Selected chapters of Athletic Training:

Strength & Core Stability
Speed and endurance/stamina

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- Certified National Athletic Coach and Lecturer of the IAAF

- Trainer of several high class sportsmen in Austria (track and field, kickboxing and boxing, triathlon, ice hockey, tennis…)

- Trainings consultant for different sportsman, clubs and federations all over europe

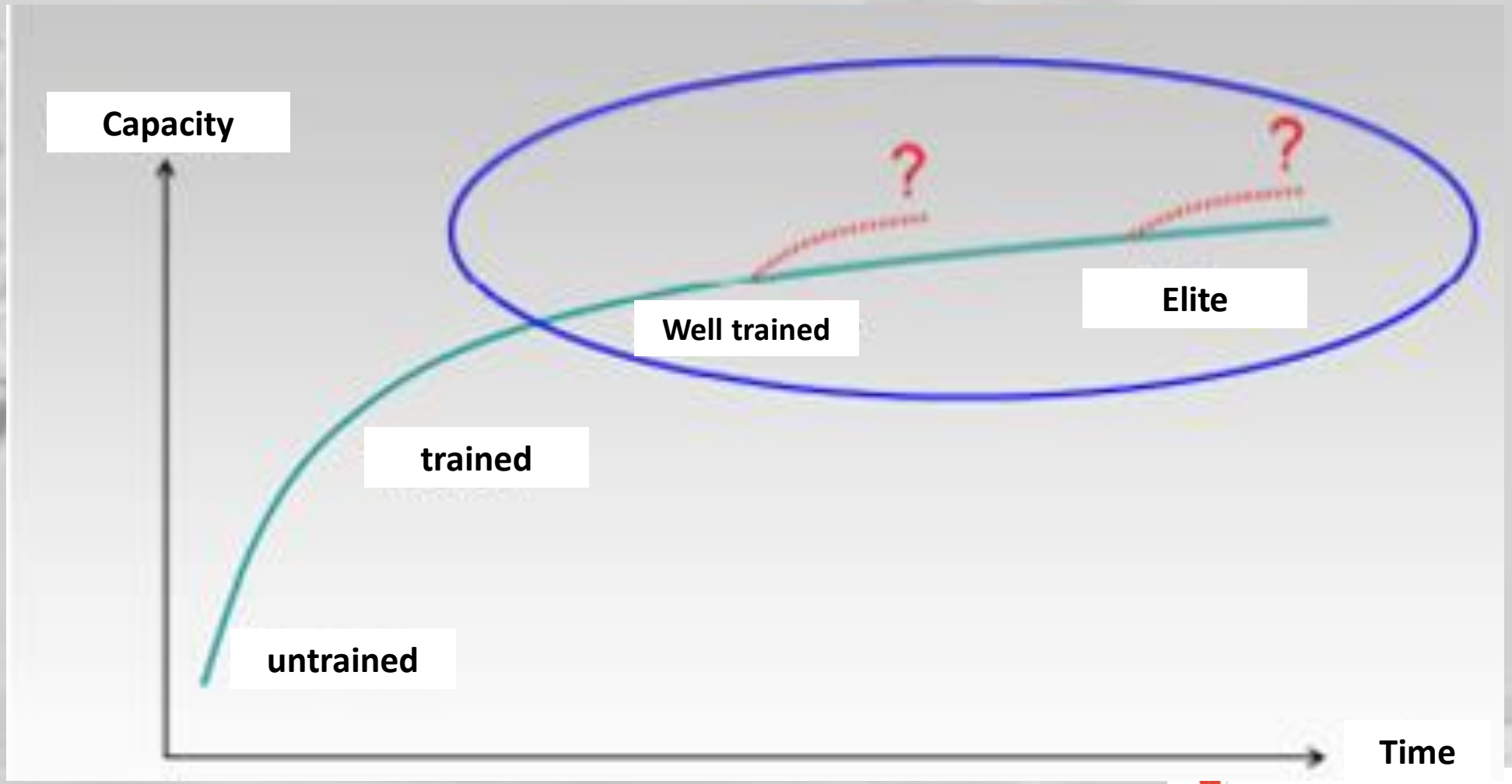
General information about the training process

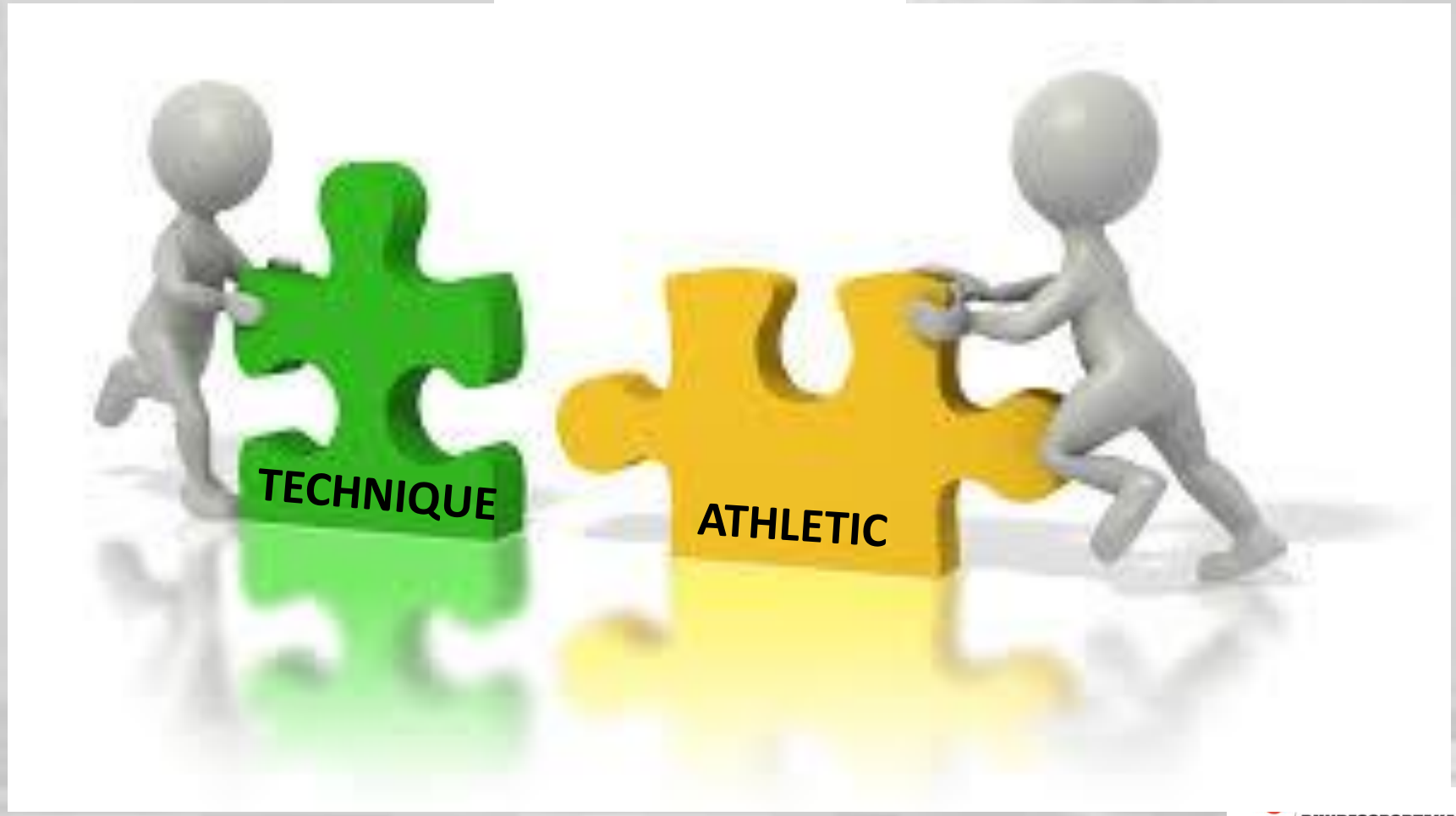
puzzle of success

Technical skill
Strategic tactical skills
Athletic (Physical) Conditons
Coordination skills
Cognitive abilities
Mental skills
Anthropometric requirements
Genetic Preconditions
Health, medical and physiotherapy support
nutritional status
environmental factors
- social (parents, friends, trainers, sponsors)
- material (training facility, sports and test equipements)
- time (work, school, study…)

The more pieces of the puzzle I have the more I realize what is shown on it – and I reach the desired result - SUCCESS!!!!

Adaptation…




TECHNIQUE
ATHLETIC

Youth training is no reduced adult training!!!

Youth training is development training !!!

Basic considerations

The game of handball is getting faster, harder and requirement in technic and taktik are growing…

- The technical skills need to be on a very high level to be successful
- the influence of good Athletic Training is getting higher
- A good aerobic condition and capacity, the strenght of muscles in interaction, the mobility of the joints and the sensorimotoric activity increased in terms of regeneration ability , injury prevention and performance development
- The anaerobic capacity, a high VO2max and the ablility to work under fatigue (lactate conditions) are necessary
- There are significant correlations between VO2max and the running distance , number of sprints and placing in the championship
- Often it is not easy and sometimes not possible to integrate the athletic training in the game with the ball – the technical skills could suffer

CORE STABILITY

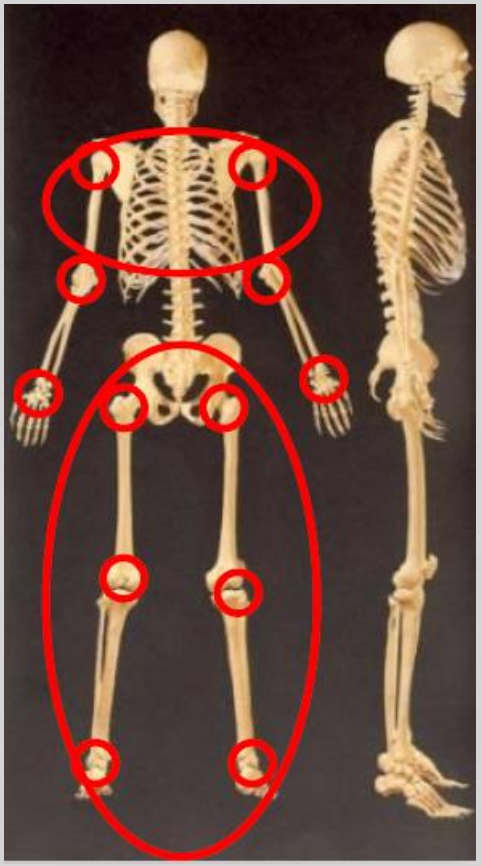
Global muscles

Local stabilizers

Muscle Chains

Sensorimotor Activity

WHAT MEANS CORE STABILITY...



