

RUHR-UNIVERSITÄT BOCHUM

RUB

TESTING AND TRAINING IN TEAM AND RACKET SPORTS

PROF. DR. ALEXANDER FERRAUTI







Department of Training & Exercise Science

RUB





LEHR- UND FORSCHUNGSBEREICH TRAININGSWISSENSCHAFT

Anschrift: Gesundheitscampus Nord Nr.10, 44801 Bochum | [E-Mail](#)

LEITER

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(0234) 32-22451

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(0234) 32-28950

DOC SNYDER HÄLT DIE WELT IN ATEM



Wir gratulieren Christoph Schneider zum Abschluss seines Promotionsverfahrens.

[weiterlesen](#)

LATEST PEER REVIEWED PAPERS

- ▶ Fett, J., Oberschelp, N., Vuong, J.L., Wiewelhoeve, T. & Ferrauti, A. (2021). Kinematic characteristics of the tennis serve from the ad and deuce court service positions in elite junior players. PLoS ONE, 16(7), 1-14. <https://doi.org/10.1371/journal.pone.0252650>
- ▶ Hacker, S., Reichel, T., Hecksteden, A., Weyh, C., Gebhardt, K., Pfeiffer, M., ferrauti, A., Kellmann, M., Meyer, T. & Krüger, K. (2021). Recovery-Stress Response of Blood-Based Biomarkers. International Journal of Environmental Research and Public Health, 18 (11). 5776. <https://doi.org/10.3390/ijerph18115776>
- ▶ Hottenrott, L., Ketelhut, S., Schenider, C., Wiewehove, T. & Ferrauti, A. (2021). Age- and Sex-Related Differences in Recovery from High-Intensity and Endurance Exercise: A Brief Review. Human Kinetics Journals, 16 (6), 752-762. <https://doi.org/10.1123/ijsp.2020-0604>

"SPORT FÜR KINDER - WAS IST GUT FÜR DIE KLEINEN"



Kinder müssen sich bewegen. Aber wie - während der Corona-Pandemie?

[weiterlesen](#)

DR. THIMO WIEWELHOVE FOLGT EINEM RUF AN DIE IST-HOCHSCHULE DÜSSELDORF



Nach über zehnjähriger Zugehörigkeit an der Fakultät für Sportwissenschaft verlässt uns Thimo Wiewelhoeve und folgt einem Ruf auf eine W2-Professur für Trainingswissenschaft an die IST-Hochschule.

[weiterlesen](#)





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Master of Science (SEHP)

Sport & Exercise for Health & Performance

FACULTY OF SPORT SCIENCE



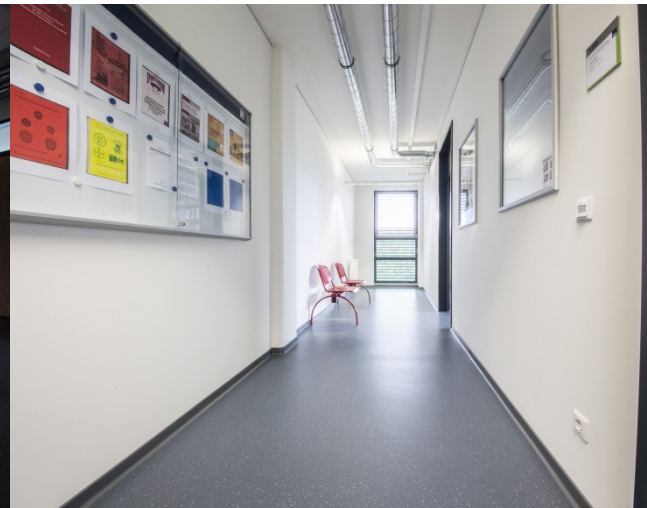
Master of Science (SEHP)

Sport & Exercise for Health & Performance

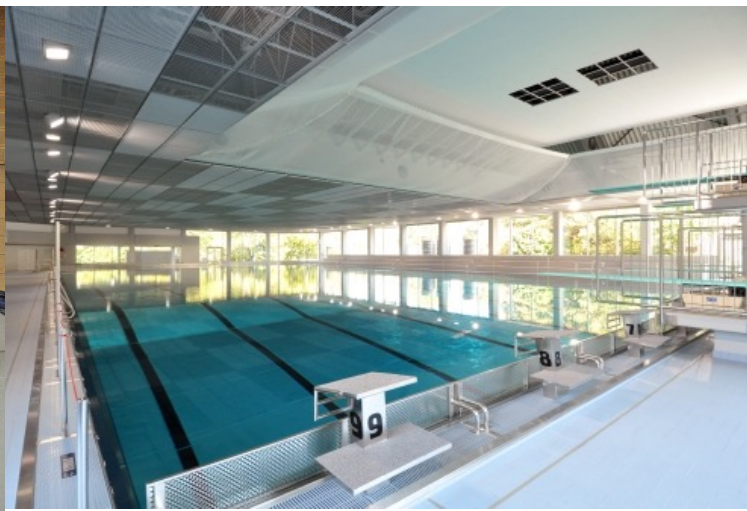
Contents:

- Physiological Performance Testing
- Biomechanical Analysis
- Athletic Training
- Prevention & Rehab in Elite and Recreational Athletes
- Nutritional Science
- Psychological Measurements & Interventions

Facilities



Facilities



Master of Science (SEHP)

Sport & Exercise for Health & Performance

Requirements:

Bachelor of Sport Science with 180 CP or comparable
Scientific-medical studies with at least 9 CP

Certificate for knowledge of English language:

Confirmation of the B2 language level in the certificate of the German
general university entrance qualification (Abiturzeugnis)

IELTS (British Concil): Score 6.5

TOEFL (Paper-based): Score 550

TOEFL (Computer-based): Score 213

TOEFL (Internet-based): Score 80

TESTING AND TRAINING IN TEAM AND RACKET SPORTS

PROF. DR. ALEXANDER FERRAUTI

1 TESTING

- SOCCER GOAL KEEPER TEST
- HIT & TURN TENNIS TEST
- TESTING BATTERIES

2 TRAINING

- INDIVIDUALIZED TRAINING CONCEPT

3 SUMMERY

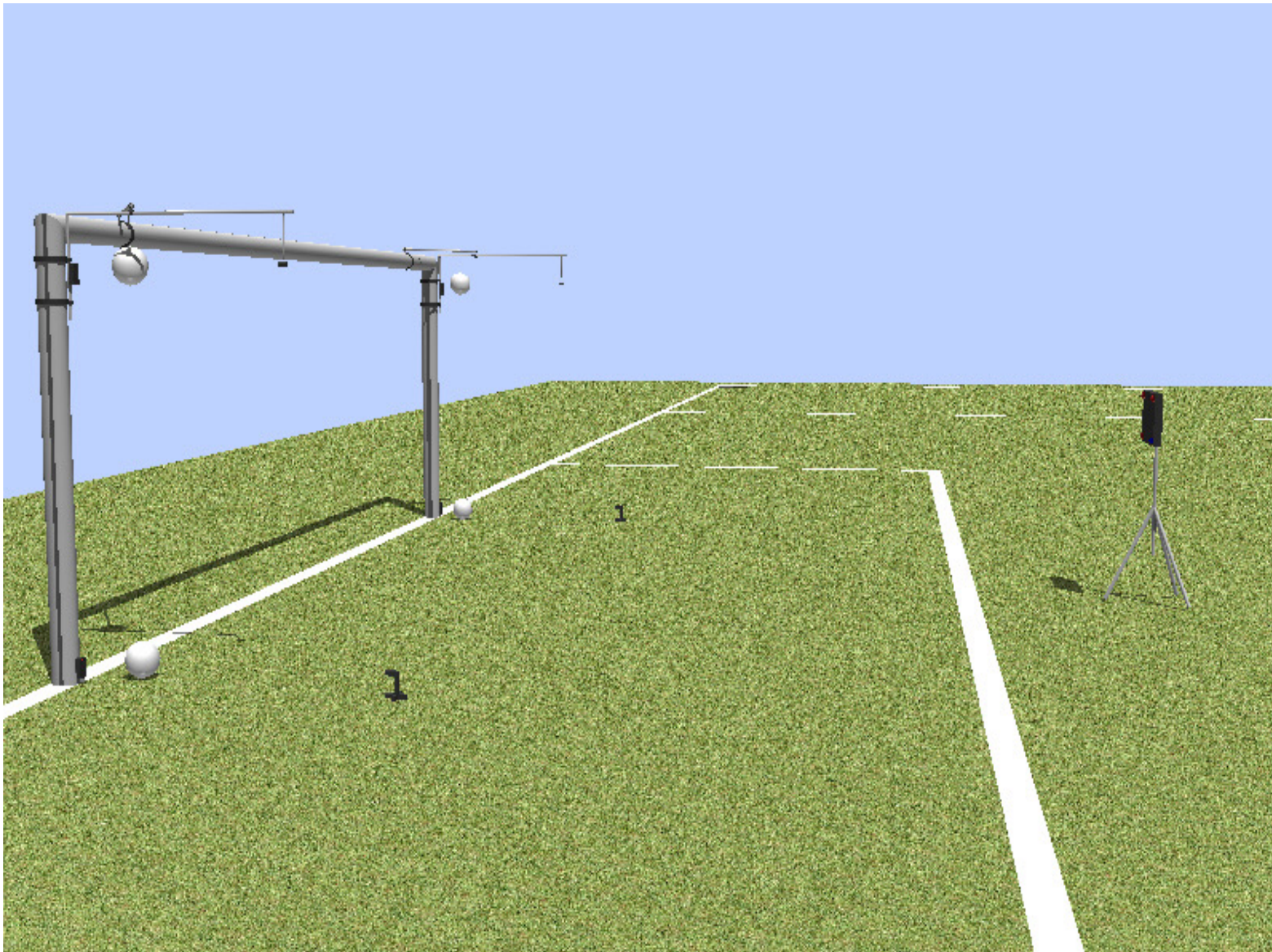
EVALUATION OF A SPECIFIC REACTION AND ACTION SPEED TEST FOR THE SOCCER GOALKEEPER

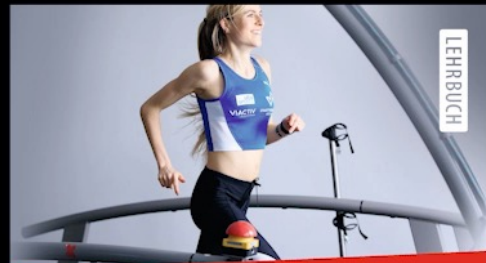
MARCO KNOOP, JAIME FERNANDEZ-FERNANDEZ, AND ALEXANDER FERRAUTI

Department of Training and Exercise Science, Faculty of Sports Science, Ruhr University Bochum, Bochum, Germany



Knoop, M., Fernandez-Fernandez, J. & Ferrauti, A. (2013). Evaluation of a specific reaction and action speed test for the soccer goalkeeper. *Journal of Strength and Conditioning Research*, 27(8), 2141-2148.





