Development of overuse injuries in running

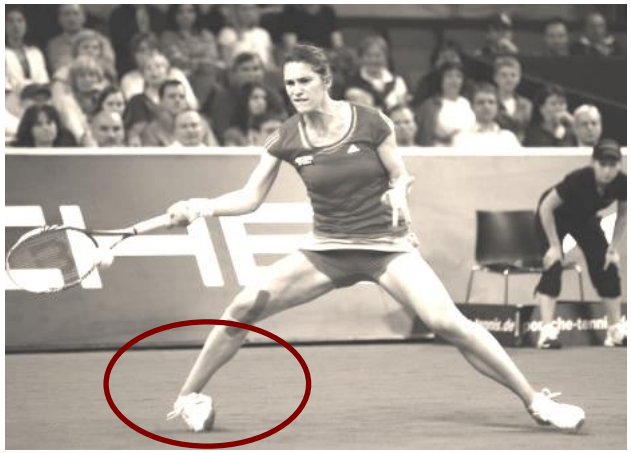
- Analysis, Therapy and Prevention -

Prof. Dr. Stefan Grau

Department of Food and Nutrition, and Sport Science
University of Gothenburg, Sweden

Definition **SPORT INJURY:**

Sudden trauma leads to damage of the skeleton (Fracture, Luxation, Ligament Rupture).

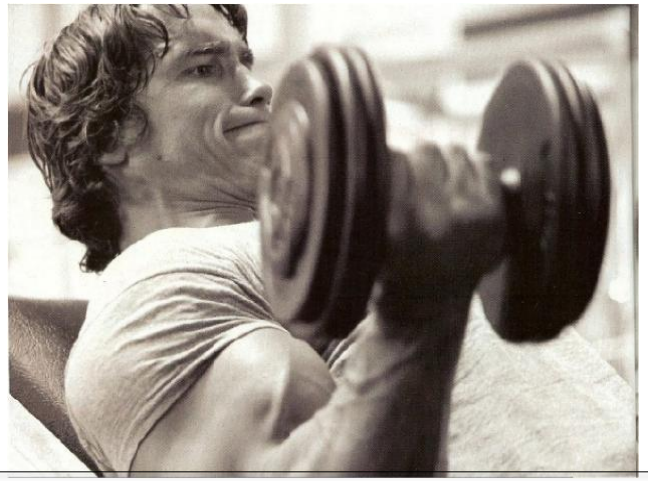


http://sportbild.bild.de/SPORT/sportmix/tennis

Definition **OVERUSE:**

Continuous micro traumata leads to limited damage of the skeleton. Dysbalance between repetitive stress and ability of tissues such as ligaments, bands, muscles, bones and apophysis to regenerate.

(Weinberg, 2005)



http://www.ironmagazine.com

Types of overuse injuries -> Overuse Pain

- Insertional irritations of ligaments
- Inflammation of Bursa
- Joint Damage
- Stress Fractures

Common Overuse injuries Knee

- ITBS (Runner´s Knee)
- Tendinopathy of Patella (Jumper´s knee)
- Damage of Cartilage

Common Overuse injuries Ankle

- Tendinopaty of Achilles Tendon
- Plantarfasciitis

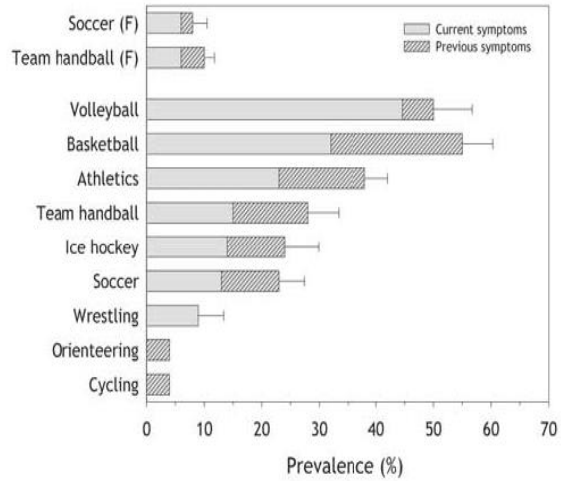
The American Orthopaedic Society for Sports Medicine
The American Journal of Sports Medicine