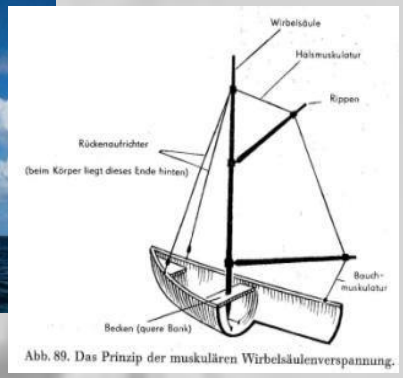
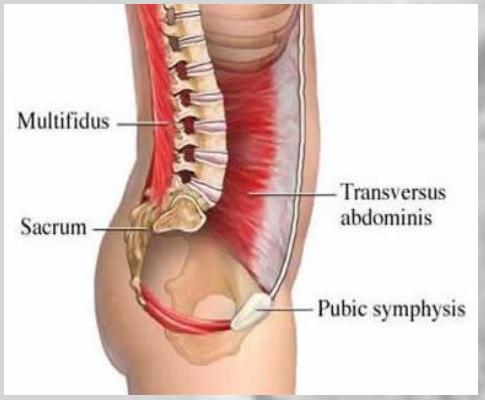


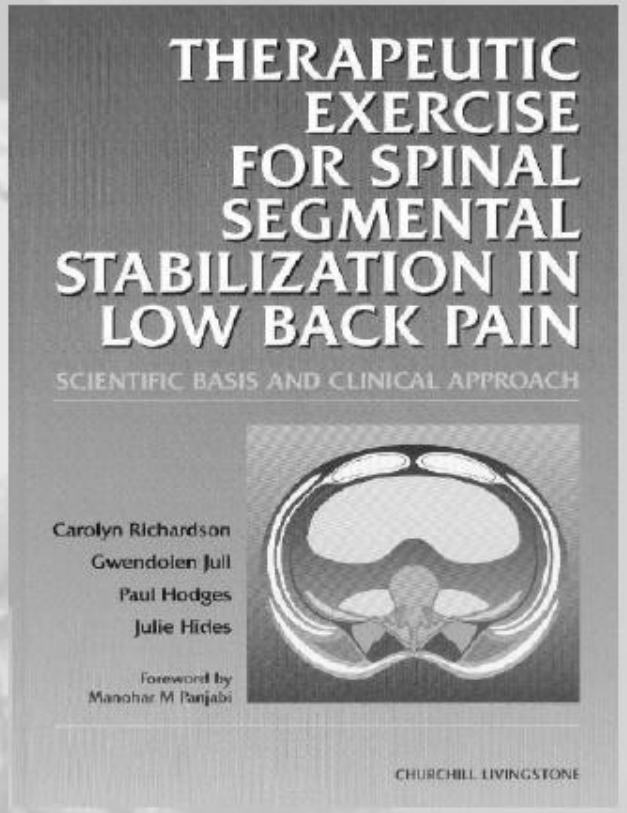
Abb. 89. Das Prinzip der muskulären Wirbelsäulenverspannung.



bracing of the spine and a stong trunk

History

- **Australian research group - Hodges** [1990]



S-E-T concept

- **Vidar Vindal, *Gitle Kirkesola* , Silvia Kollos**

  [PT from Norway, Austria and Germany]

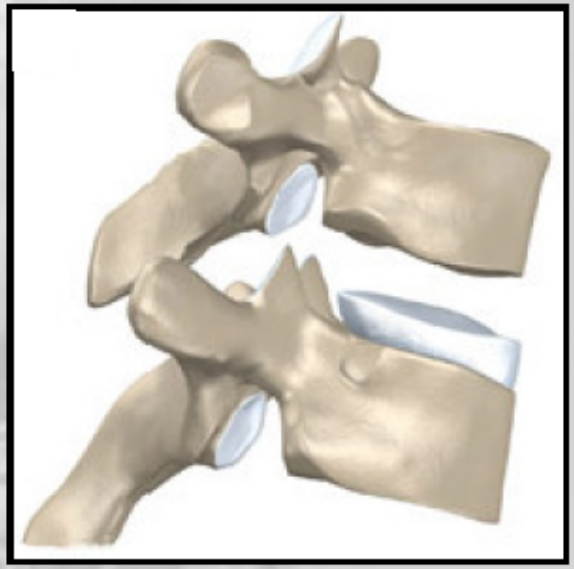
Hannspeter (Hape) Meier

Anatomic basics

Muscle classification

- „global“ and
- „local“ stabilizers

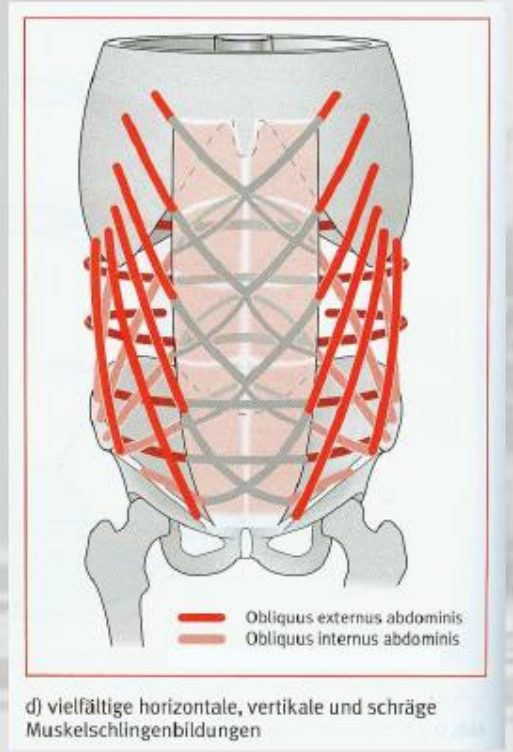
……. to control segments and joints



segment system

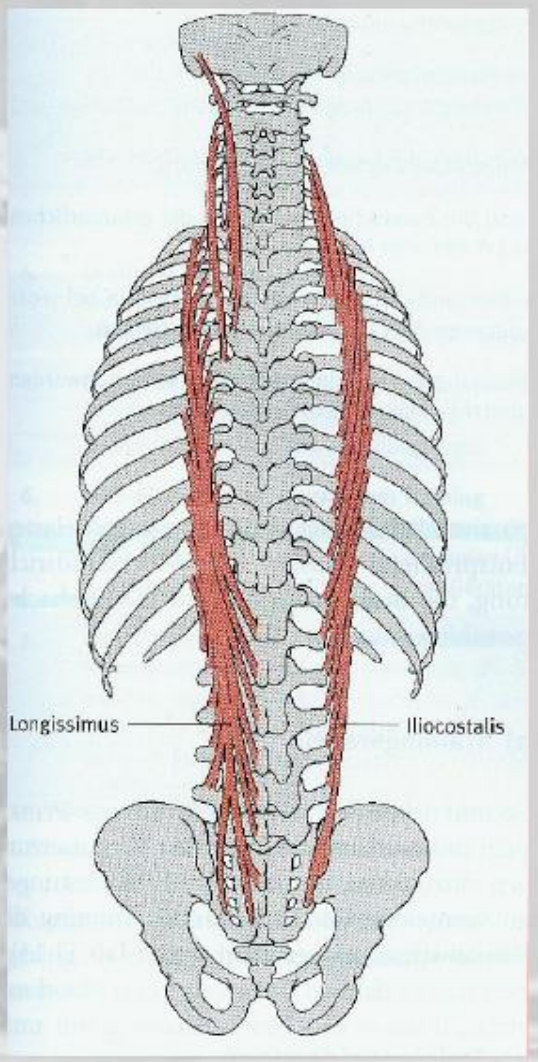
Global muscles [lumbar area]

- back muscles [m. erector spinae]
- abdominal muscles [different parts]