Alexander Ferrauti *Hrsg.*

Trainings- wissenschaft für die Sportpraxis

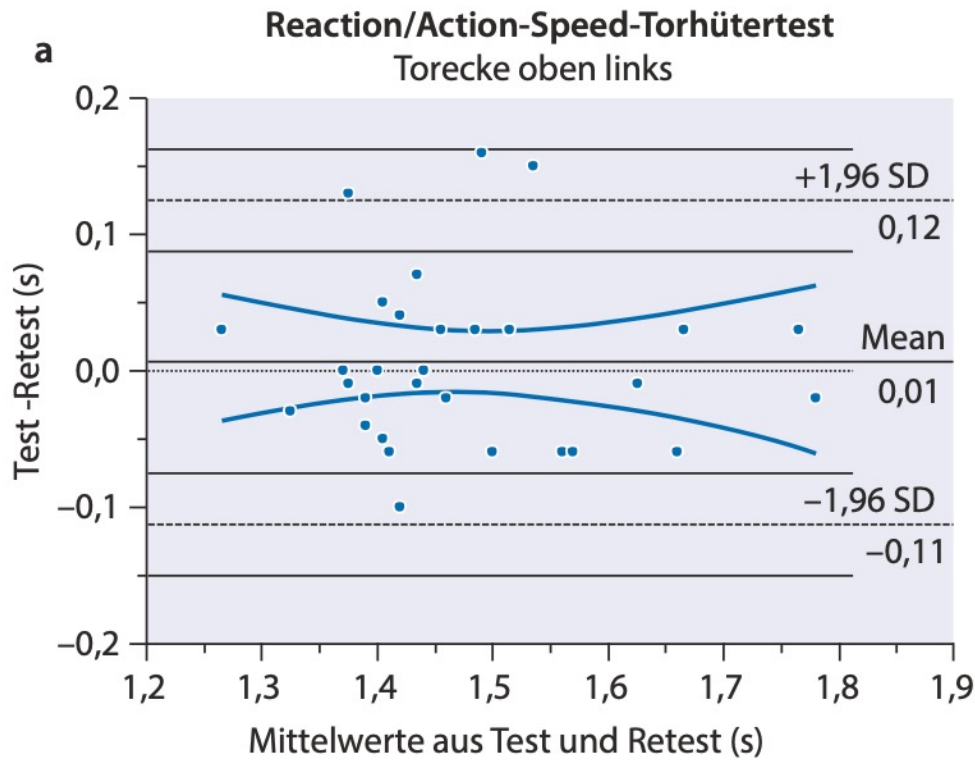
Lehrbuch für Studium, Ausbildung
und Unterricht im Sport



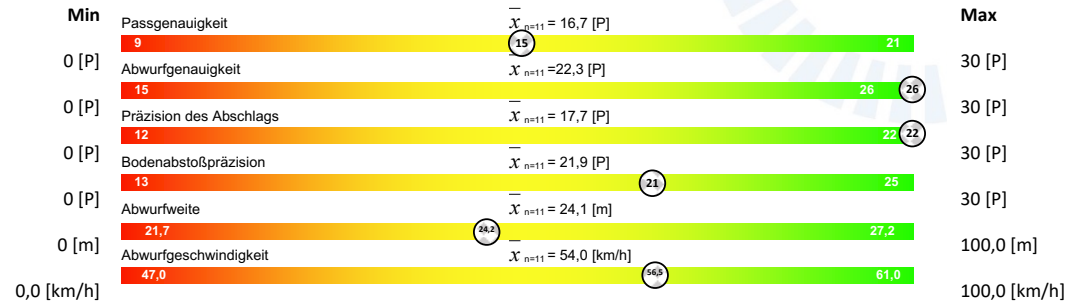
 Springer Spektrum

Reaction & Action Speed Test für Fussball-Torhüter

Reliabilität

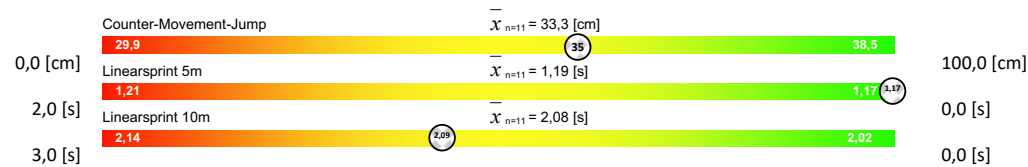


Komplex- offensive Fertigkeiten

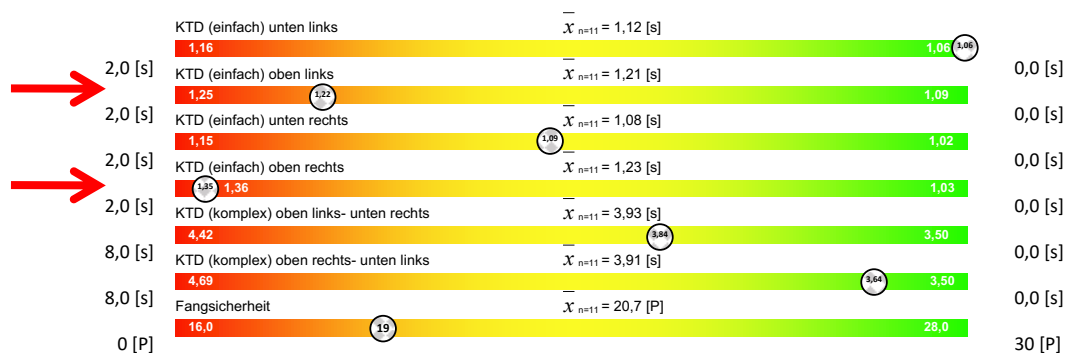


Niklas Süßmann
(VFL Bochum)

Elementare Fähigkeiten



Komplex- defensive Fertigkeiten



TESTING AND TRAINING IN TEAM AND RACKET SPORTS

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- TESTING BATTERIES

2 TRAINING

- INDIVIDUALIZED TRAINING CONCEPT
- RECOVERY MANAGEMENT

3 SUMMERY



Journal of Sports Sciences

Publication details, including instructions for authors and subscription information:
<http://www.informaworld.com/smpp/title~content=t713721847>

The Hit & Turn Tennis Test: An acoustically controlled endurance test for tennis players

Alexander Ferrauti^a; Vanessa Kinner^a; Jaime Fernandez-Fernandez^a

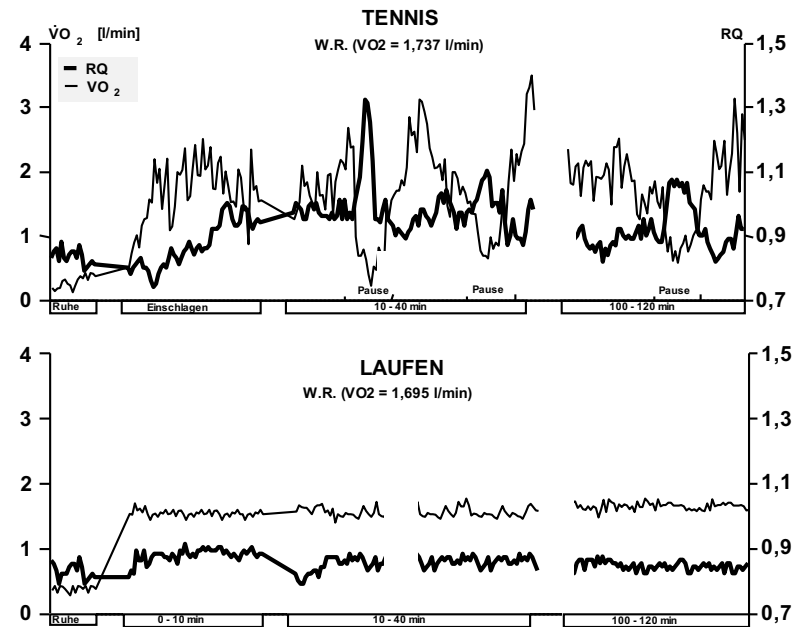
^a Department of Coaching Science, Faculty of Sports Science, Ruhr Universität Bochum, Bochum, Germany

First published on: 02 February 2011

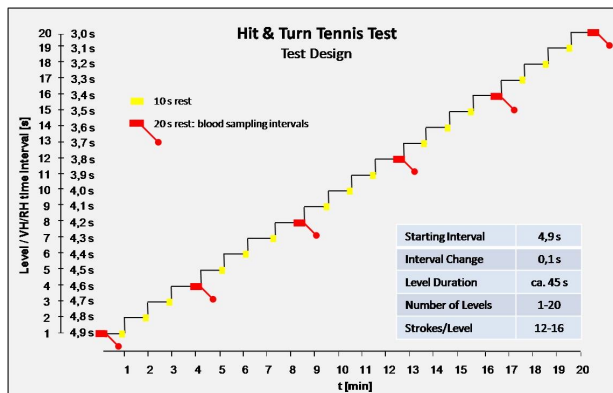


Ferrauti, A., Kinner, V.J. & Fernandez-Fernandez, J. (2011). The Hit & Turn Tennis Test: an acoustically controlled endurance test for tennis players. *Journal of Sports Sciences*, 29(5), 485-494.

Physiology of match play in Tennis



Ferrauti, A., Bergeron, M.F., Pluim, B.M. & Weber, K. (2001). Physiological responses in tennis and running with similar oxygen uptake. *European Journal of Applied Physiology*, 85(1-2), 27-33.



(Ferrauti et al. 2011)

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3 SUMMERY

The biannual nationwide DTB-Test



SPORT Orthopädie
Traumatologie

SCHWERPUNKT / ORIGINALARBEIT

Sport Orthop. Traumatol. 29, 180–192 (2013)
Elsevier – Urban&Fischer
www.elsevier.de/SportOrthoTrauma
<http://dx.doi.org/10.1016/j.orthtr.2013.07.005>

Abstract

Background: A player's fitness can be a key factor that may make the difference between victory and failure. Because technical and tactical skills are predominant factors in tennis it is of great importance to organize the fitness training as efficient and time saving as possible. The German Tennis Federation (DTB) has established a biannual nationwide physical testing including ~ 400 squad players. The results obtained are used for basic talent identification as well as the development of training guidelines, including individualized training programs. The present article shows the concept for fitness testing and training design of the DTB.

ORIGINALARBEIT/ORIGINAL PAPER

Conception for Fitness Testing and individualized training programs in the German Tennis Federation

Alexander Ulbricht, Jaime Fernandez-Fernandez, Alexander Ferrauti
Department of Training and Exercise Science, Faculty of Sports Science,
Ruhr-University Bochum, Germany

Eingegangen/submitted: 14.05.2013; akzeptiert/accepted: 12.07.2013

Ulbricht, A., Fernandez-Fernandez, J. & Ferrauti, A. (2013). Conception for fitness testing and individualized training programs in the German Tennis Federation. *Sportorthopädie Sporttraumatologie* 29(3), 180-192.

Altersklasse: 10,5-11 Jahre (männlich)