Prevalence of Jumper's Knee Among Elite Athletes From Different Sports

A Cross-sectional Study

Øystein B. Lian,*† MD, Lars Engebretsen,*‡ MD, PhD, and Roald Bahr,*§ MD, PhD
*From the *Oslo Sport Trauma Research Center, Norwegian University of Sport and Physical Education, Oslo, Norway, †Kristiansund Hospital, Kristiansund, Norway, and the ‡Orthopaedic Center, Ullevål University Hospital, Oslo, Norway*

The American Journal of Sports Medicine, Vol. 33, No. 4
DOI: 10.1177/0363546504270454



Prevalence of Jumper's Knee Among Nonelite Athletes From Different Sports

A Cross-Sectional Survey

Johannes Zwerver,*† MD, PhD, Steven W. Bredeweg,† MD,
and Inge van den Akker-Scheek,† PhD
Investigation performed at University Medical Center Groningen, Groningen, The Netherlands

The American Journal of Sports Medicine, Vol. 39, No. 9
DOI: 10.1177/0363546511413370

TABLE 1
Prevalence of Jumper's Knee in 7 Different Sports and Athletes' Characteristics[a]

	Basketball	Volleyball	Handball	Korfball	Soccer	Field Hockey	Track and Field
No. of athletes	127	153	105	145	118	98	145
JK prevalence	11.8%	14.4%	13.3%	4.8%	2.5%	5.1%	6.9%
95% CI	7.3-18.6	9.7-20.8	8.1-21.1	2.4-9.6	0.9-7.2	2.2-11.4	3.8-12.2
Men	89 (70.1%)	76 (49.7%)	45 (42.9%)	76 (52.4%)	92 (78%)	49 (50.0%)	75 (51.7%)
Age, y	23.6 (4.3)	22.9 (2.7)	23.8 (5.2)	23.2 (4.2)	24.7 (5.1)	26.6 (6.2)	24.0 (4.5)
BMI, kg/m^2	22.5 (2.2)	22.2 (2.0)	23.5 (2.3)	22.5 (2.2)	23.0 (2.5)	22.7 (2.7)	21.1 (2.0)
Height, cm	186 (9.6)	182 (10.1)	179 (9.0)	180 (10.0)	181 (8.1)	179 (9.9)	178 (9.8)
Weight, kg	78.4 (11.1)	74.2 (10.9)	76.1 (11.9)	73.4 (11.2)	75.9 (11.0)	73.3 (12.4)	67.3 (10.1)
Sport history, y	9.3 (5.1)	9.9 (4.8)	13.8 (7.2)	15.1 (4.9)	16.5 (5.6)	15.5 (6.9)	8.7 (6.0)
Sporting per week, h	4.6 (1.8)	5.0 (2.2)	5.7 (4.1)	4.0 (1.3)	4.7 (1.7)	4.2 (2.1)	5.7 (3.2)

[a]Except for prevalence and gender, data are shown as the mean, with standard deviation in parentheses. JK, jumper's knee; CI, confidence interval; BMI, body mass index.

Next to acute traumata, (chronical) overuse injuries/pain at the musculskeletal system responsible for reduction or drop-out from training/competition and loading capacity in elite and recreational sports (all sports)

Running shows particularly high incidence rates
- 30-65% of all runners generate an overuse injuries per year

- 70-80% of overuse injuries are at the lower extremities

Hein et al. 2014

Soccer also shows particular high incidence rates
-26-76% Overuse injuries per year

Junge et al. 2004, Hawkins et al. 2001, Dupont et al. 2010

Development of overuse injuries multi factorial:

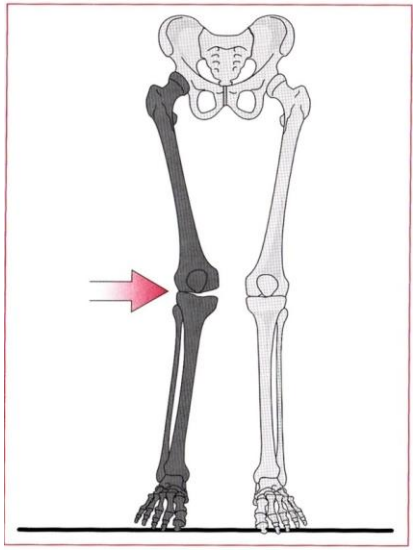
- Biomechanics
- Clinics
- Training

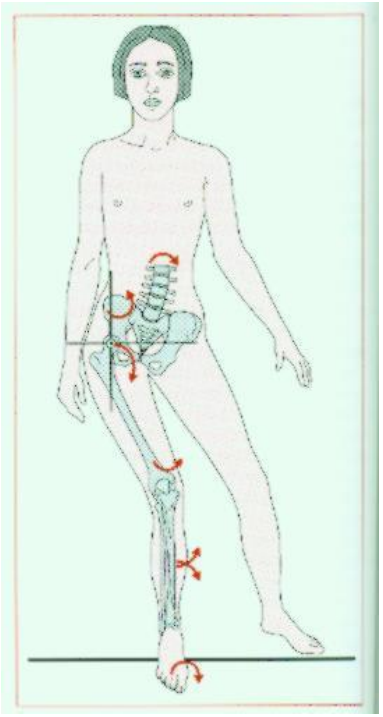
Biomechanical riskfactor 1: Leg alignement (stability vs. Instability)

a) Valgus leg axis in dynamics and „Medial Collapse“

-Increased Adduction und Internal rotation of Femur

- increased drop of pelvis on opposite side
- Increased internal rotation of tibia
- Increased subtalar pronation





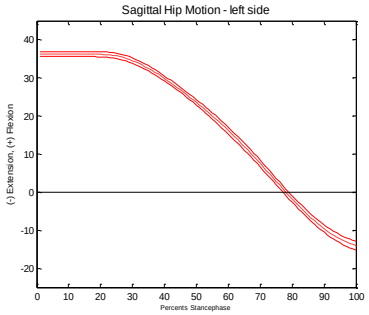
-> Lead to increased tension of muscles (Triggerpoints), typically tractus iliotibialis, gluteal/piriformis, lumbal, calf