d) vielfältige horizontale, vertikale und schräge Muskelschlingenbildungen

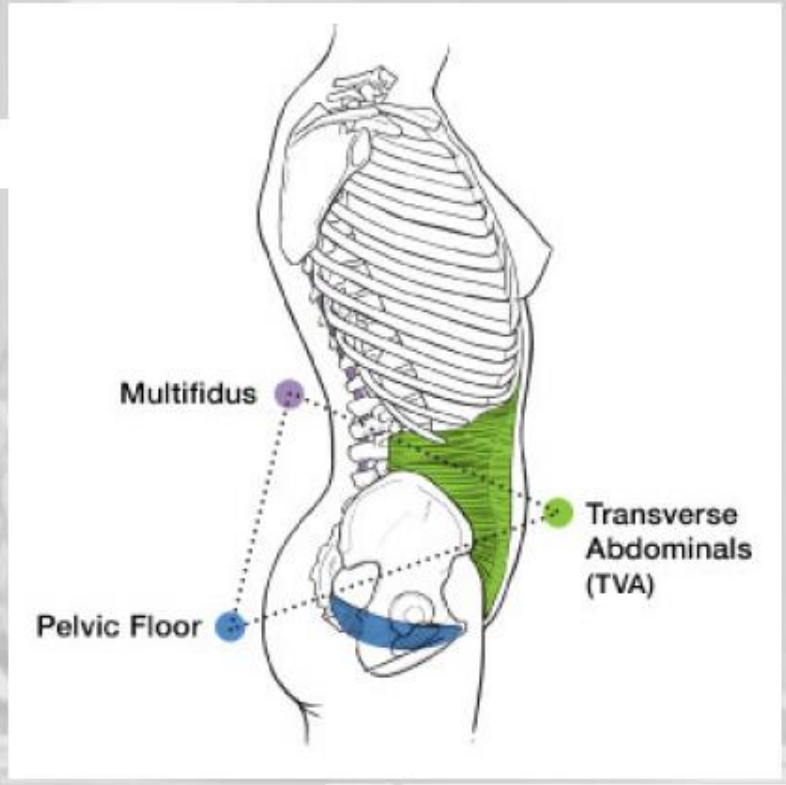
Abb. Gottlob 2001



The collective of lumbar stabilization

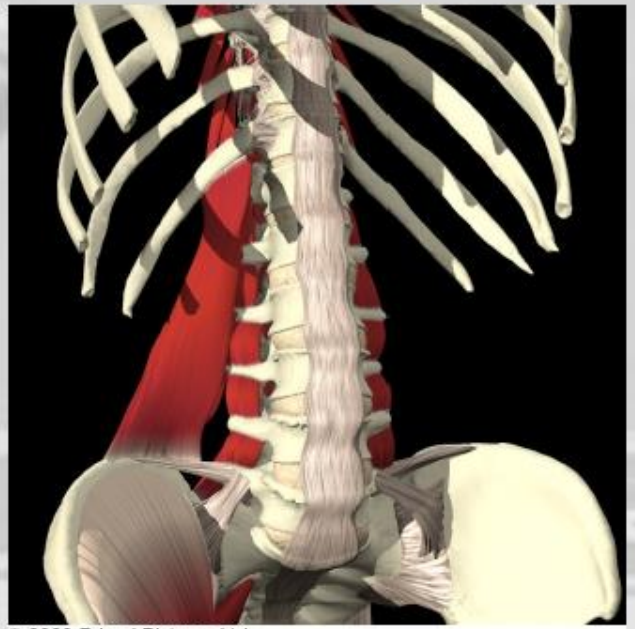
Local stabilizers „first order“ [lumbar area]

- diaphragm
- m. transversus abdominis
- mm. multifidi
- pelvic floor



Local stabilizers „second order“

- m. quadratus lumborum [medial portions]
- m. psoas major [posterior portions]
- m. latissimus dorsi
- m. obliquus internus u. externus abdominis



Local stabilizers [lumbar area]

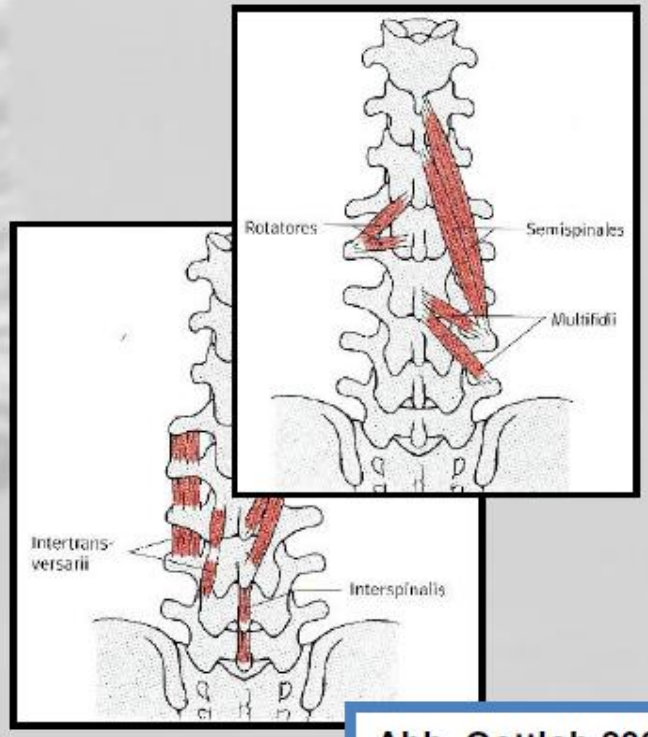


Abb. Gottlob 2001

Properties and abilities

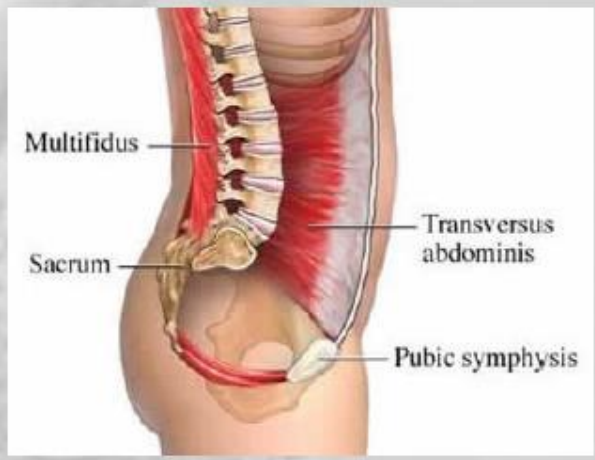
- tonic contraction
- optimal compression of joint surfaces
- „feed-forward“ ⟶

Lumbar stabilization

diaphragm

global muscles

local stabilizers

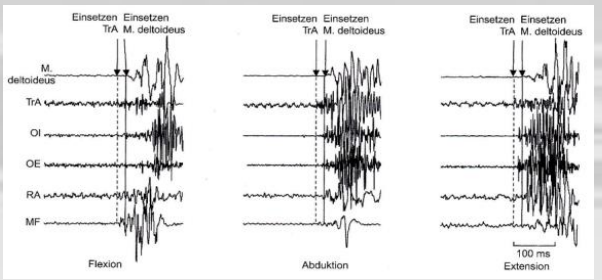


pelvic floor

Feed – forward – mechanism

Cresswell 1999, Hodges 1997 and 1999

"Transversus abdominis contracts in all quick movements of the trunk, upper extremities, and lower extremities, before the muscles producing the motion are activated."



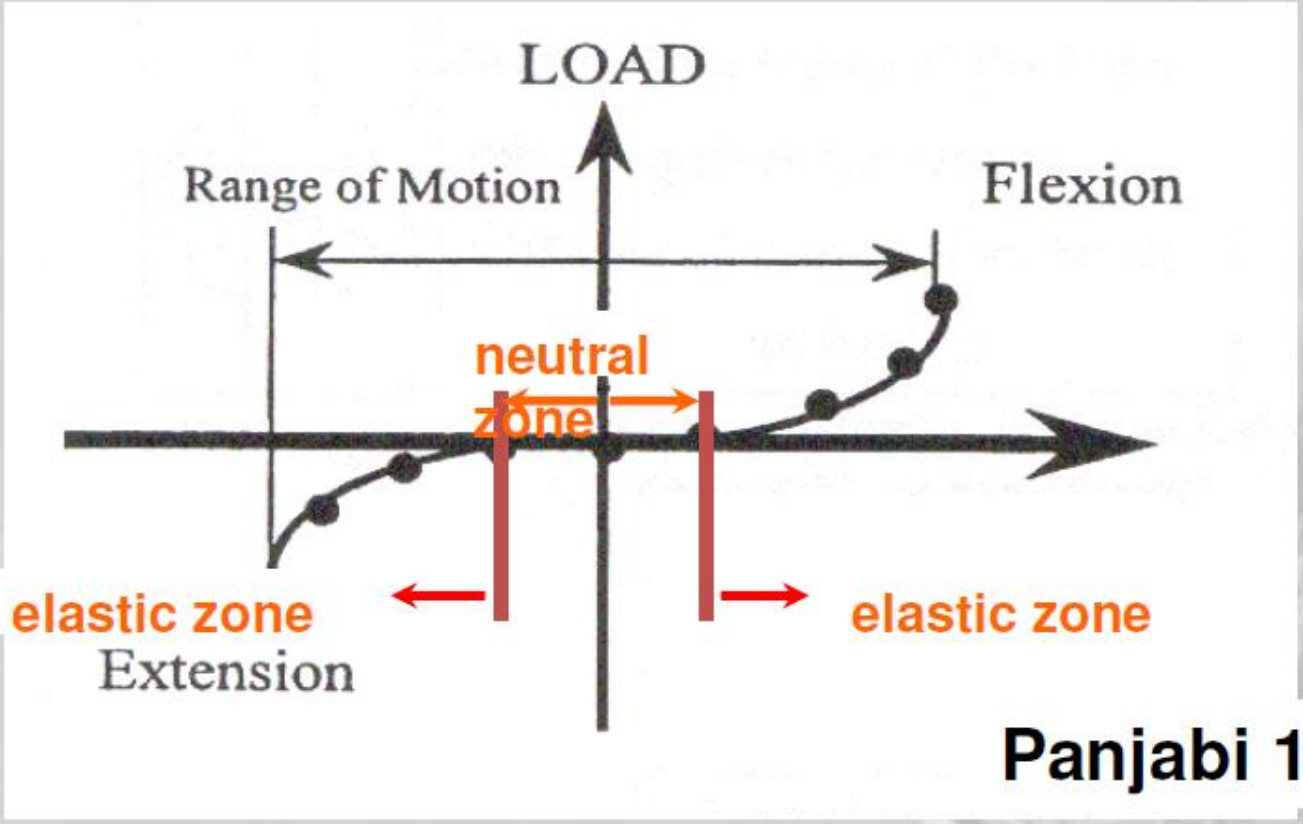
Feed – forward - mechanism

Moseley GL, Hodges PW, Gandevia SC :

"Deep and superficial fibers of the lumbar multifidus muscle are differently active during voluntary arm movements."

Spine 2002;2:E29-E36

Model of stabilizing systems [lumbar area]



Panjabi 1992

For 75%, the m. multifidus is the most important muscle for stabilization of the segment L4 - 5, during movement in the "neutral zone!"

Wilke 1995

This stabilizing system depends on the performance of the sensorimotoric system!