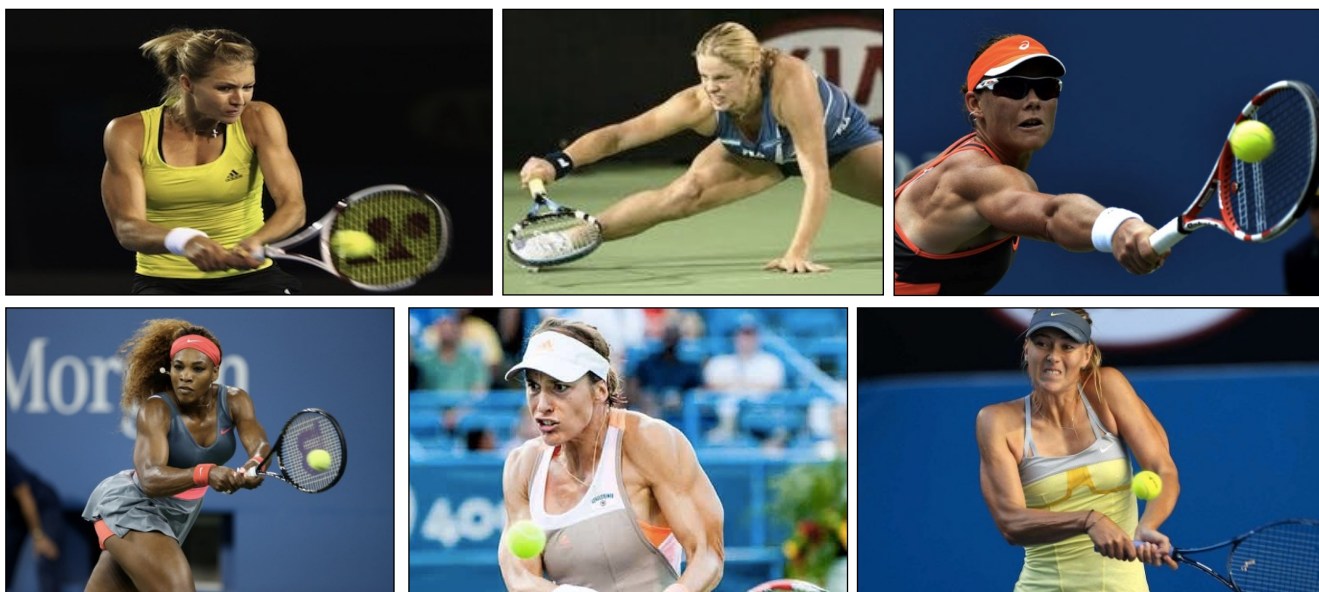
Prozentrang	Größe	Spannweite	Gewicht	BMI	Rumpfbeuge	Handkraft		Liegestütz	Bauch Test	Rücken Test
[%]	[cm]	[cm]	[kg]	[kg/m]	[cm]	D [kg]	ND [kg]	[n]	[n]	[n]
Mittelwert	147,4	145,9	37,7	17,3	2,3	21	18	19	24	18
10	139,6	138,2	31,9	15,2	-6,0	17	13	10	11	6
20	142,7	140,0	33,2	16,4	-3,0	18	15	13	14	10
30	144,1	142,0	35,7	16,7	-0,5	20	16	16	15	15
40	145,8	143,7	37,0	17,0	1,0	20	17	17	16	16
50	147,5	146,5	37,8	17,4	3,0	22	18	19	18	17
60	148,8	148,1	39,0	17,7	5,0	22	19	20	22	18
70	150,3	150,0	39,8	18,0	6,5	23	20	21	27	20
80	151,6	150,6	41,7	18,4	8,0	24	21	24	40	22
90	156,7	153,9	43,8	18,8	10,0	24	22	27	50	24
Prozentrang	Tapping	C-Movement	Standwelt-	Rep. Jumps	Medizinball Weitwurf			Aufschlag Test		
[%]	Frequenz	Jump	Sprung	Effizienz	Vorhand	Rückhand	Über Kopf	Mittelwert	Max	
[%]	[Hz]	[cm]	[cm]	[Index]	[cm]	[cm]	[cm]	[km/h]	[km/h]	
Mittelwert	10,6	28,3	176	1,07	663	622	524	118	125	
10	9,0	22,8	157	0,80	561	522	410	102	108	
20	9,3	24,4	163	0,92	580	560	465	108	115	
30	10,0	25,3	170	0,99	616	583	482	113	121	
40	10,3	26,8	172	1,02	640	612	510	117	123	
50	10,5	27,5	175	1,04	665	620	520	120	127	
60	10,7	29,2	180	1,08	676	630	540	121	128	
70	11,0	30,2	183	1,16	699	650	550	123	130	
80	11,4	31,5	187	1,29	736	695	570	125	132	
90	12,0	35,0	195	1,60	750	720	590	130	137	
Prozentrang	Linearsprint			Richtungswechselsprint				Hift & Turn Test		
[%]	5m	10m	20m	VH Wende	VH Gesamt	RH Wende	RH Gesamt	Level max	VO2max test	
[%]	[s]	[s]	[s]	[s]	[s]	[s]	[s]	[s]	[ml/min/kg]	
Mittelwert	1,17	2,04	3,64	1,26	3,09	1,38	3,21	12,0	52,9	
10	1,27	2,18	3,88	1,42	3,28	1,56	3,47	9,8	49,2	
20	1,23	2,12	3,78	1,36	3,22	1,50	3,35	10,6	50,7	
30	1,21	2,08	3,71	1,31	3,17	1,47	3,25	11,0	51,3	
40	1,19	2,07	3,69	1,29	3,10	1,43	3,24	11,4	51,9	
50	1,17	2,06	3,64	1,28	3,08	1,40	3,20	12,0	52,9	
60	1,16	2,05	3,62	1,24	3,07	1,36	3,18	12,2	53,3	
70	1,14	2,01	3,57	1,20	3,04	1,31	3,15	13,0	54,6	
80	1,12	1,95	3,50	1,17	2,99	1,25	3,06	13,9	56,1	
90	1,11	1,92	3,40	1,10	2,94	1,17	2,99	14,7	57,3	

Physical Performance & Tennis Ranking

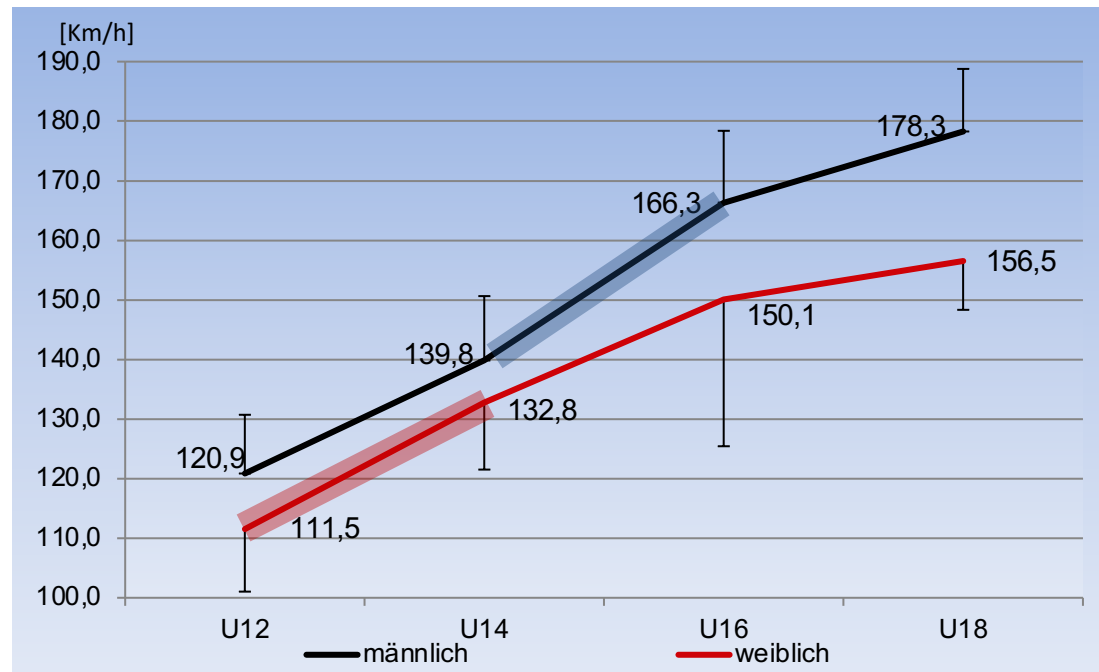
Boys 12-14 (n=75)	r	Boys 14-16 (n=63)	r	Boys 16-18 (n=40)	r
Service Mean Velocity	0,506	Medicine Ball Backhand	0,440	Service Mean Velocity	0,558
Medicine Ball Backhand	0,487	Service Mean Velocity	0,397	Service Max Velocity	0,470
Service Max Velocity	0,486	Service Max Velocity	0,379	Hit & Turn Test	0,344
Medicine Ball over Head	0,482	Hit&Turn Test	0,348	Medicine Ball Backhand	0,333
Upper Back Strength	0,442	Medicine Ball Forehand	0,313	MB VH	0,260
Hit & Turn Test	0,389	Hand Grip Force	0,309	20m Sprint	0,218
Medicine Ball Forehand	0,373	Medicine Ball over Head	0,301	Präzision	0,209
Body Height	0,373	Standing Long Jump	0,291	Isometrische Kraft	0,170
Hand Grip Force	0,336	Shuttle Run Sprint	0,282	RWS VH Gesamt	0,158
10m Sprint	0,315	Body Height	0,272	Rumpfbeuge	0,132
5m Sprint	0,257	20m Sprint	0,256	RWS VH Wende	0,116
Standing Long Jump	0,235	RWS VH Gesamt	0,196	Körpergröße	0,115
Rumpfbeuge	0,210	10m Sprint	0,191	EKA	0,102
EKA	0,197	Tapping	0,168	MB über Kopf	0,084
Präzision	0,194	EKA	0,153	Standweitsprung	0,071
RWS RH Gesamt	0,180	Isometrische Kraft	0,114	10m Sprint	0,059
Tapping	0,179	Bauch Test	0,104	RWS VH Gesamt	0,047
CM-Jump	0,178	CM-Jump	0,089	Tapping	0,029
RWS VH Gesamt	0,168	Rumpfbeuge	0,070	CM-Jump	0,011
Isometrische Kraft	0,153	RWS VH Wende	0,069	5m Sprint	-0,022
RWS RH Wende	0,068	5m Sprint	0,058	Handkraft DH	-0,034
20m Sprint	0,050	RWS VH Wende	0,054	RWS VH Wende	-0,079
Liegestütz	0,044	Gleichgewicht	-0,014	Rückentest	-0,134
Gleichgewicht	-0,004	Präzision	-0,020	Liegestütz	-0,189
Bauch Test	-0,024	Rückentest	-0,022	Bauch Test	-0,252
RWS VH Wende	-0,039	Liegestütz	-0,057	Gleichgewicht	-0,324

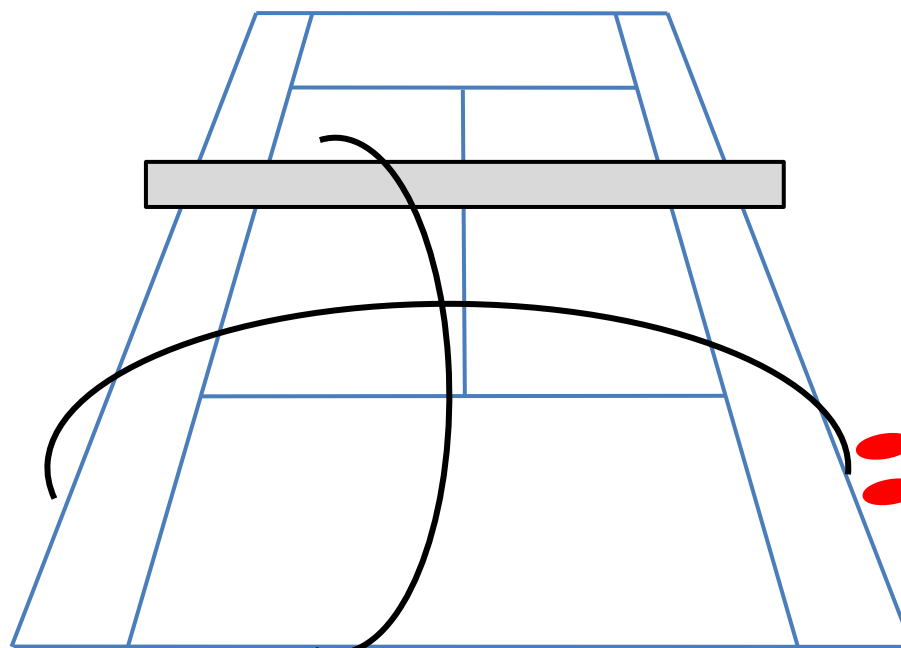
(Ulbricht et al. 2015, 2016)

FROM AGILITY TO POWER



Service Velocity (age related Development)

