8	52,0	52,0	52,1	52,2	52,3	52,4	52,6	52,8	53,0	53,2	53,4	53,6	53,8	**54,0**			
13	3,7	54,0	54,0	54,1	54,2	54,3	54,4	54,6	54,8	55,0	55,2	55,4	55,6	55,8	**56,0**			
14	3,6	56,0	56,0	56,1	56,2	56,3	56,4	56,6	56,8	57,0	57,2	57,4	57,6	57,8	**58,0**			good
15	3,5	58,0	58,0	58,1	58,2	58,3	58,4	58,6	58,8	59,0	59,2	59,4	59,6	59,8	**60,0**			
16	3,4	60,0	60,0	60,1	60,2	60,3	60,4	60,6	60,8	61,0	61,2	61,4	61,6	61,8	**62,0**			
17	3,3	62,0	62,0	62,1	62,2	62,3	62,4	62,6	62,8	62,7	62,8	63,0	63,2	63,4	63,6	63,8	**64,0**	excellent
18	3,2	64,0	64,0	64,1	64,2	64,3	64,4	64,6	64,8	64,7	64,8	65,0	65,2	65,4	65,6	65,8	**66,0**	
19	3,1	66,0	66,0	66,1	66,2	66,3	66,4	66,6	66,8	66,7	66,8	67,0	67,2	67,4	67,6	67,8	**68,0**	international
20	3,0	68,0	68,0	68,1	68,2	68,3	68,4	68,6	68,8	68,7	68,8	69,0	69,2	69,4	69,6	69,8	**70,0**	champion

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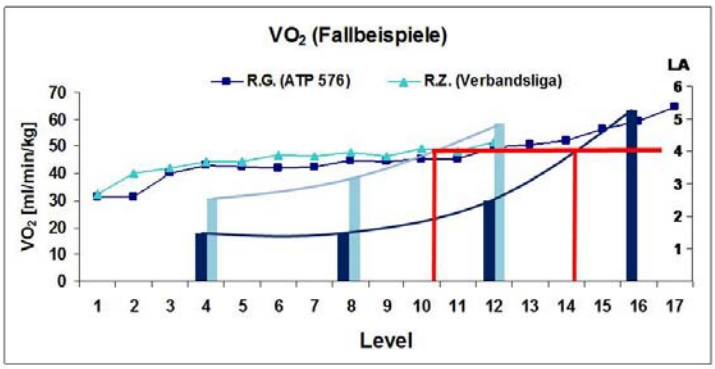
Endurance Testing: „The Hit&Turn Tennis Test“

HTT individual value discussion



Player R.G. (ATP 576)
Test break-off: Level 17
VO_2max: 67.0 ml/min/kg
4 mmol/l: Level 14.2
Evaluation: excellent

Player R.Z. (4th division)
Test break-off: Level 12
VO_2max: 51.0 ml/min/kg
4 mmol/l: Level 10.3
Evaluation: average

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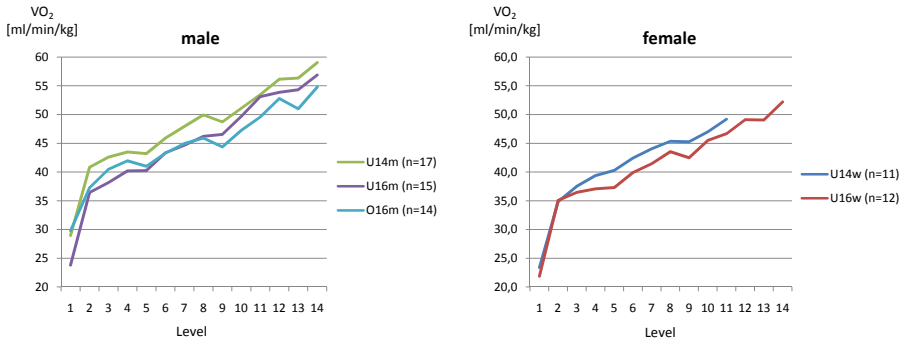
HTT mean oxygen consumption
(national ranked players)



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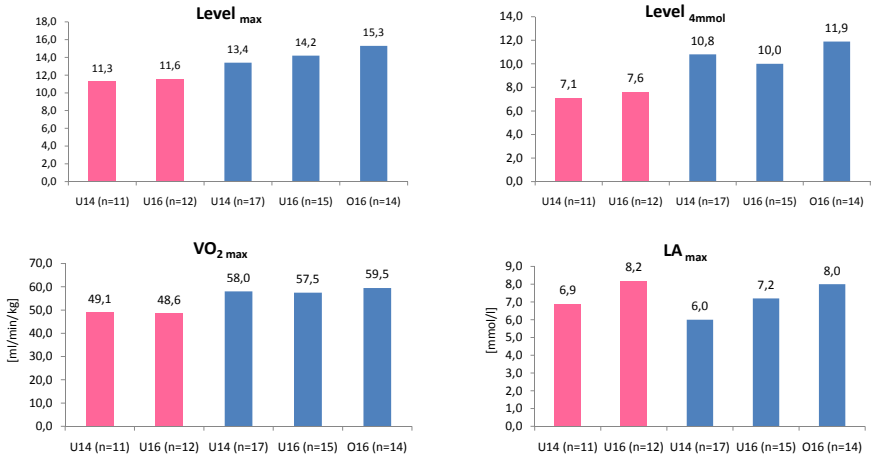
HTT performance
(age, sex)



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HTT Validity and Reliability

	n=12	$VO_{2\ max}$	$L_{4\ mmol}$
Reliability	Carpet/Carpet	0,942**	0,848**
	Carpet/Clay	0,713**	0,880**
Validity	HTT/Ball Machine Test	0,961**	0,756**
	HTT/Threadmill Test	0,619 *	0,617 *

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