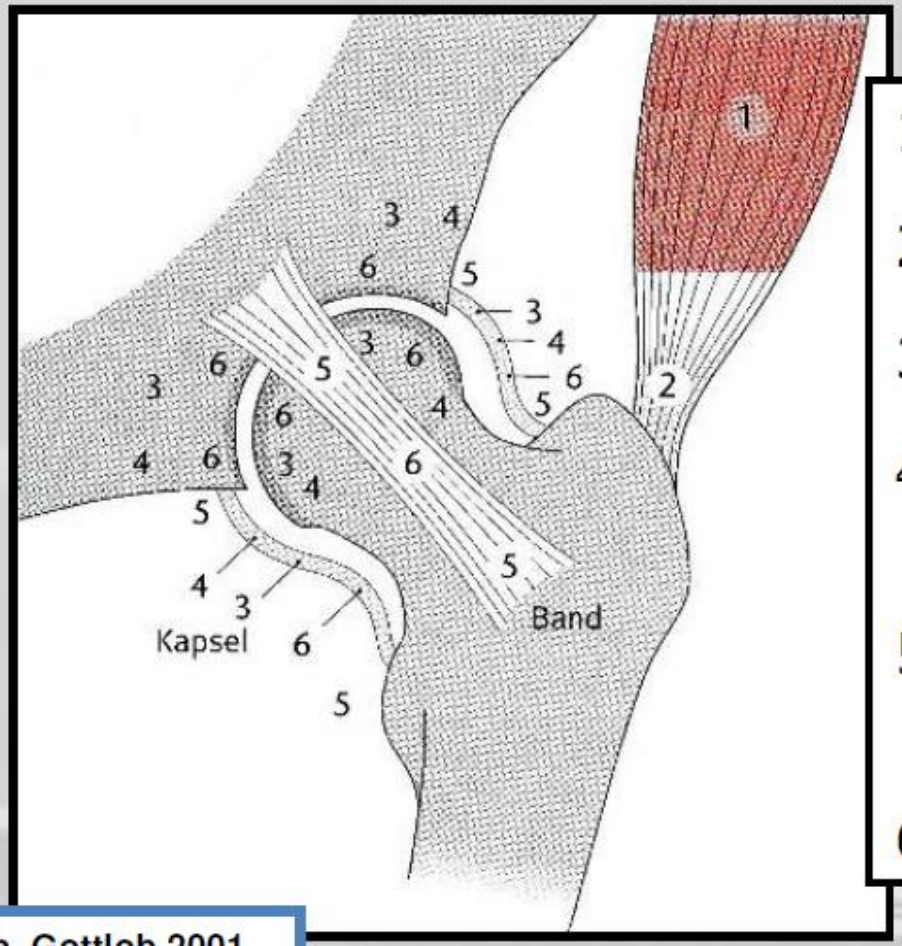


Abb. Gottlob 2001

Sensors .....

1] ..... muscles

2] ..... tendons

3] ..... joints

4] sensors for movement and acceleration

5] sensors for pain and injuries

6] sensors of the skin

Sensorimotoric training

Labile und unstable training devices

Unstable training devices

- high sensorimotoric activity based on …….
- fast, aggressive und unstable stimuli

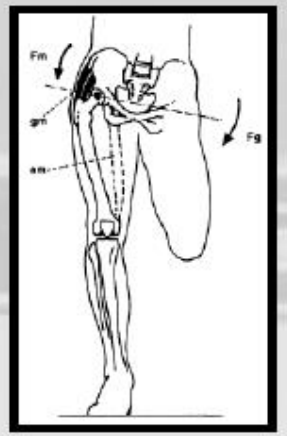
Sensorimotoric training

Injury prevention and performance development:

- Hypertrophy and

  synchronous activity of the local stabilizers

- coordinated interaction



Chronic injuries or pain in the locomotor system means ....

- ..... reduced information from the senscri-motoric system and
- reduced local stabilization
- reduced strength
- shear forces

Emergency programm/ paradoxic innervation

The „global“ muscle system

- mainly takes the stabalizing control
- tries to limit painful movement
- hypertension
- coordinated interaction is disordered
- structural muscle shortening

Summary

Without sensorimotoric activity no motoric!

Pain reduces the flow of information from the sensors ……

„Feed – forward“ mechanism does not work at peak level!

…… paradoxical innervation/relieving posture

Methodological approach

- reduce pain
- reduce tension
- increase metabolism in the global muscle system
- sensorimotoric training

I. First, activate the „local“ stabilizers.
II. Second, the „global“ muscle system.

Remember: methodological approach

- high sensorimotoric activity based on …….
- fast, aggressive und unstable stimuli with and on unstable training devices and …
- pain free
- open and closed kinetic chains

5 – steps program to develop Core Stability and Support Force

I. Activate the „local“ stabilizers.

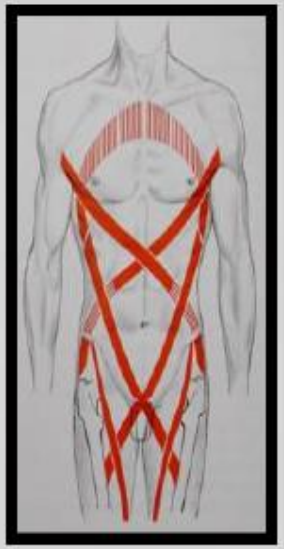
II. Train the „global“ muscle system.

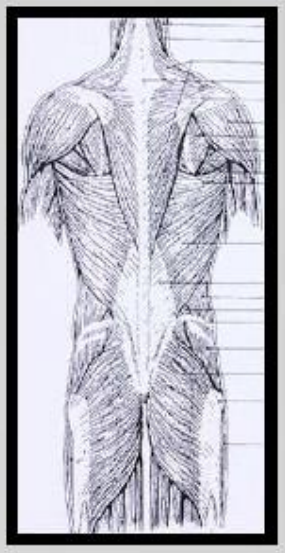
III. Use muscle chains

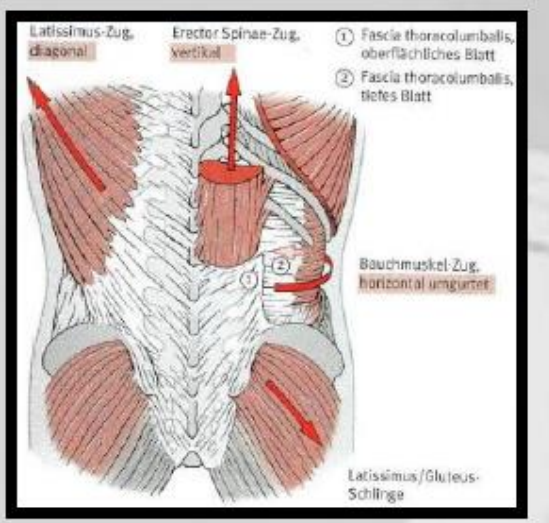
IV. Train the core muscles over time

V. Use the system in rotational and exzentric work

Muscle chains





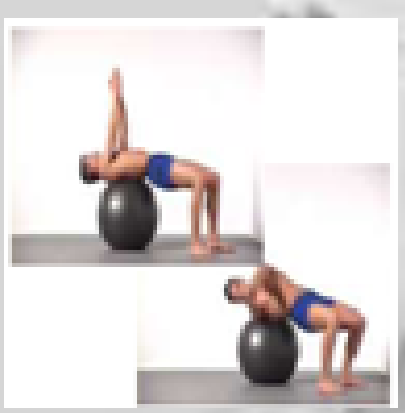


Muscle chains are groups of muscles which belong together (structurally and functionally) and which are involved in movements and allow all kind of movement in all directions -> They work together!!!

Anterior (ventral) Muscles Chains
Posterior (dorsal) Muscles Chains
Side (lateral) Muscles Chains

Flexion Chain
Extension Chain

Training of the muscle chains...



Training the core muscles over time

Is it enough trainings load to make 4 x 20reps?
How long is a handball game? How long is a training?
Don't we use or need this muscles over the whole time?

Schmidtbleicher:
„Every core training which not last at a minimum of 30 minutes continous strenghtening is not enough load... “

Train the core muscles over time

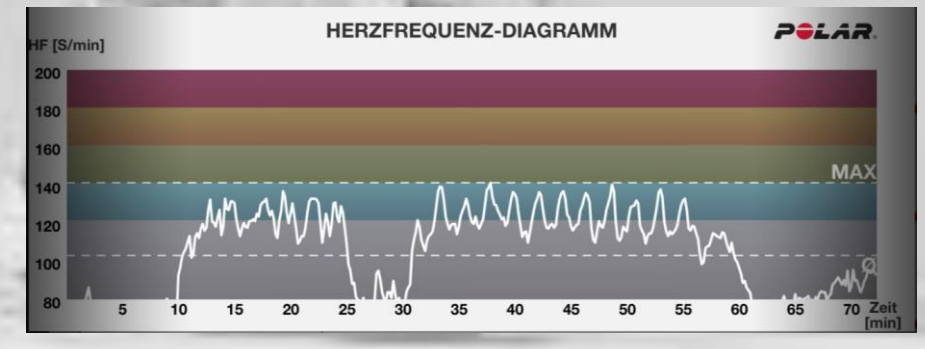
Is it enough trainings load to make 4 x 20reps?
How long lasts a handball game? How long lasts a training?
Don't we use or need this muscles over the whole time?