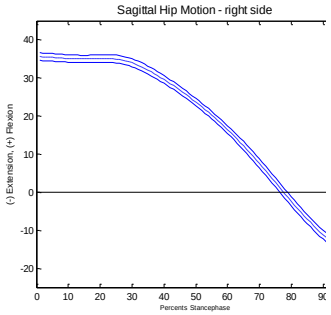
Krauss, I. et al. 2007

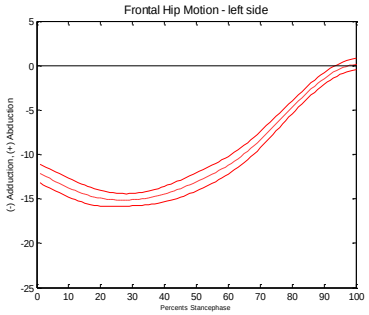
Noehren et. al et al. 2007

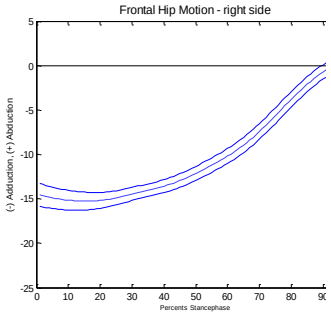
Video Medial collapse

Typical hip motion

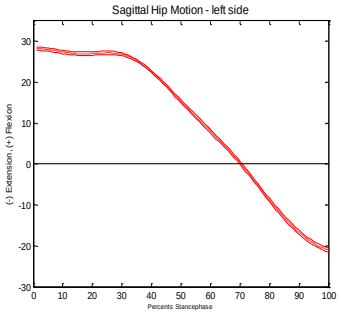


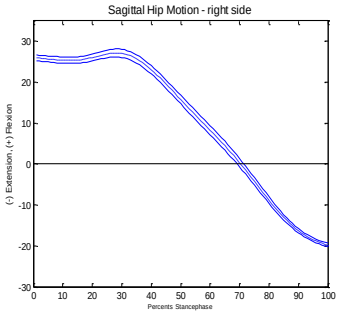


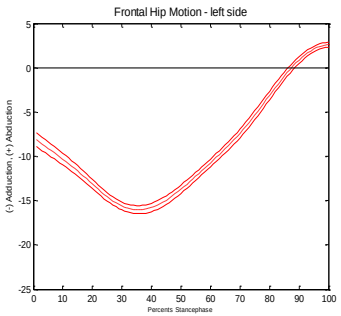


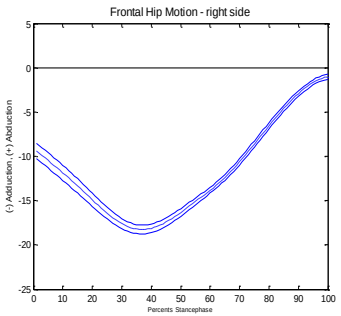


Instable hip motion frontal





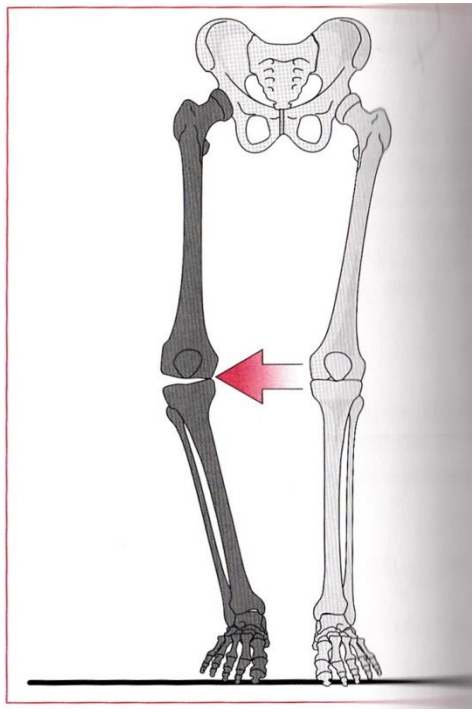




b) Varus leg axis in dynamics

- „Relatively“ increased abduction und external rotation of Femur
- Invreased external rotation of Tibia
- „Relative“ subtalar supination

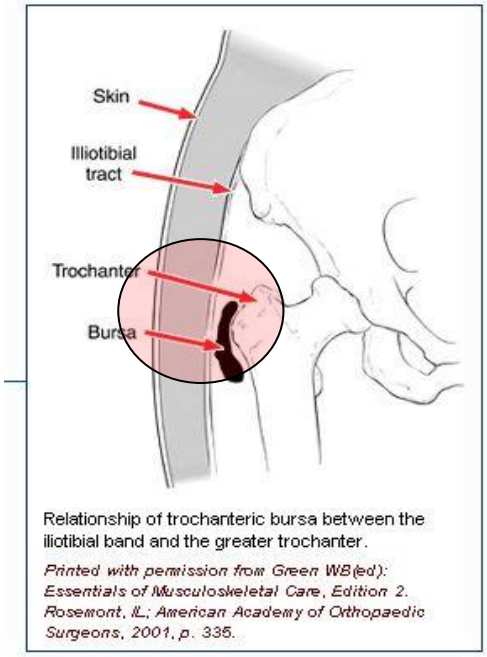
-> Lead to increased tension of muscles (Triggerpoints), typically tractus iliotibialis, calf



Grau, S. et al. 2008c

Possible & common location of pain (valgus)

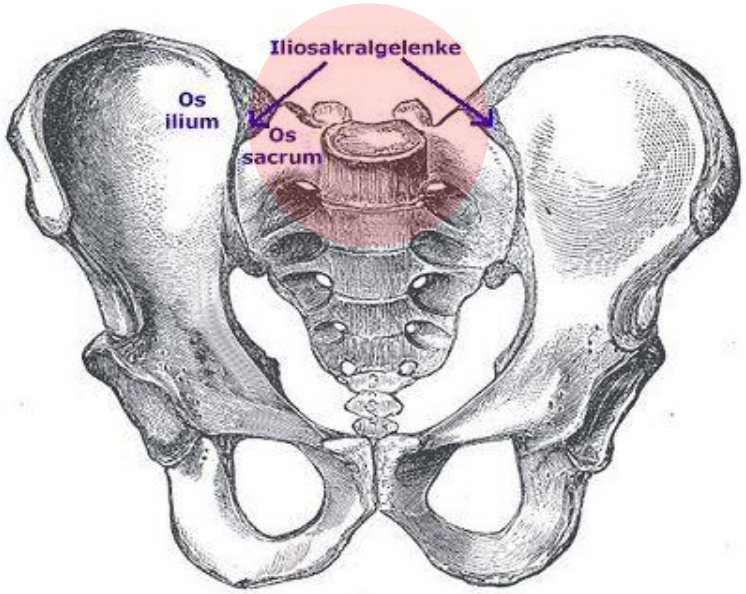
Trochanter



Relationship of trochanteric bursa between the iliotibial band and the greater trochanter.