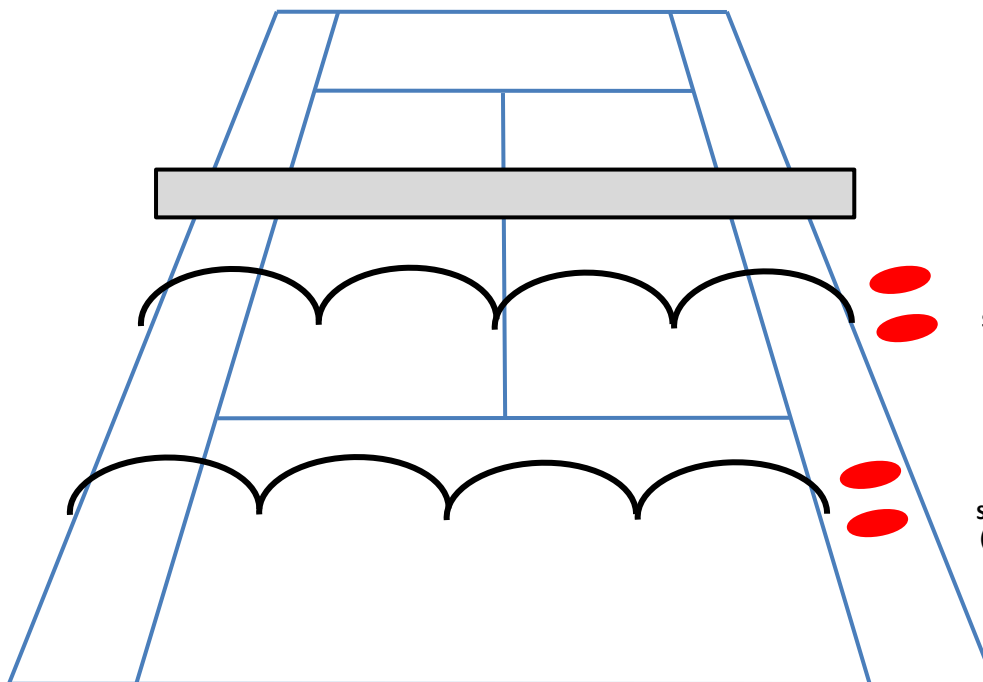




Boys, 18 yrs
Medicine Ball (2 kg)
Over Head Throw
(14 m)



Boys, 15 yrs
Medicine Ball (2 kg)
Over Head Throw
(11 m)



Boys, 18 yrs
Standing Long Jump
(11 m, 4 x 2,75 m)

Boys, 15 yrs
Standing Long Jump
(9,60 m, 4 x 2,40 m)

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1 TESTING

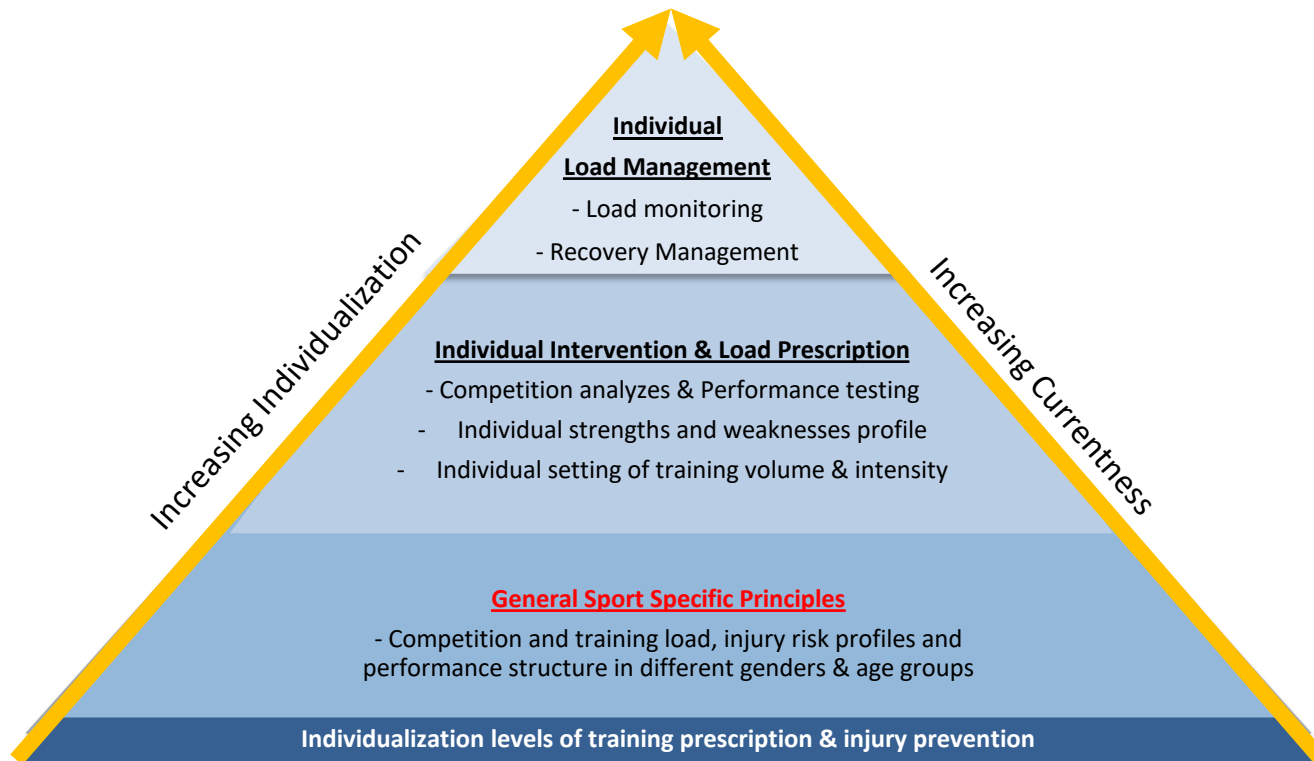
- SOCCER GOAL KEEPER TEST
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- TESTING BATTERIES

2 TRAINING

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3 SUMMERY

Individualization levels of training prescription & injury prevention



Knowledge about Competition and Training Load in Badminton



Review

German Journal of Exercise and Sport Research
<https://doi.org/10.1007/s12662-019-00610-4>
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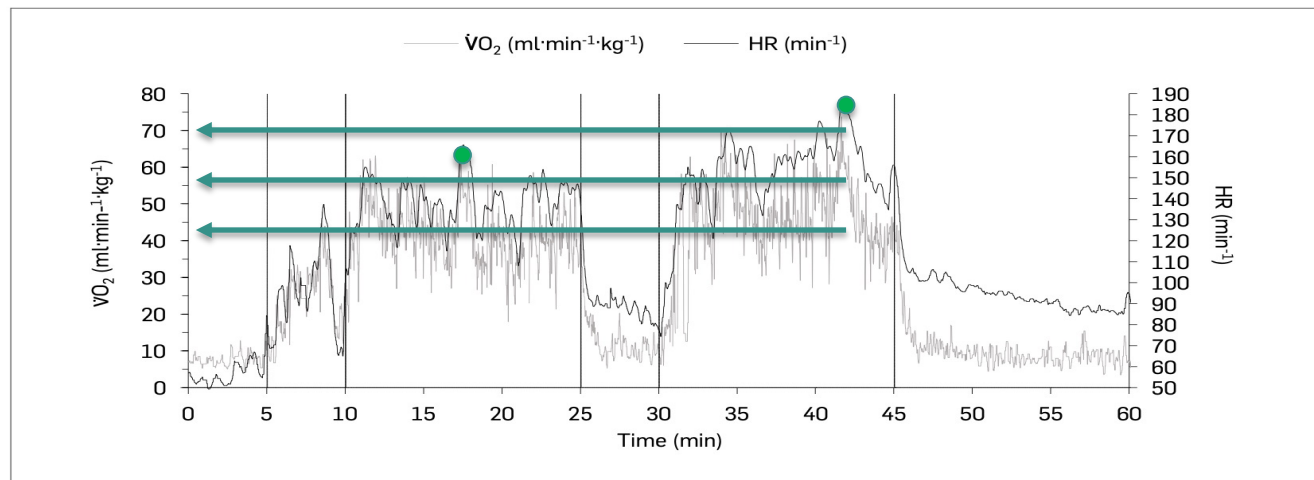
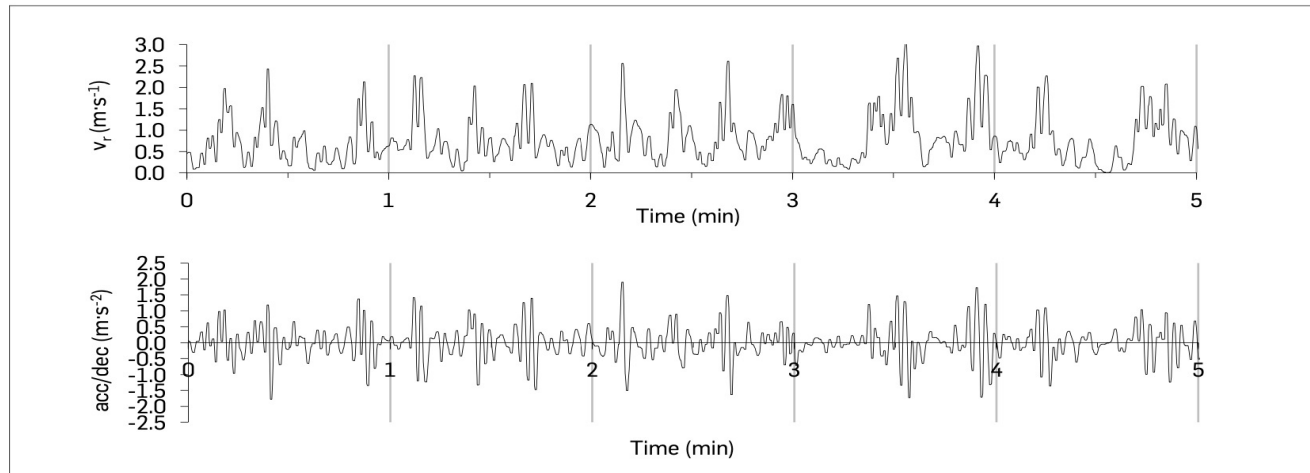


Antonia Edel · Yuchen Song · Thimo Wiewelhove · Alexander Ferrauti
Faculty of Sport Science, Ruhr University, Bochum, Germany

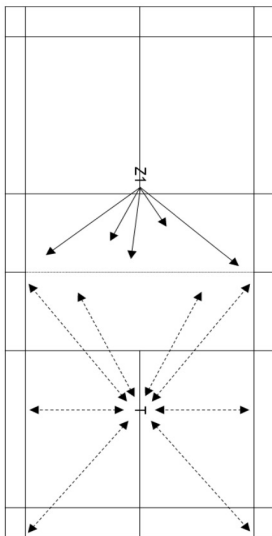
Activity profiles and physiological responses during match play in four popular racquet sports

A literature review

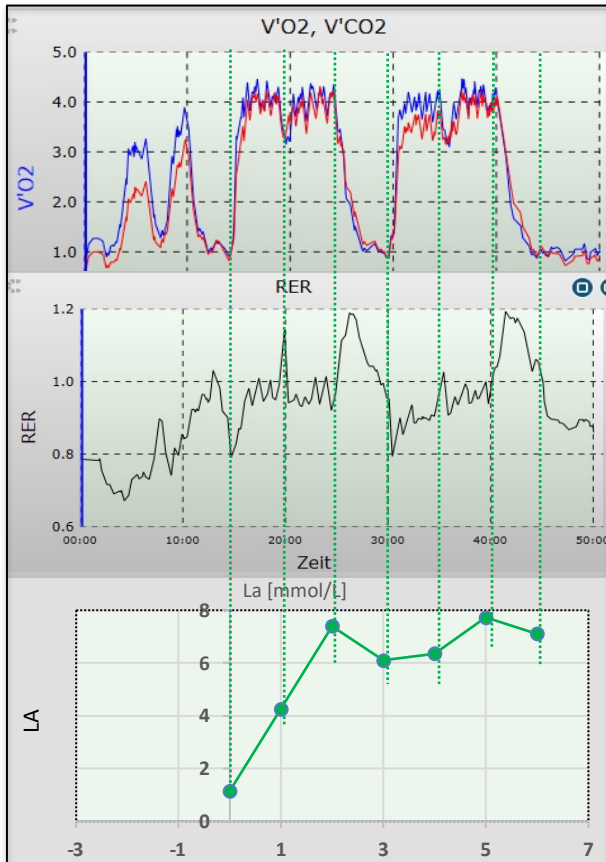
Edel, A., Song, Y., Wiewelhove, T. & Ferrauti, A. (2019). Activity profiles and physiological responses during match play in four popular racquet sports. *German journal of exercise and sport research*, 1-11.