Schmidtbleicher:
„Every core training which not last at a minimum of 30 minutes continous strenghtening is not enough load... “

Intermittend core stability training

Including the core stabilty exercices in an extensice endurance training…

For example
60“ … easy tecnical pass play
30“ … static core exercise
30“ … dynamic core exercise



warm up

Rotation and exzentric work

Speed

Aquility

Frequency

Quickness

Plyometrics

5 – steps program to develop Speed

Vock 2013

I. Neuro – transmitting biochemical way

II. Speed under the aspect of coordination

III. Speed under the aspect of strenght

IV. Speed under the aspect of the tecnical training

V. Speed under the aspect of energetic

Training of Speed

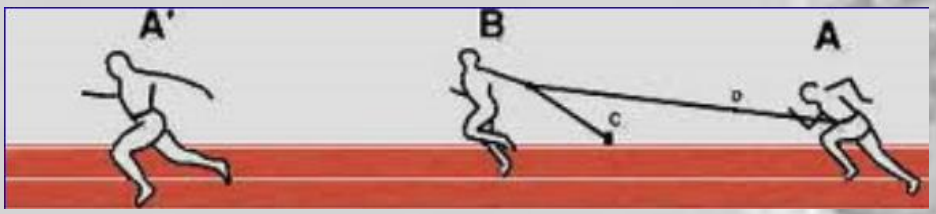
… the neuro – transmitting biochemical way

OVERSPEED

SUPRAMAXIMALSPEED

SUPRAMAXIMALFREQUENZ

„FASTER THAN IT's POSSIBLE....



Training of Speed

… under the aspect of Coordination

„Agility or Quickness“

Coordination under TIME PRESSURE

Reaction – time Training
Agility drills
Frequency Training

GENERAL vs. SPECIFIC!!!!

For children and youth athletes the exercises could be general… BUT
at the high level sport the energetic-, spatial - temporal and dynamic- flow must match the target motion!!!

Training of Speed

… under the aspect of Strength

Training with **really high load**

Training using the **stretch-shortening cycle** (Plyometrics)

Plyometrics can be defined as any movement that utilizes the Stretch-Shortening Cycle (SSC). This employs the energy storage capabilities and stimulation of the stretch reflex to facilitate a maximal increase in muscle recruitment over a minimal amount of time -> INTRAMUSCULAR COORDINATION

Explosive Training with light weight (also called plyometrics…)
-> *INTER-MUSCULAR COORDINATION*

STRETCH - SHORTENING CYCLE

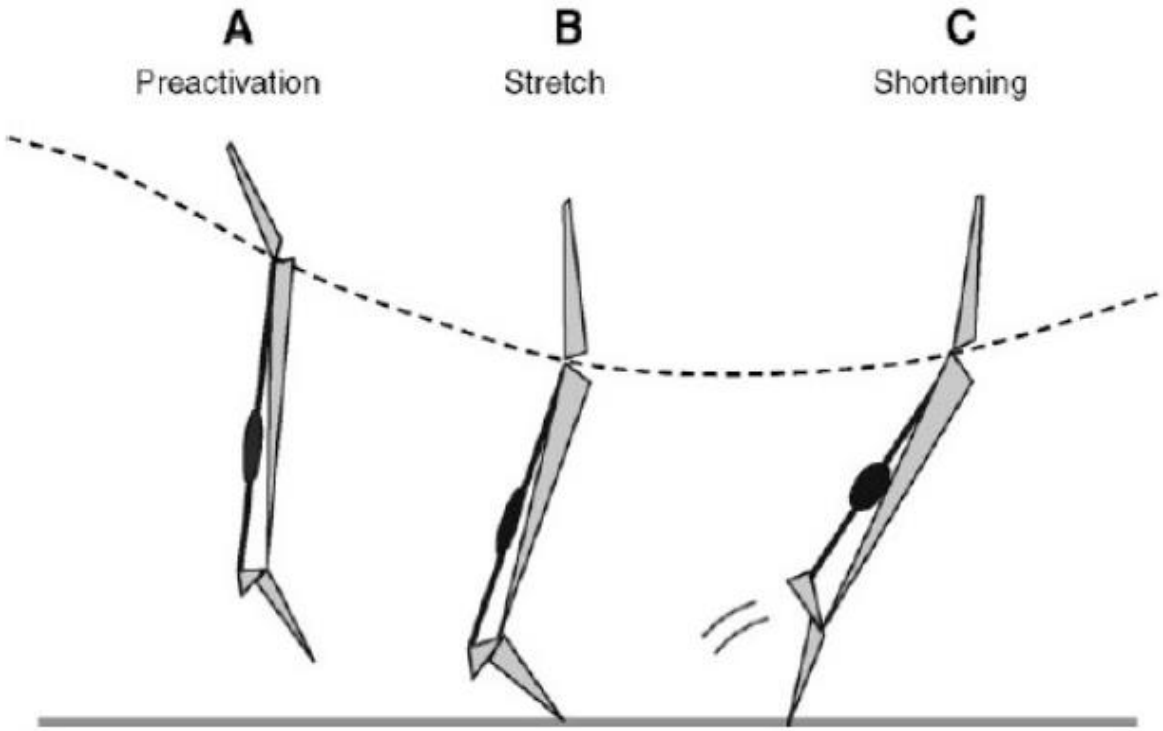
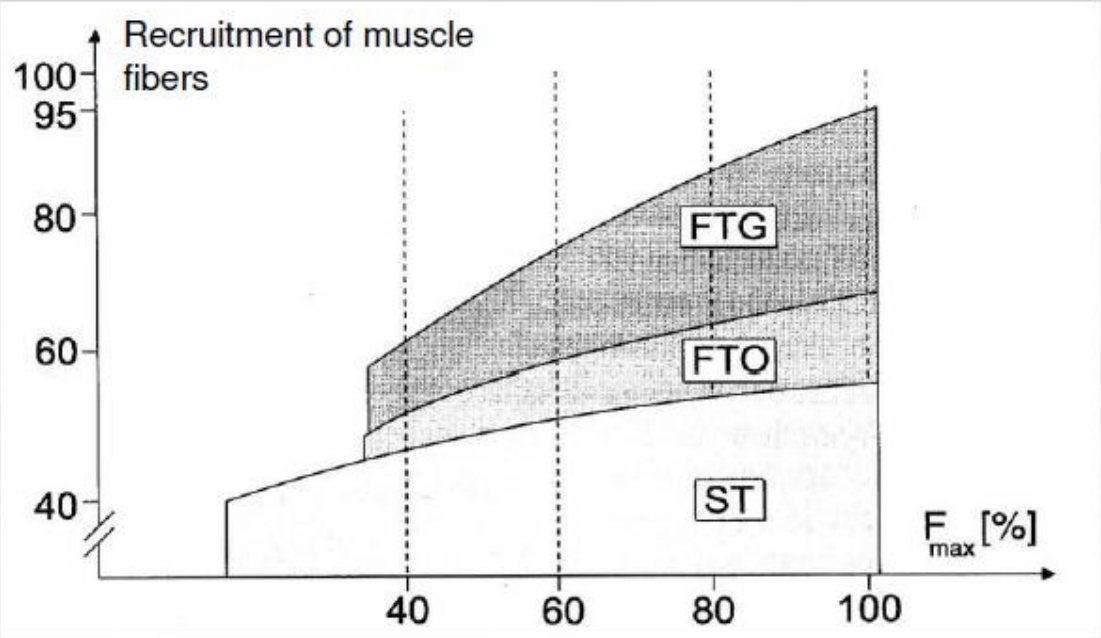


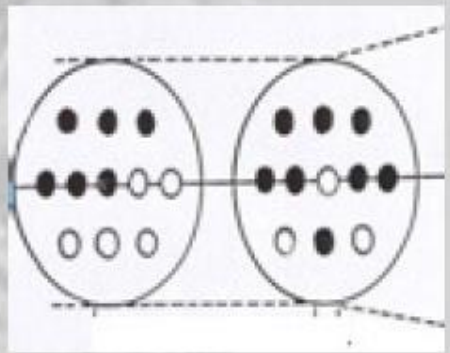
Fig. 1. In human walking, hopping and running considerable impact loads occur when contact takes place with the ground. This requires preactivation from the lower limb extensor muscles before the ground contact to make them ready to resist the impact (A) and the active braking phase (B). The stretch phase is followed by a shortening (concentric) action (C) (adapted from Komi, 1984).

INTRA - vs. INTER-MUSCULAR COORDINATION

Intramuscular Coordination means that alll fibers in the muscle contract and relax in sync, then you are producing more muscle power, without your muscle necessarily being very big. Basically, good intra-muscular coordination means that you are moving your muscles efficiently and you can get a higher and faster strenght output.

Intermuscular coordination is the coordination between the contraction of the active muscle and the relaxation of the antagonist work.





Training of Speed

… under the aspect of tecnical training

REACTION

ANTICIPATION

DECISSION

ACTION

ACCELERATION

…

Training of Speed

… under the aspect of endurance

Speed endurance

-> without strenght (frequenzy or agility training over a longer period)

-> with strenght (running, cycling, jumping,…)

The accumulation of blood lactate disturbs the excitation contraction coupling and cross-bridge formation. In other words, the muscle's mechanical properties are disturbed. The result? A decrease in force production, peak force and velocity.

Speed endurance Training can improve the clearance rate of lactate and reduce early lactate formation

SHORT or SPRINT INTERVAL TRAINING!!!

ENDURANCE

Interval Trainig

Aerobic conditioning

Short Interval Training

High Intensity Training

Endurance Training

The base of the methodology in endurance training are the different energy delivering systems.

Regeneration	Aerobic Conditioning / Capacity			Specific endurance
A 0	A 1	A 2	A 3	A 4
60 % HRMax	65-75 %	75-85 %	85-90 %	> 90 %
50-55 % VO2max	55-75 %	75-85 %	85-100 %	100 %

The methodology...

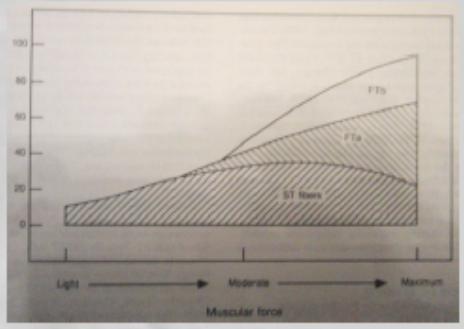
High Volume Training for Aerobic Conditioning (continous methods)

vs.