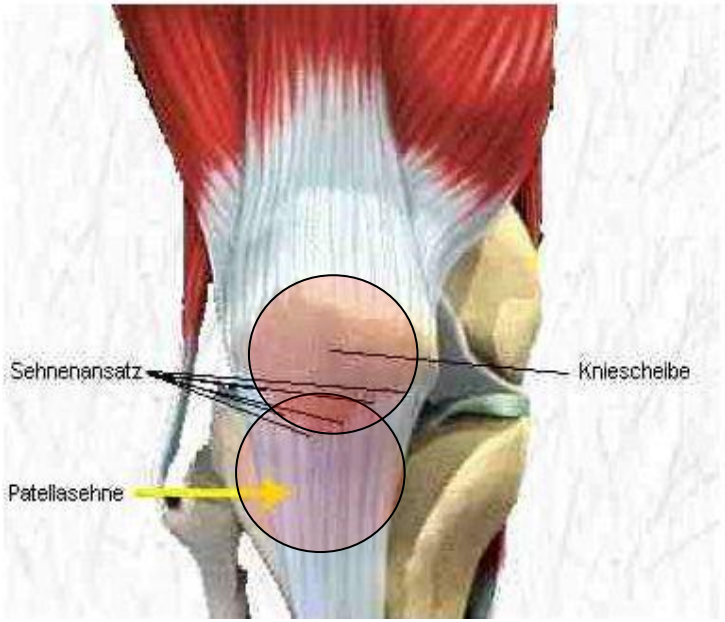
Printed with permission from Green WB(ed): Essentials of Musculoskeletal Care, Edition 2. Rosemont, IL; American Academy of Orthopaedic Surgeons, 2001, p. 335.

Lumbar Region/ISJ

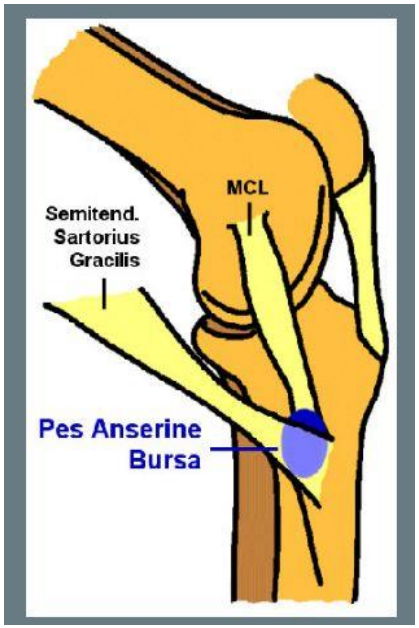


Possible & common location of pain (valgus)