MULTIFEEDING			ZWEI GEGEN EINS - KOMPLEX				ZWEI GEGEN EINS - ABWEHR		
Standard	Variation 1	Variation 2	Standard	Variation 1	Variation 2	Variation 3	Standard	Variation 1	Variation 2
Warm-Up 2 x 10 x 30 s WP = 10 s	Warm-Up 3 x 20 x 10 s WP = 10 s	Warm-Up 1 x 12 x 50 s WP = 50 s	Warm-Up 3 x 5 x 1 min WP = 30 s	Warm-Up 3 x 5 x 1 min WP = 20 s	Warm-Up 3 x 5 x 1 min WP = 40 s	Warm-Up 2 x 4 x 2 min WP = 30 s	Warm-Up 3 x 4 x 2 min WP = 20 s	Warm-Up 3 x 8 x 1 min WP = 20 s	Warm-Up 3 x 3 x 3 min WP = 20 s

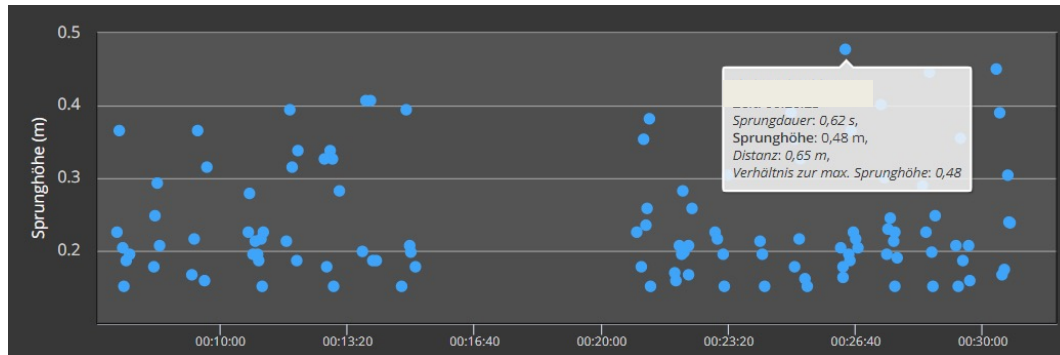


Single Case - Physiology



Player ID	6		
Geschlecht	Männlich		
	Training	Match	%Match
$VO_{2\text{ mean}}$ [ml/min/kg]	59.2 ± 7.0	44.1 ± 8.0	134%
$VO_{2\text{ peak}}$ [ml/min/kg]	70.2	62.2	112%
RER_{mean}	0.95 ± 0.06	0.78 ± 0.07	121%
RER_{peak}	1.18	0.88	134%
EE_{mean} [kcal/h]	1139 ± 135	941 ± 170	121%
HR_{mean} [bpm]	155 ± 10	160 ± 8	97%
HR_{peak} [bpm]	171	173	99%
La_{peak} [mmol/L]	7.7	2.6	299%

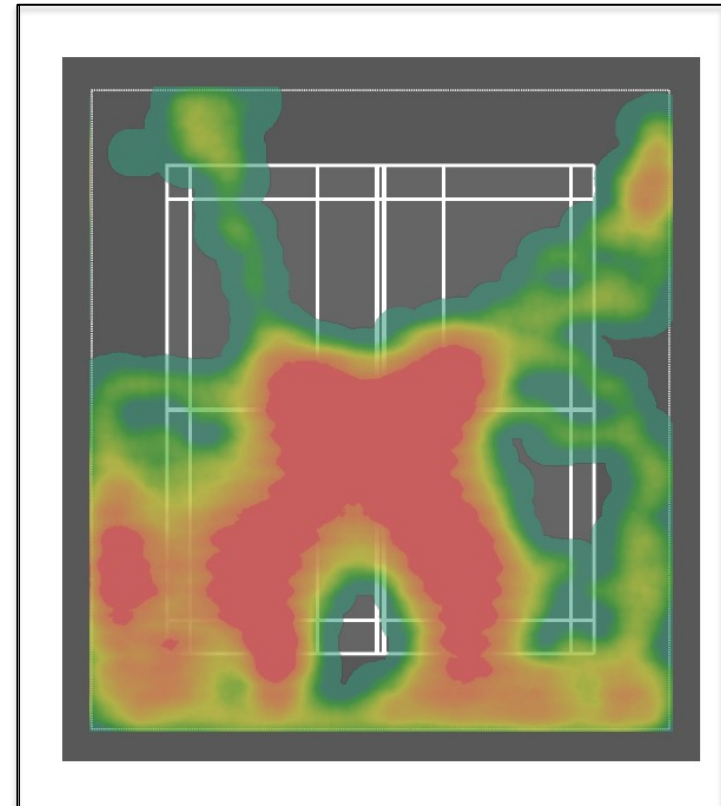
Single Case - Kinematics



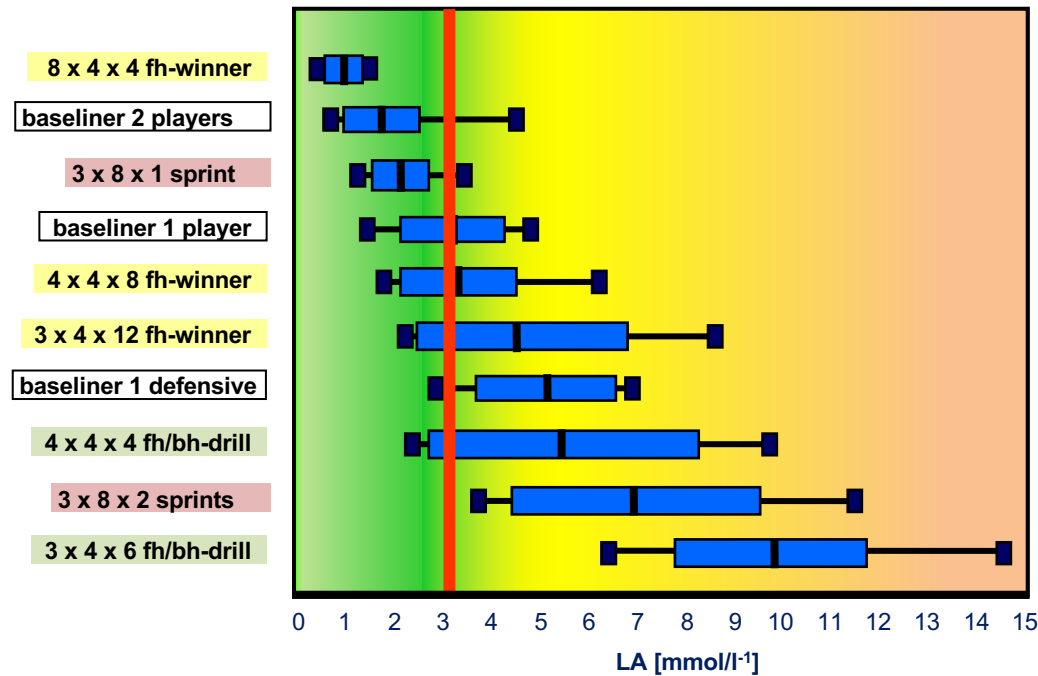
SPIELERÜBERSICHT-TABELLE

Gesamte Session

🕒 Gesamtzeit	00:23:03 ↓ -6.6%
🏃 Gesamtdistanz	964 m ↓ -3.8%
🏃 Durchschnittsgeschwindigkeit	0,76 m/s ↑ 3.4%
🏃 Höchstgeschwindigkeit	6,2 m/s ↑ 29%
↑ Sprung	130 ↑ 49%



Knowledge about Training Drills in Tennis



Ferrauti, A., Pluim, B.M. & Weber, K. (2001). The effect of recovery duration on running speed and stroke quality during intermittent training drills in elite tennis players. *Journal of Sport Sciences*, 19(4), 235-242.



Eur J Appl Physiol (2013) 113:2769–2779
DOI 10.1007/s00421-013-2712-x

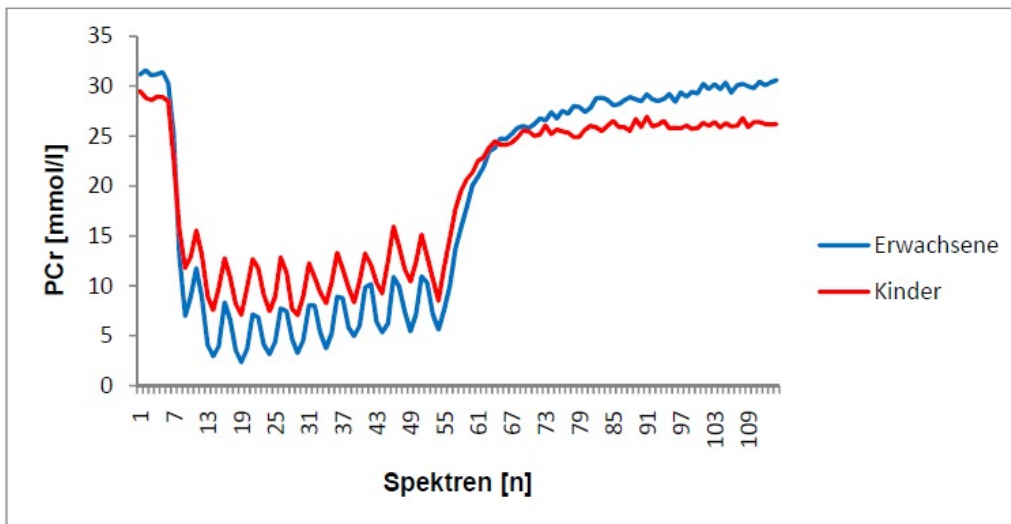
ORIGINAL ARTICLE

Changes in phosphocreatine concentration of skeletal muscle during high-intensity intermittent exercise in children and adults

J. Kappenstein · A. Ferrauti · B. Runkel ·
J. Fernandez-Fernandez · K. Müller ·
J. Zange

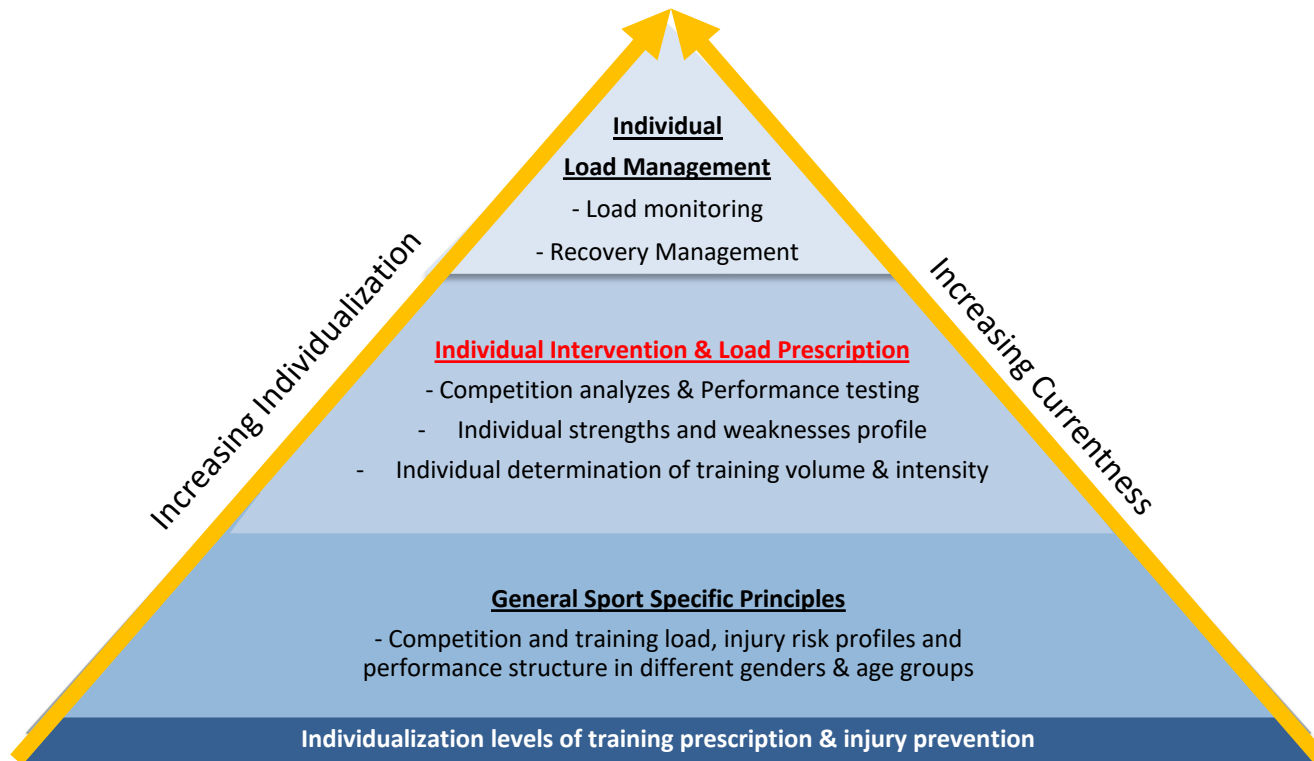
Kappenstein, J., Ferrauti, A., Runkel, B., Fernandez-Fernandez, J., Müller, K. & Zange, J. (2013). Changes in phosphocreatine concentration of skeletal muscle during highintensity intermittent exercise in children and adults. *European Journal of Applied Physiology*, 113(11), 2769 - 2779.