Interval Training

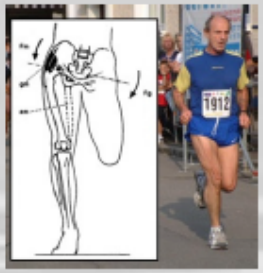
Advantages of Interval Training

- Training is more of the power structure of the sports game
- Sparing of muscle glycogen stores!
- More effective and shorter recovery times
- Activation of fast and
  medium fast muscle fibers

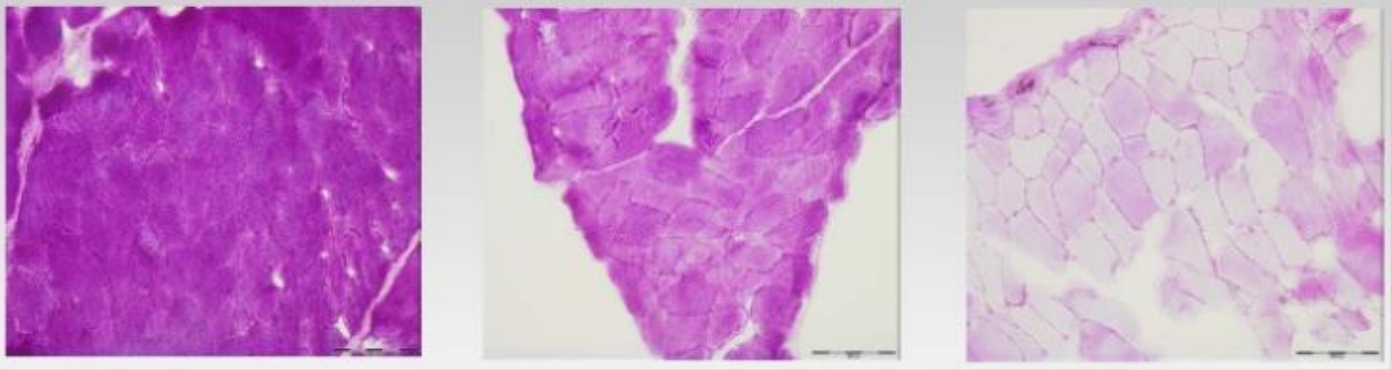


- Development of VO2max as high-performance
  determining parameter!
-Counteracting the monotony of training
- Protection of the passive structures (joints)
  by active muscle contraction in faster running

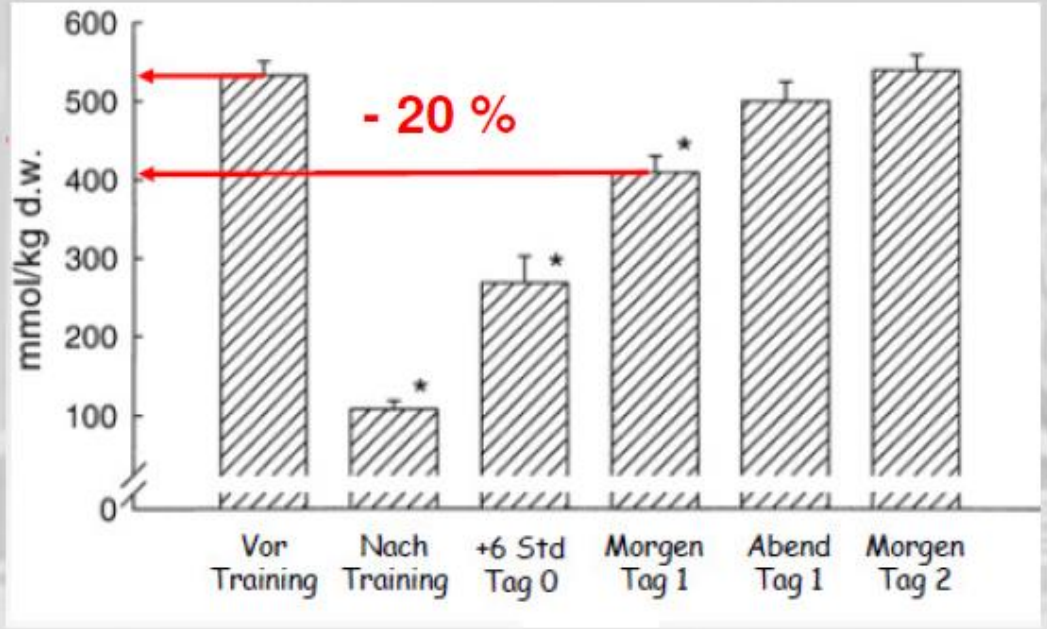
Commodification / more effective!



Decrease in carbohydrate stores



Recovery of carbohydrate stores



To train the aerobic conditioning

- Short Interval - Training

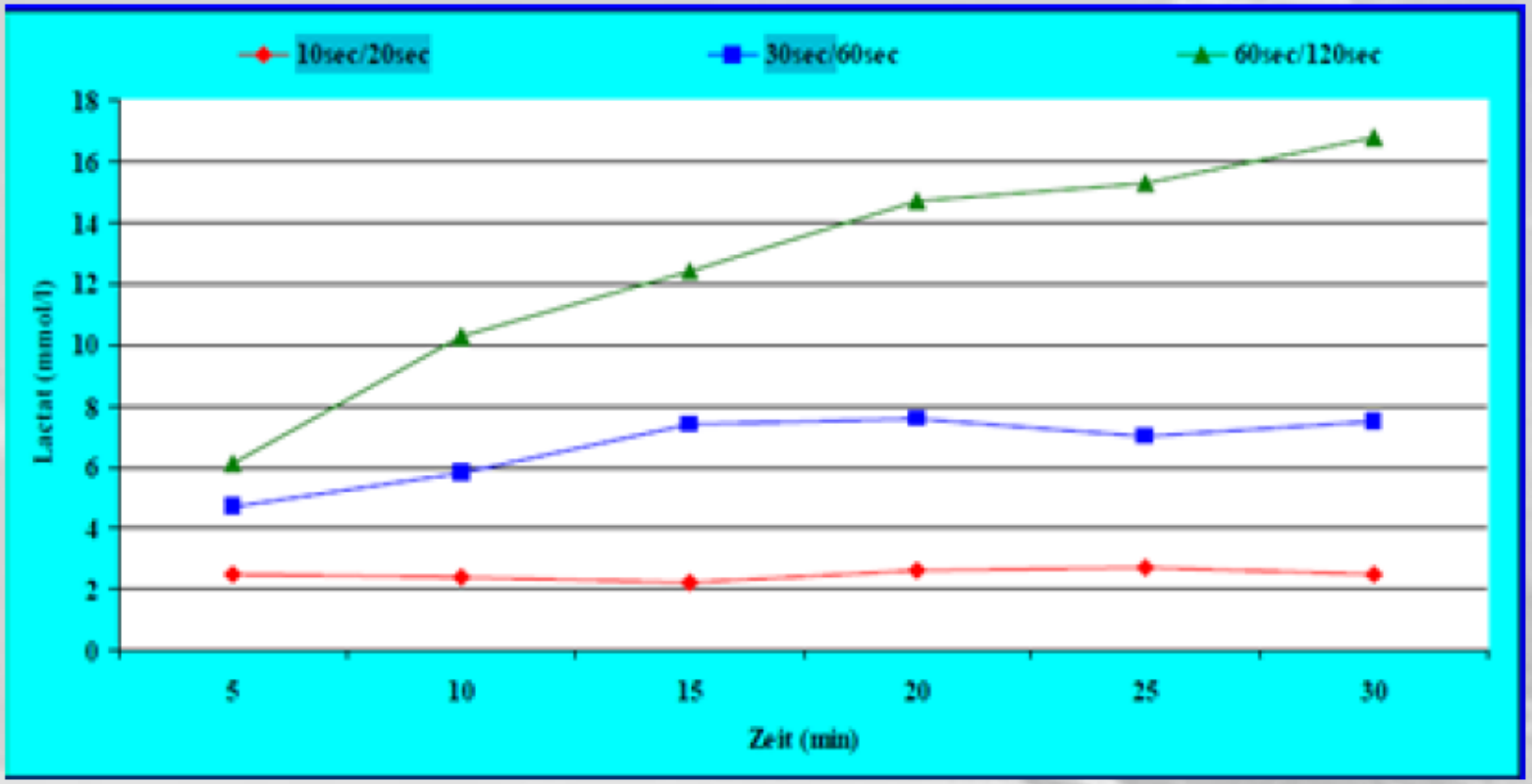
To train the anaerobic capacity and to increase the VO2max