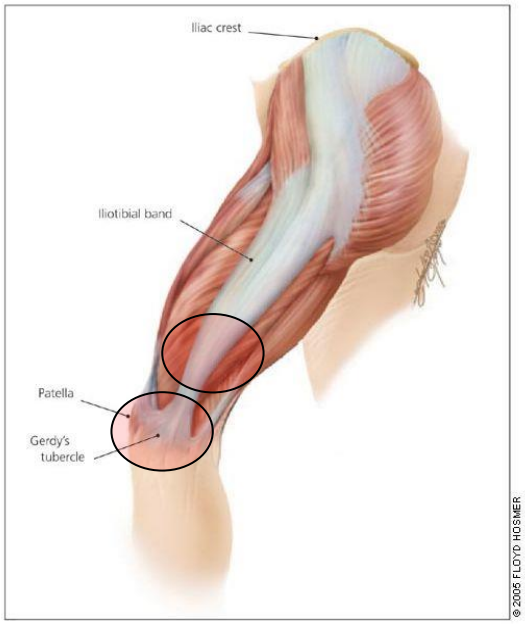
Tip of Patella, retropatellar



Pes anserinus

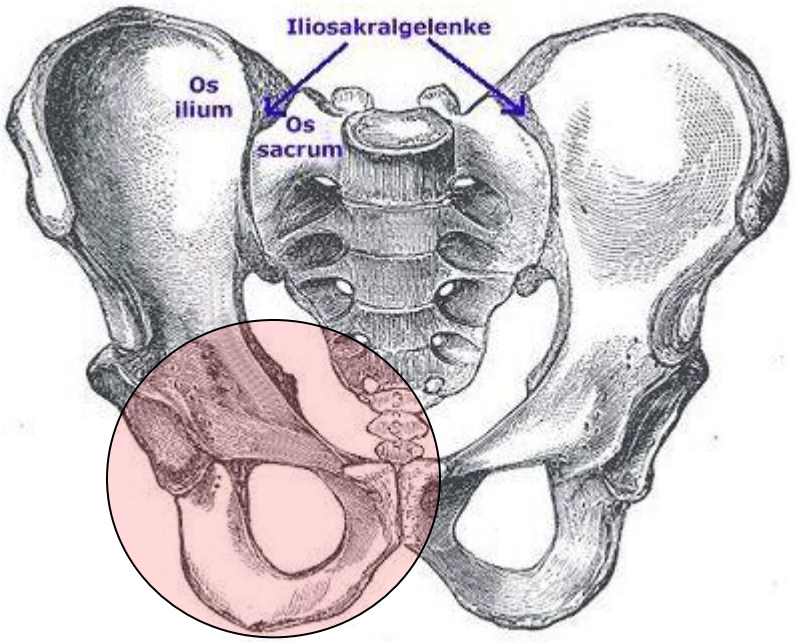


Iliotibial Band

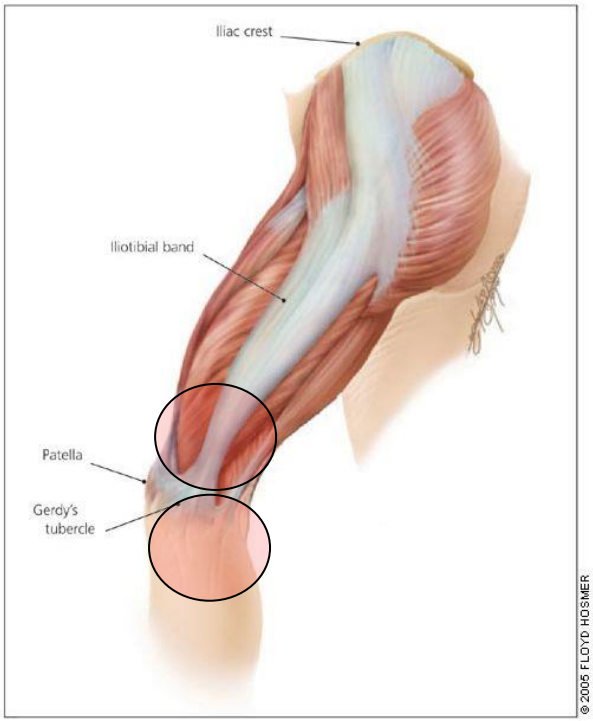


Possible & common location of pain (varus)