Knowledge about age specifics

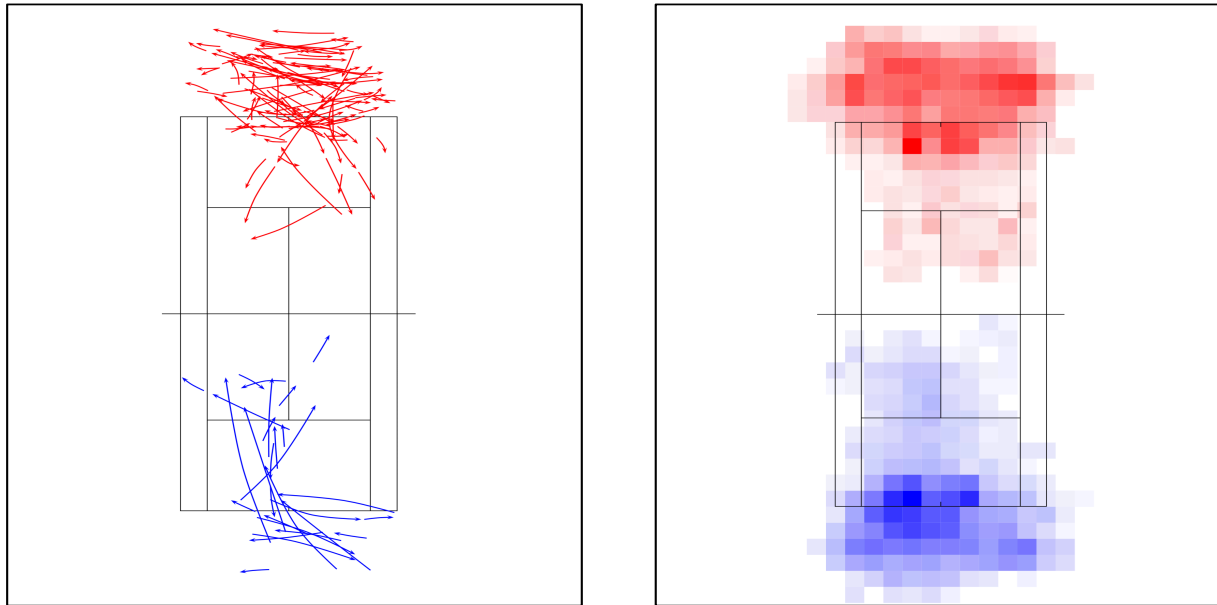




Individualization levels of training prescription & injury prevention

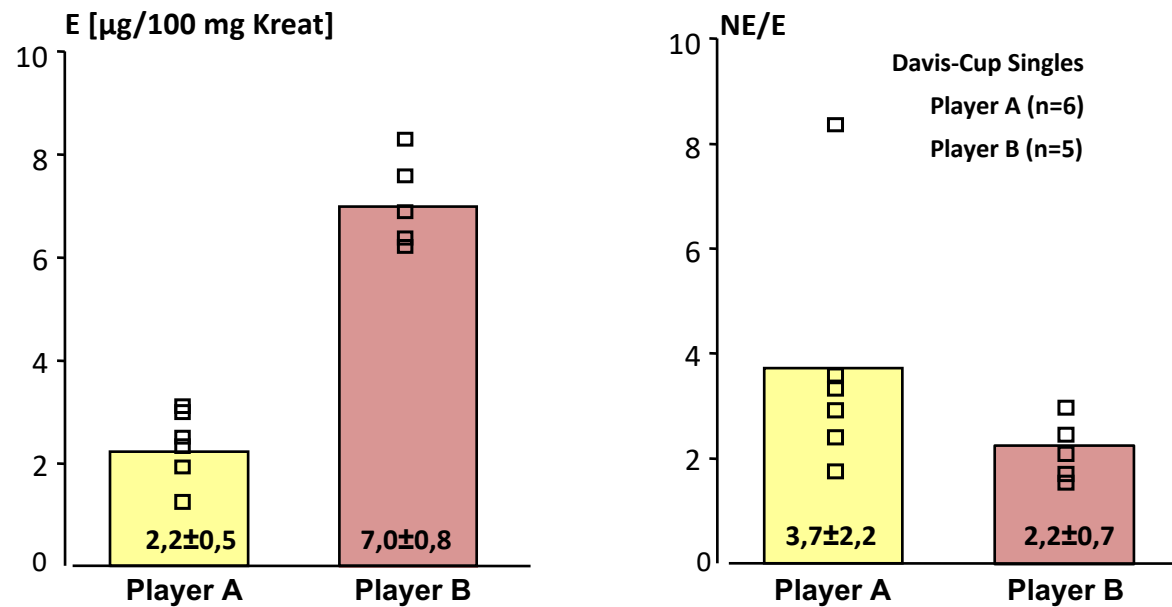


Tactical Profiling



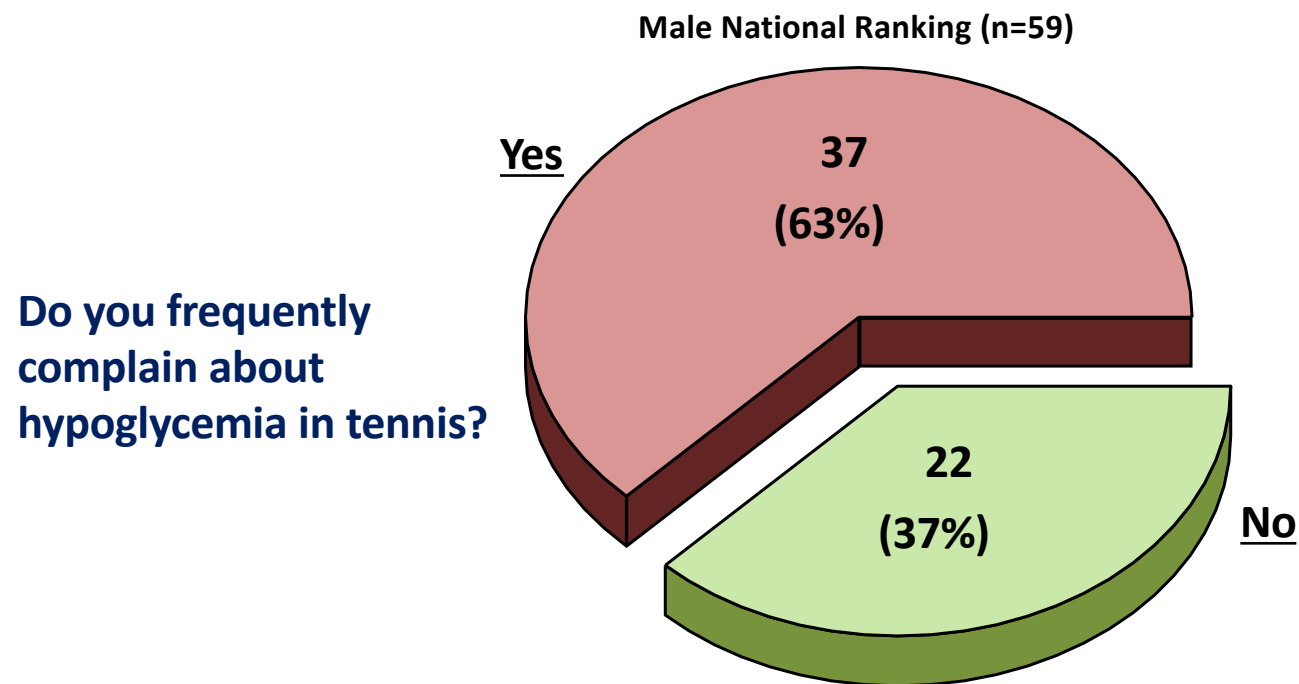
Schlipfing, M., Salmen, J., Tschentscher, M., & Igel, C. (2014). Adaptive pattern recognition in real-time video-based soccer analysis. *Journal of Real-Time Image Processing*, 1–17.

Psychological Profiling



Ferrauti, A., Neumann, G., Weber, K. & Keul, J. (2001). Urine catecholamine concentrations and psychophysical stress in elite tennis under practice and tournament conditions. *The Journal of Sports Medicine and Physical Fitness*, 41(2), 269-274.

Physiological Profiling



Ferrauti, A., Pluim, B.M., Busch, T. & Weber, K. (2003). Blood glucose responses and incidence of hypoglycemia in elite tennis under practice and tournament conditions. *Journal of Science and Medicine in Sport*, 6(1), 28-39.



RUHR-UNIVERSITÄT BOCHUM
FAKULTÄT FÜR SPORTWISSENSCHAFT

REGman - Open 2015

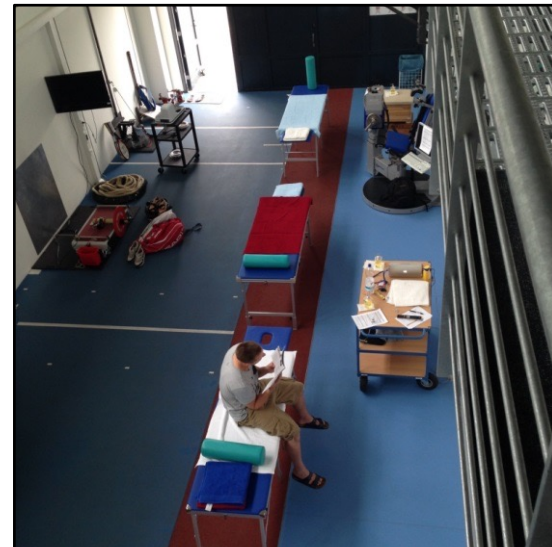
Ein Herren-Einzel-Turnier unter sportwissenschaftlichen Fragestellungen
im Rahmen des BISP-Projekts „Regenerationsmanagement im Sport“