- High Intensity - Training

- Sprint Interval - Training

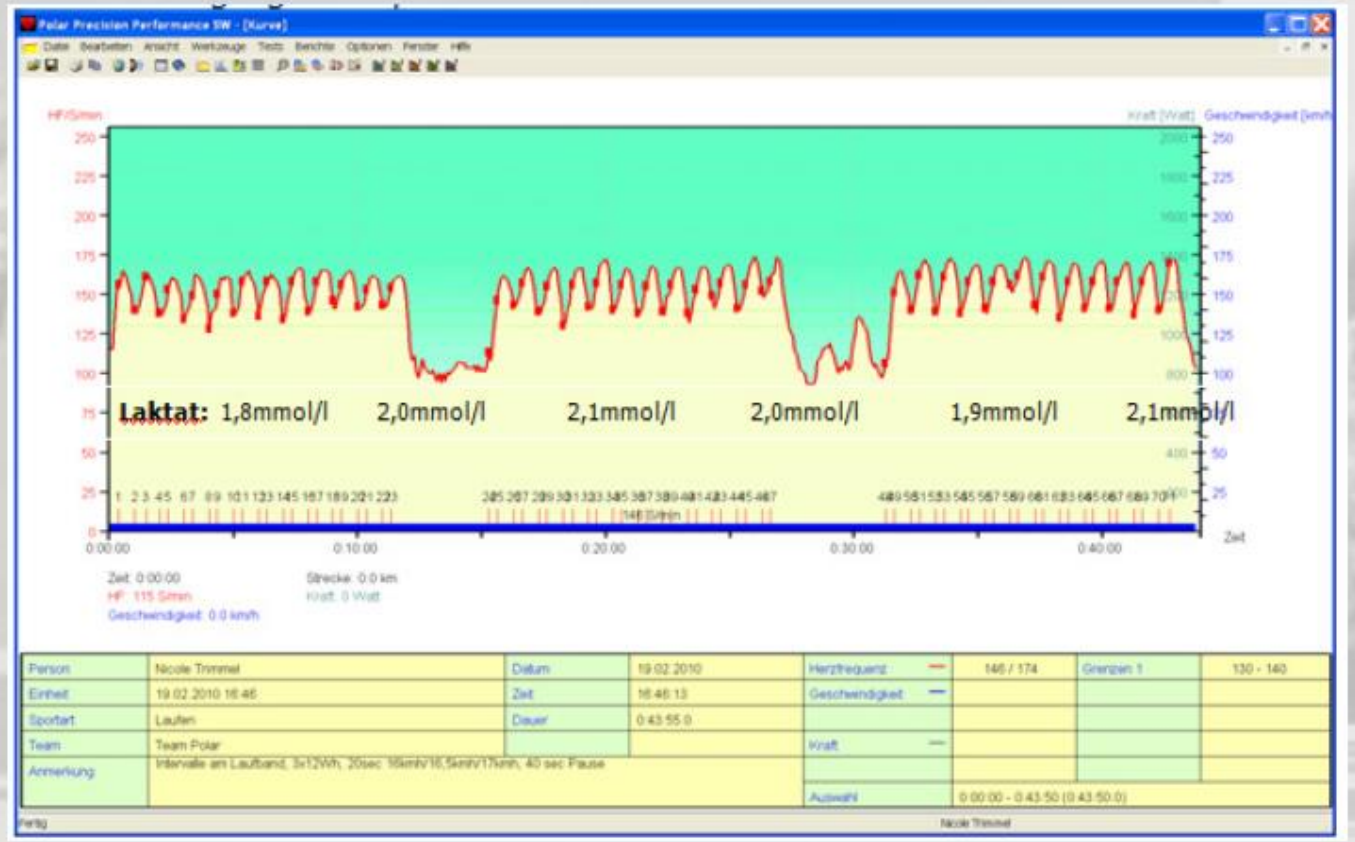
Short – Interval - training

Influence of different exercise – break regimes at the same intensity (100% vVO2max) on the lactate concentration



Planning short interval training

The training concept "short interval training" is about the special needs of a Speed oriented endurance training using short runs (between 50 - 120m) completed several times quickly and adequate breaks between the runs to prevent a lactate accumulation!



For example

3 x 12 x 100m

100m – 20sec

Break 40 sec

Seriesbreak 5 min

Planning short interval training

normativa of short interval

(depending on performance and training period)

- Stimulus duration: between 50 - 120m (10 - 25 sec)
- Stimulus intensity: vVo2max by 100% or between 70 - 85% Vmax
- Stimulus volume: 2 - 5 series, each with 5-10 reps (20 - 60 runs)
- Stimulus density: breaks between 0.30 to 2 min (VO2 max: 50%)
- Stimulus frequency: 1 - 2 times a week

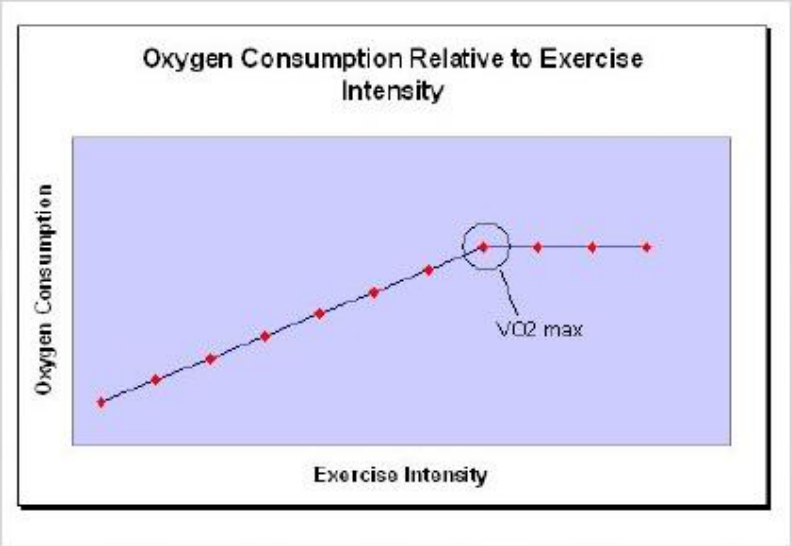
High Intensity Training...

A new way...?

In **1960**, the pioneer Swedish physiologist Per Oløf Astrand developed long interval training at a velocity between the critical velocity and vVO2max (90 to 95% vVO2max) . These 3 minutes run at about 90 to 92% of vVO2max elicited VO2max in the last repetitions, despite the complete rest in between. Astrand et al. considered that this was one of the best forms of interval training to improve VO2max since all cardiorespiratory parameters were at their maximum.

The importance of VO2max

VO2 max has been defined as:
"the highest rate of oxygen consumption attainable during maximal or exhaustive exercise" .
As exercise intensity increases so does oxygen consumption. However, a point is reached where exercise intensity can continue to increase **without** the associated rise in oxygen consumption.

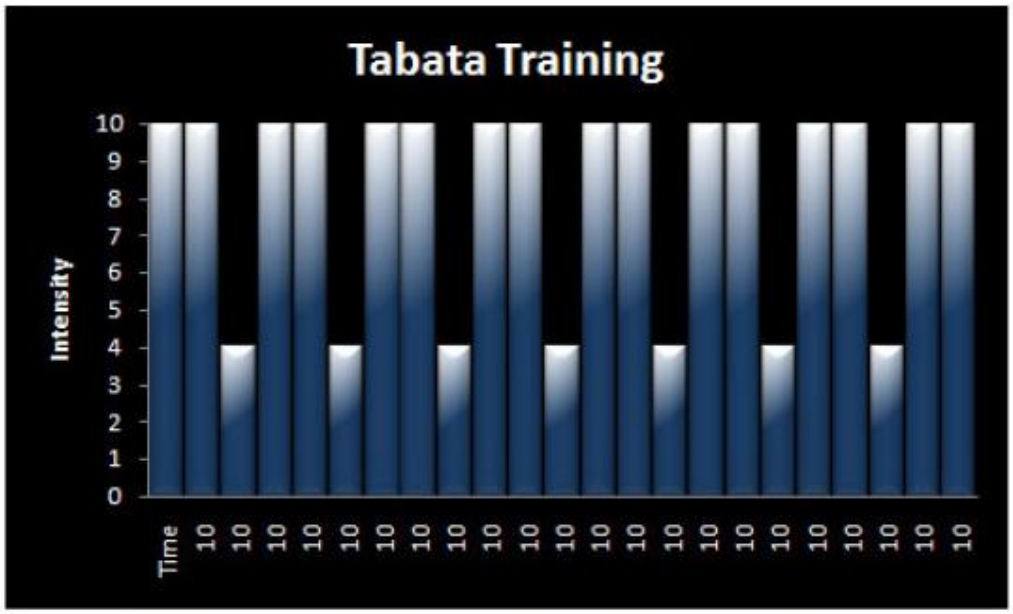


J Physiol. 2008 January 1; 586(Pt 1): 25–34.
Published online 2007 November 15.

$\dot{V}O_{2,max}$: what do we know, and what do we still need to know?

What we know is that you can train the VO2 max or the performance at the VO2 max and theres a relation between the VO2 max and the performances in the game!

High Intensity Training



Sprint Phases	Rest Phases	Number of Sets
20 Seconds	10 Seconds	8

Results after 5 weeks: significant increase

- **Vo2max (6,5%)**

- **performance at aerobic treshold (+14%)**

- **performance at lactate treshold (+28%)**

Tabata I, Nishimura K, Kouzaki M, Hirai Y, Ogita F, Miyachi M, Yamamoto K (1997). Effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and VO2max. Medicine and Science in Sports and Exercise, 28, 1327-1330

Micro shock cycles

Norwegian soccer team - 2. Division – 10 days of H.I.T

1st. Groupe:

4 x 4 min Intervals – Dribblingparcours

90-95% maximum heart rate (MHF

acitive break: 3 min

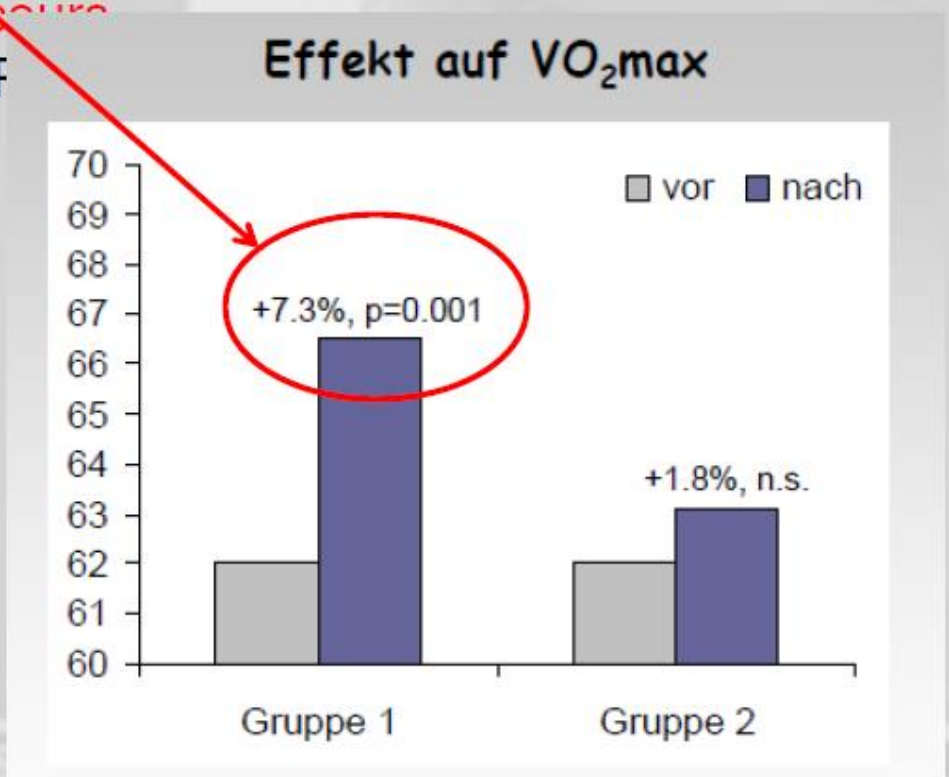
– 60-70% MHR

2nd Groupe:

28 min – continuous training

70-75 % MHR

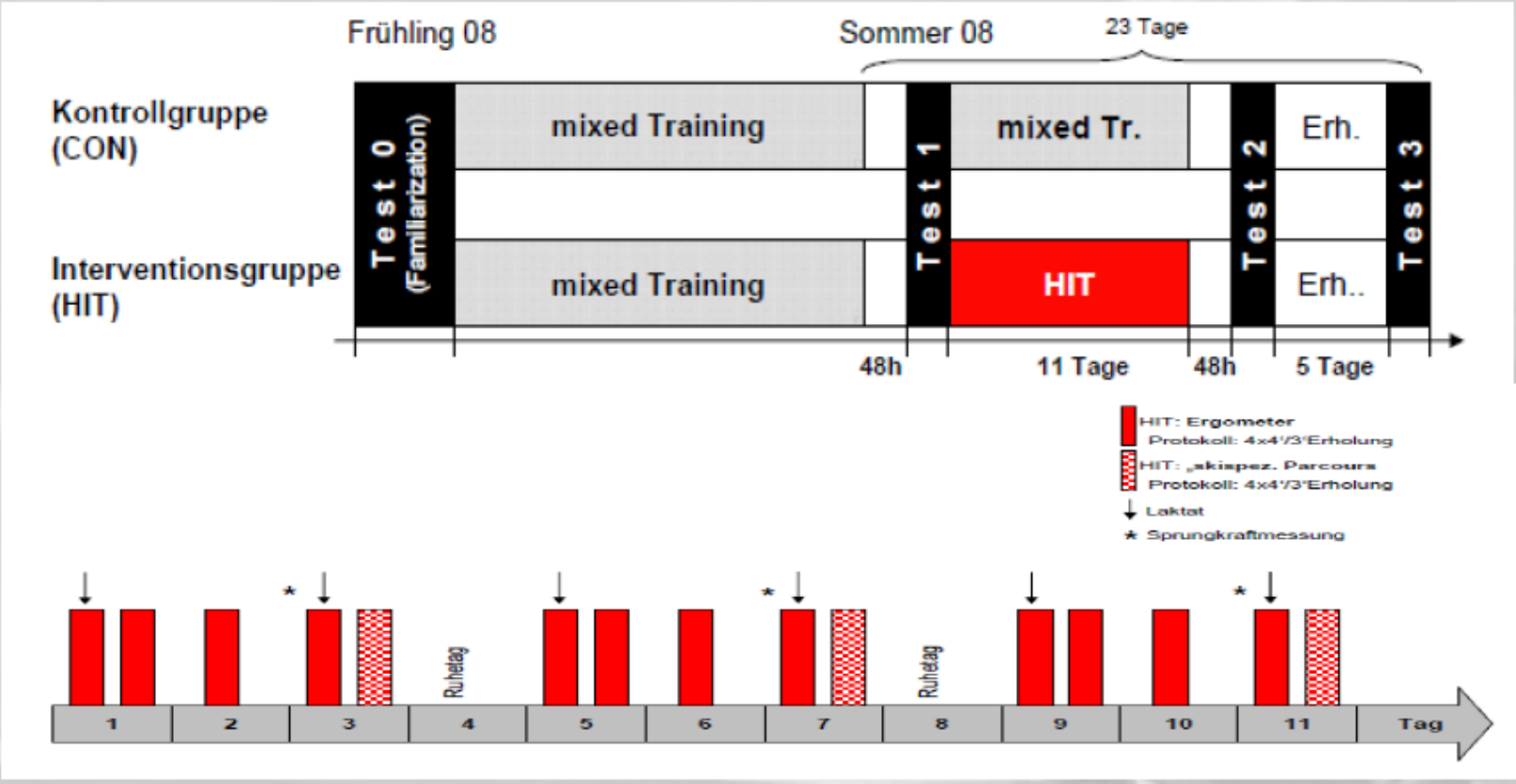
(Stolen et al. 2005)



Block training periodization in alpine skiing: effects of 11-day HIT on VO2max and performance.

Breil FA, Weber SN, Koller S, Hoppeler H, Vogt M

Eur J Appl Physiol. 2010 Aug;109(6):1077-86. Epub 2010 Apr 4.



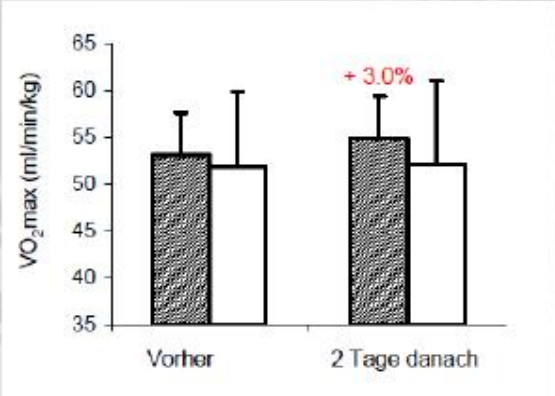
Results

	HIT	CON
Maximum performance	+4.4% **	+2.0%
Performance at AeT (2)	+9.6% **	+1.0%
Maximum jump height	-0.1%	+4.0%

11 days of HIGH INTENSITY TRAINING leads to increased growth in endurance performance

BloodVolume	+10.2 % **	+3.4%
Stroke Volume	+9.3% **	+8.1%

VO_2 max



Conclusions for the training process

In recent years numerous studies have shown, the success of various High Intensity Training methods:

4 x 4 min continuous loads
4 x (8 x 15 "/ 15") intervals
4 x (8 x 20 "/ 10") intervals
4 x (4 x 30 "/ 30") intervals

Improvement in
10 - 12 days (shock cycles / rhythm as 1 - 2 - 0)
or by 2 – H.I.Training times / week for 8 weeks
by 6 - 7% increase in VO2max

Improvements in the aerobic and anaerobic threshold

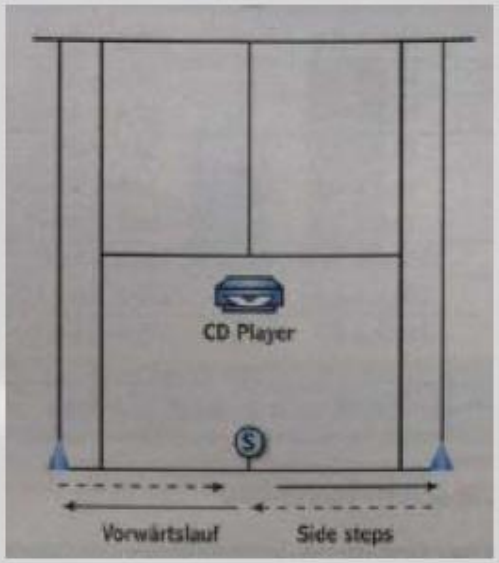
Variation in play mode (Minigames - Attack / Defense) Parcours vs. General training (running, ergometer)

Studies (Stolen et al., 2005) showed theres also a receipt of performance at on time training a week

Sprint Interval Training

Zimek, et al. (2011) Leistungssport: Sprint Interval Training more effective than High Intensity Training in sports games

running paths



HIT		IST
3 x 90 s level$_{max}$*, 3 min aktives Traben (70% of HF$_{max}$)	1. Serie	10 x 5 s all-out 15 s Pause
1:1 Spiel		1:1 Spiel
3 x 90 s level$_{max}$*, 3 min aktives Traben (70% of HF$_{max}$)	2. Serie	10 x 5 s all-out 15 s Pause
1:1 Spiel		1:1 Spiel
3 x 90 s level$_{max}$*, 3 min aktives Traben (70% of HF$_{max}$)	3. Serie	10 x 5 s all-out 15 s Pause
1:1 Spiel		1:1 Spiel

Results:

Variable	Gruppe	Pre-Test	Post-Test
VO_{2peak} (ml/kg/min)	IST	55,6 ± 5,0	58,6 ± 2,9[a,b]
	HIT	56,3 ± 4,0	59,1 ± 2,9[a,b]
	KON	57,3 ± 4,0	57,4 ± 3,8
v_{LA4} (km/h)	IST	13,4 ± 2,1	14,2 ± 0,9
	HIT	13,1 ± 0,6	13,8 ± 1,0
	KON	12,9 ± 1,1	13,1 ± 1,3
HF_{max} (S./min)	IST	196,6 ± 10,4	194,8 ± 11,7
	HIT	188,9 ± 6,6	187,3 ± 8,6
	KON	194,9 ± 8,7	191,8 ± 5,6

Arrangement of H.I.T. during the year

Technology-oriented basic endurance training (with ball) all year!

Preparation / training camp:

10 days shock cycle H.I.T
or receipt of 2 - Training times / week

In Comination withTechnique - tactical training or strength training (functional)!

In the season:

1 x H.I.T (in small game variation)
1 - 2 x short intervals (possible before / after training)

In Comination withTechnique - tactical training or strength training (functional)!

Additional Training

(Functional) strength training and muscle building (in preparation) and maximum / explosive strength training (in season)

- Performance enhancement and injury prevention
- Stabilization of the joint systems
- Adaptation of the connective tissue
- Development of speed or quick / explosive strength
- Development of motion (full range of motion)

Sling muscle training (asymmetric)
Sensorimotoric activity training
Coordination training
Shoulder stabilization training ...

Regenerative measures (increasing importance of Kryotherapy!)

Nutritional measures

Sport psychological measures …

Thank you for ATTENTION

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