Iliac Region

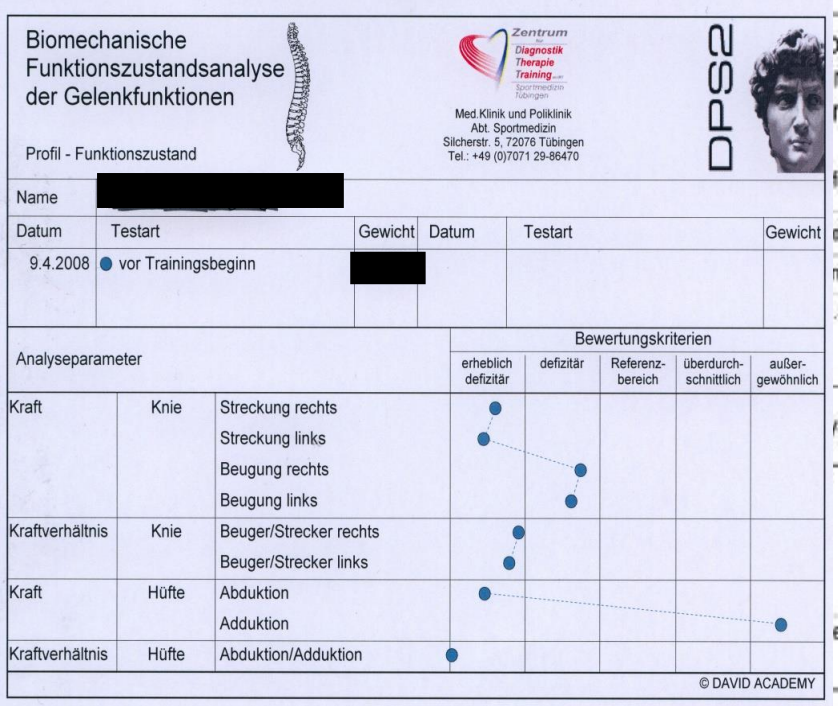


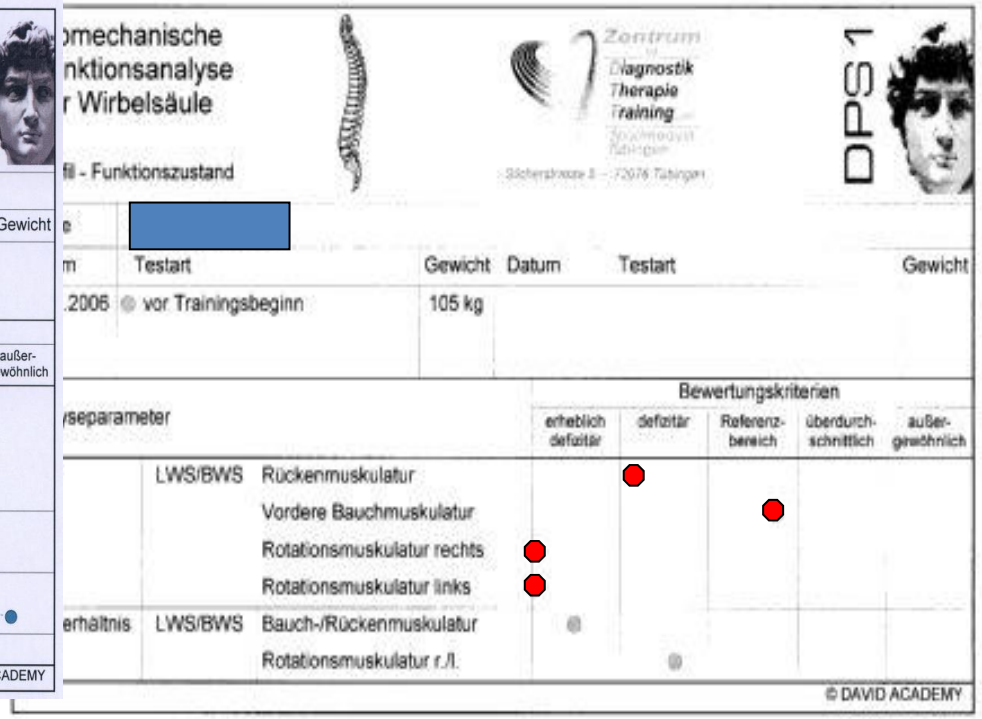
Iliotibial Band



Causes of Instability of Leg Axis

- Deficits of hip stabilizing muscles and leg muscles
- Dysbalance of hip stabilizing muscles and leg muscles (Agonist-Antagonist; right-left)





Noehren et al. 2007, Grau et al. 2008

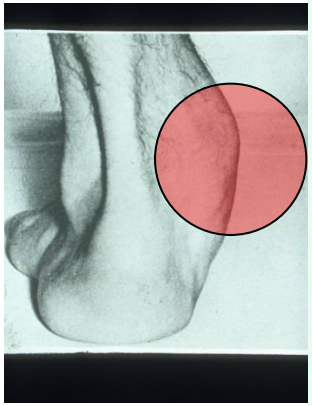
Biomechanical riskfactor 2: Ankle alignement (stability vs. Instability)