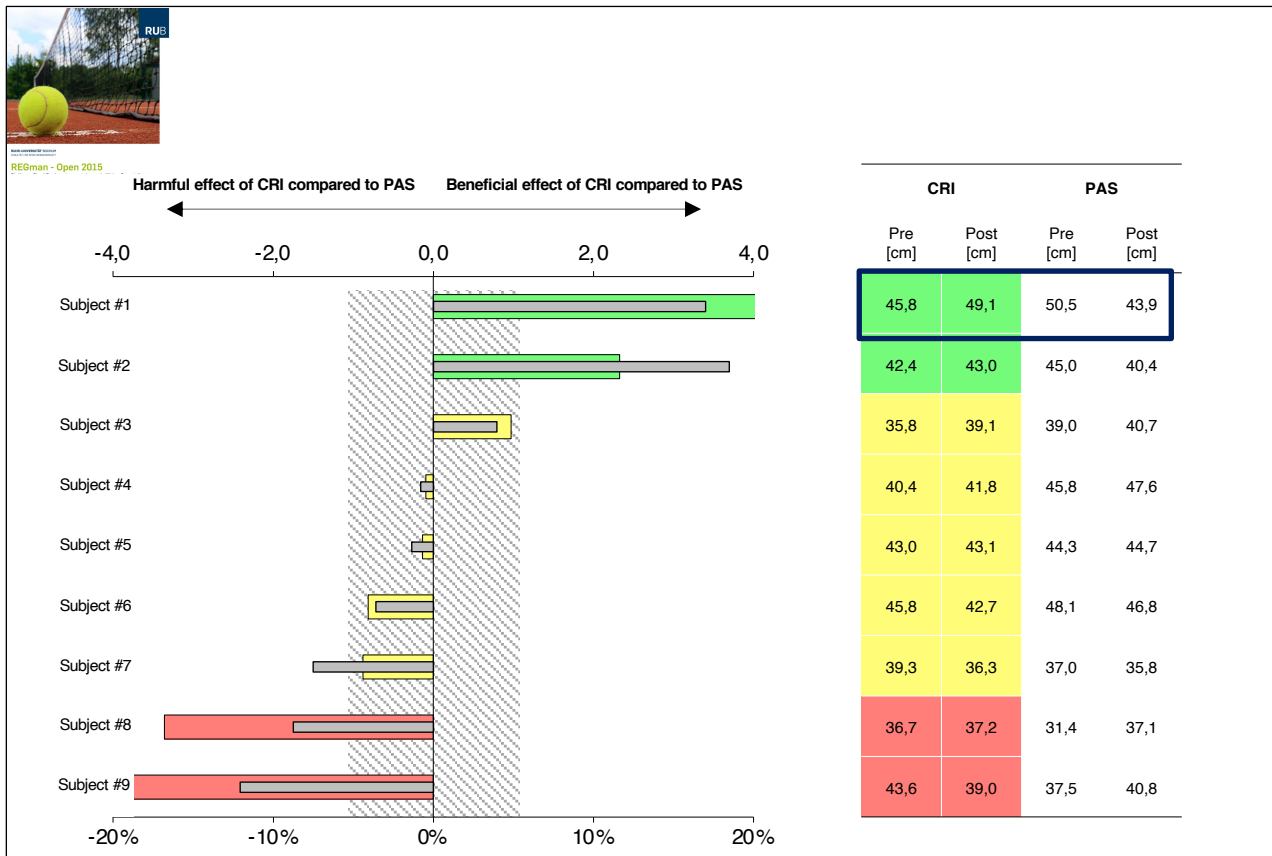
- **1000€** Antrittsgeld und **3000€** Preisgeld! (zur Verfügung gestellt von der ITF)
- individuelle Leistungsdiagnostik für jeden Teilnehmer!
- zwölf garantierte Tennismatches - aufgeteilt auf zwei Turnierblöcke!

Recovery Profiling

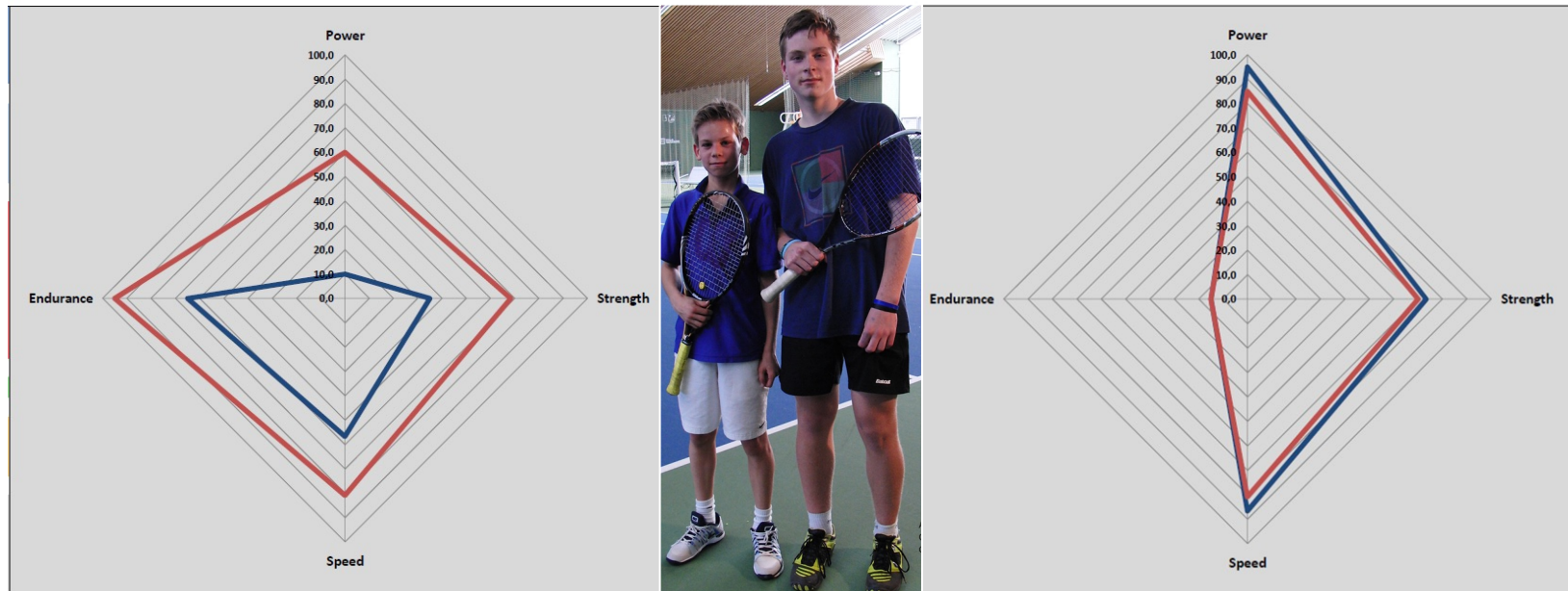


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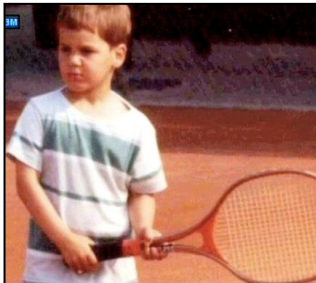


Physical Performance Profiling

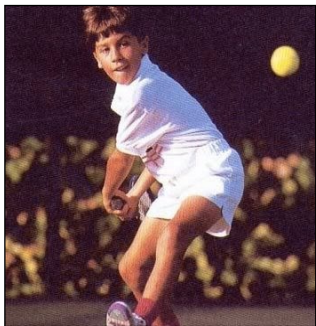


Ulbricht, A., Fernandez-Fernandez, J. & Ferrauti, A. (2013). Conception for fitness testing and individualized training programs in the German Tennis Federation. *Sportorthopädie Sporttraumatologie* 29(3), 180-192.

Playing Style Profiling

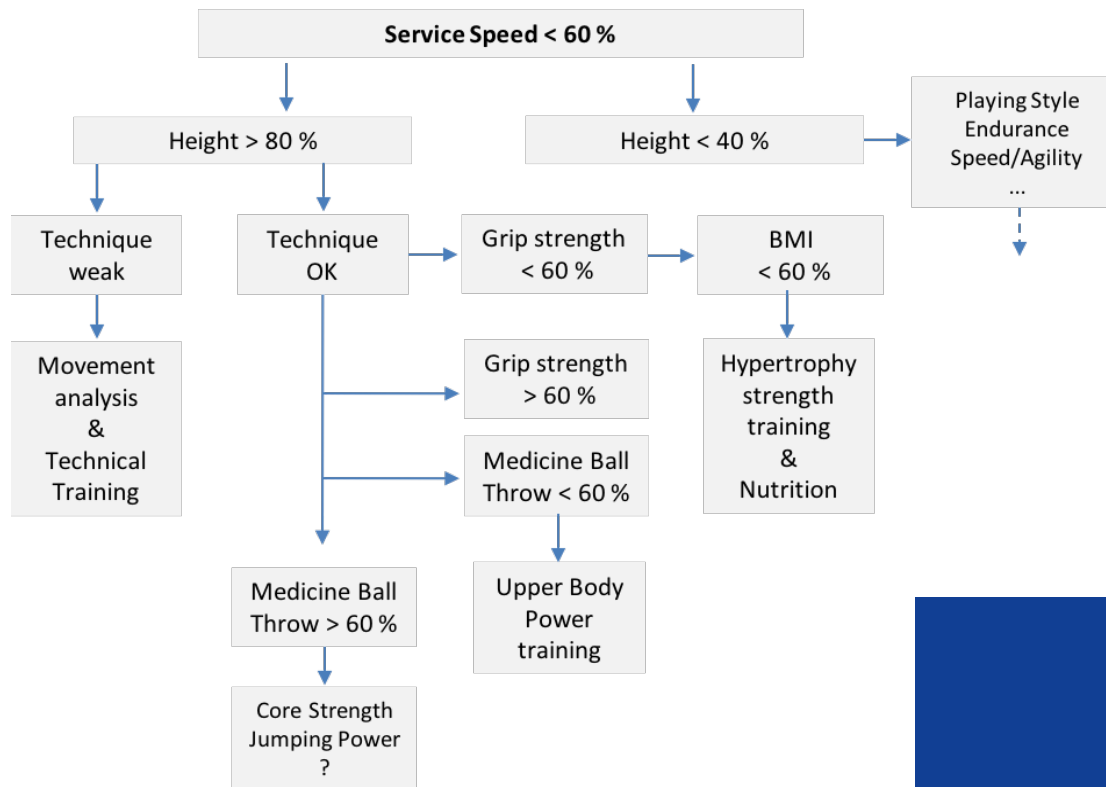


Roger Federer
(SWI)



Rafael Nadal
(ESP)

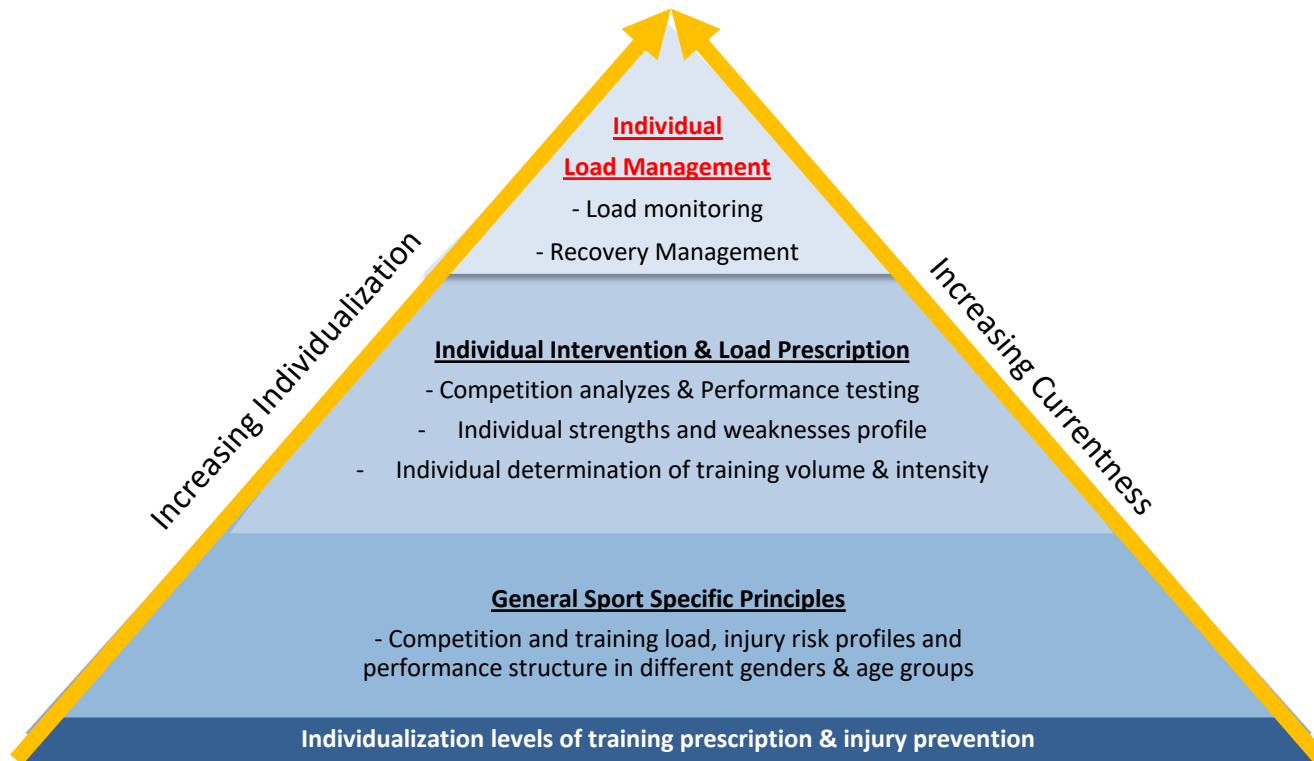
Decision Tree Guided Individualization



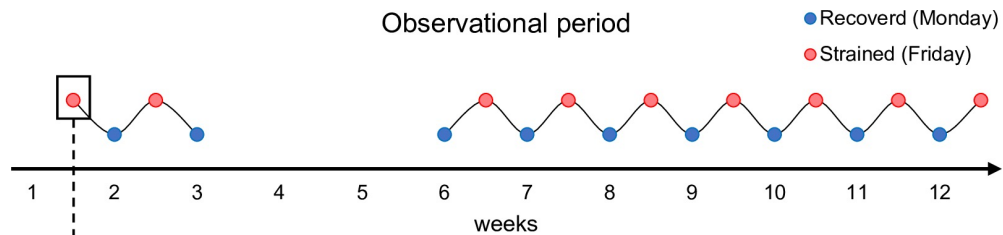
Giovanni Di Giacomo
 Todd S. Ellenbecker
 W. Ben Kibler
 Editors

Tennis Medicine

Individualization levels of training prescription & injury prevention



Experiences in Badminton

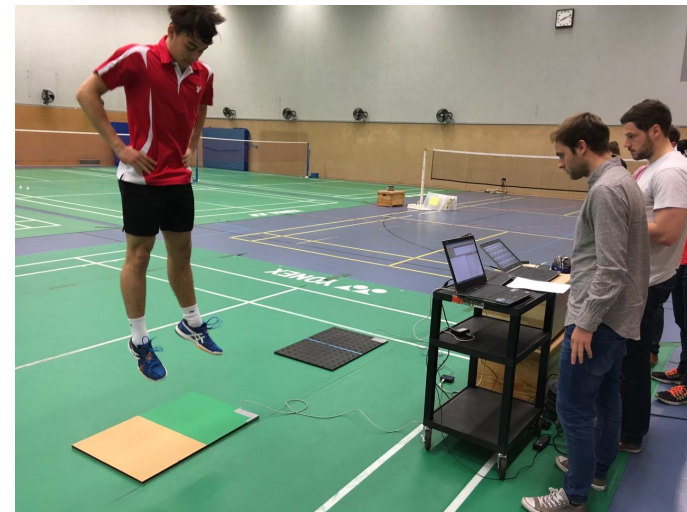


Monitoring procedure

- Capillary blood samples (CK, urea)
- Short Recovery and Stress Scale (8 items, 7-point Likert scale)
- Countermovement jump (peak jump height)
- Multiple rebound jumps (jump efficiency)
- Submaximal shuttle-run test (HRex, HRR, RPE 6-20 scale)

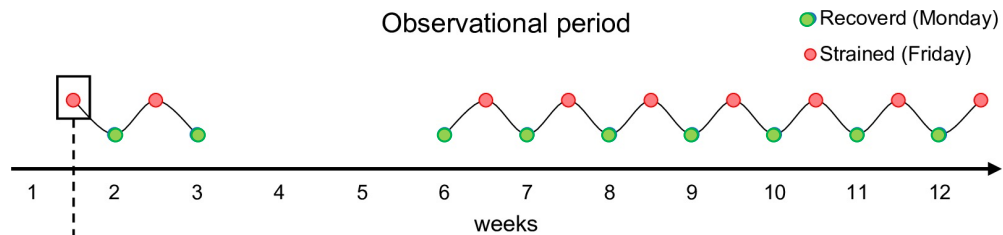
~7:45 AM

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Schneider, C., Wiewelhove, T., McLaren, S. J., Röleke, L., Käsbauer, H., Hecksteden, A., Kellmann, M., Pfeiffer, M., & Ferrauti, A. (2020). Monitoring training and recovery responses with heart rate measures during standardized warm-up in elite badminton players. SportRxiv Preprint. <https://doi.org/10.31236/osf.io/86vh3>

Experiences in Badminton



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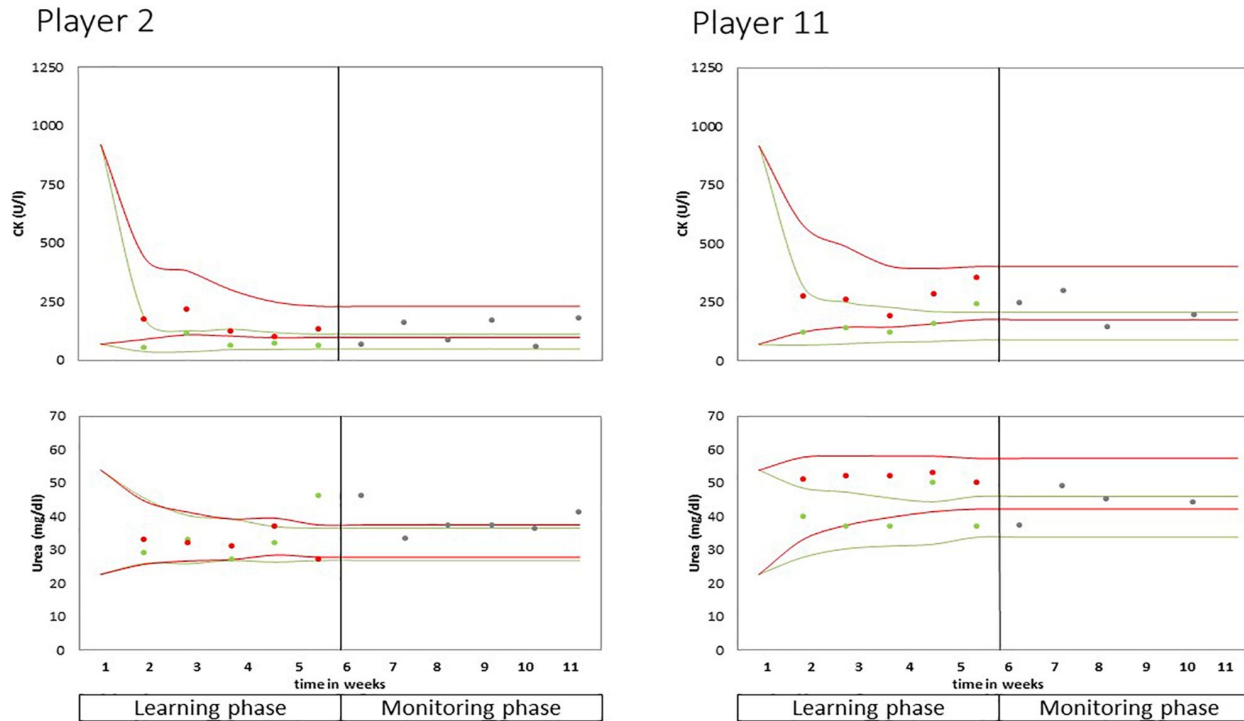
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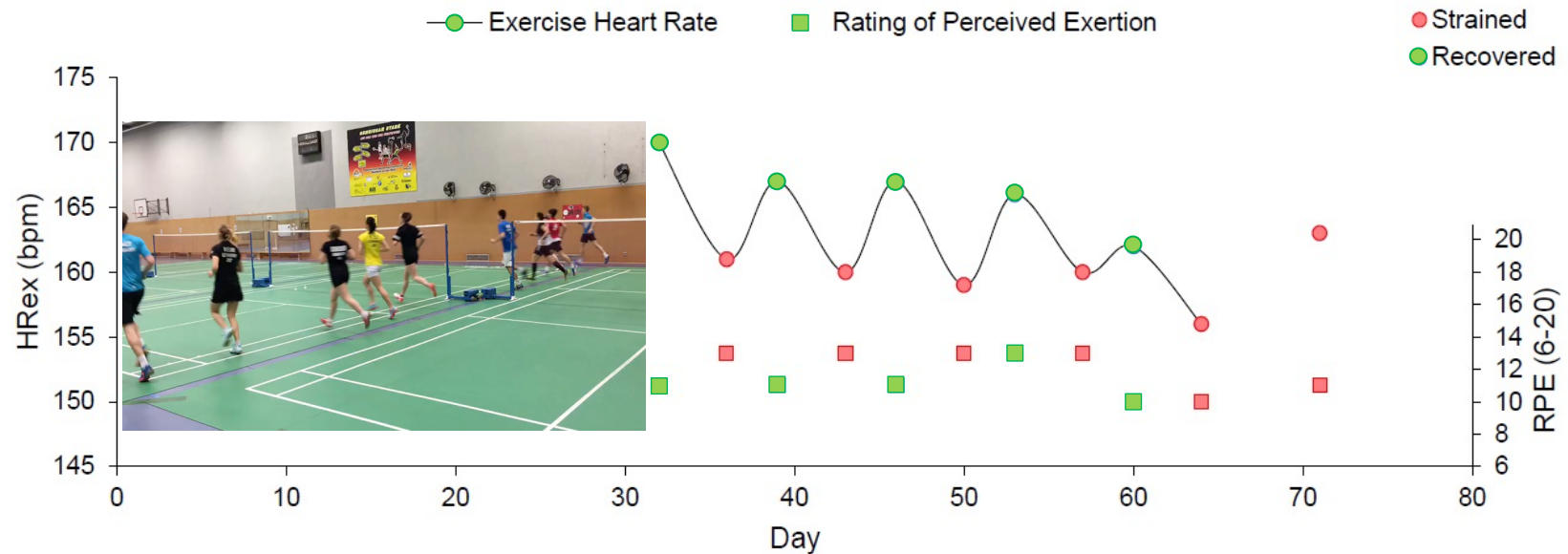
Bayesian Approach for Individualization



Barth, V., Käsbauer, H., Ferrauti, A., Kellmann, M., Pfeiffer, M., Hecksteden, A., & Meyer, T. (2019). Individualized Monitoring of Muscle Recovery in Elite Badminton. *Frontiers in Physiology*, 10, 778. <https://doi.org/10.3389/fphys.2019.00778>

HREx: a potential marker of fatigue & recovery?

Player D



Schneider, C., Wiewelhove, T., McLaren, S. J., Röleke, L., Käsbaauer, H., Hecksteden, A., Kellmann, M., Pfeiffer, M., & Ferrauti, A. (2020). Monitoring training and recovery responses with heart rate measures during standardized warm-up in elite badminton players. SportRxiv Preprint. <https://doi.org/10.31236/osf.io/86vh3>

TESTING AND TRAINING IN TEAM AND RACKET SPORTS

PROF. DR. ALEXANDER FERRAUTI

1 TESTING

- SOCCER GOAL KEEPER TEST
- HIT & TURN TENNIS TEST
- TESTING BATTERIES

2 TRAINING

- INDIVIDUALIZED TRAINING CONCEPT
- RECOVERY MANAGEMENT

3 SUMMERY

TESTING IN TEAM AND RACKET SPORTS...

- Testing in team and racket sports should always include ...
- Development of specific testings should consider...
- The risk of specific testings consists in a drop of ...
- The performance structure of a
-

TRAINING IN TEAM AND RACKET SPORTS...

- ...
- ...

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TESTING AND TRAINING IN TEAM AND RACKET SPORTS

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