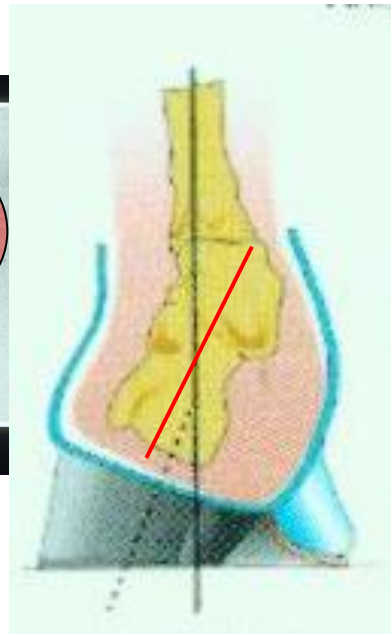
„Overpronation“ at stance phase

Lowering of longitudinal arch and

- Increased inversion of calcaneus, ankle bone, metatarsals (+ velocity)

-> Increased internal rotation of lower leg (coupled movement)





Lead to increased tension of muscles (Triggerpoints), typically at the calf (also hardening of calf)

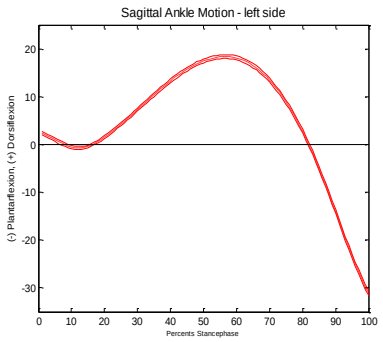
Davis et al. 2010

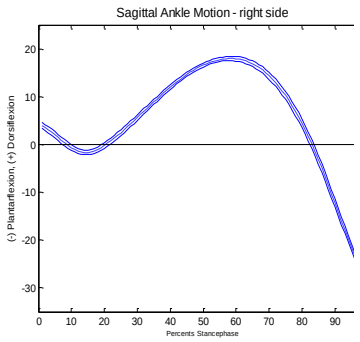
Krauss, I. et al. 2007

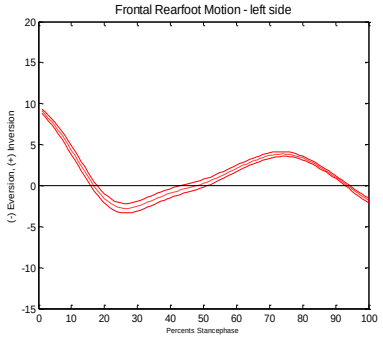
Grau, S. et al. 2008a,b,c

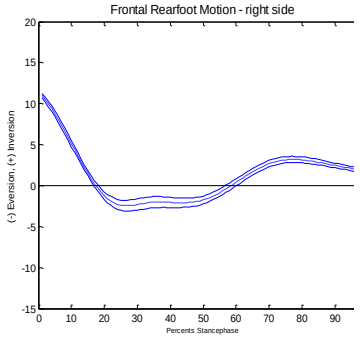
Videos overpronation

Typical ankle motion

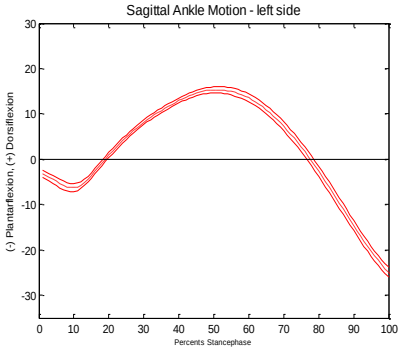


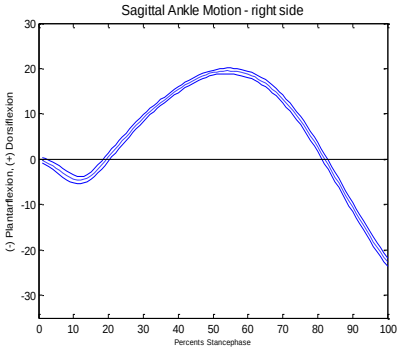


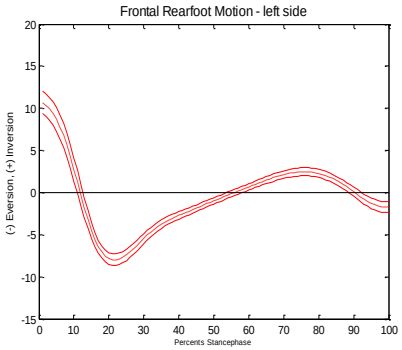


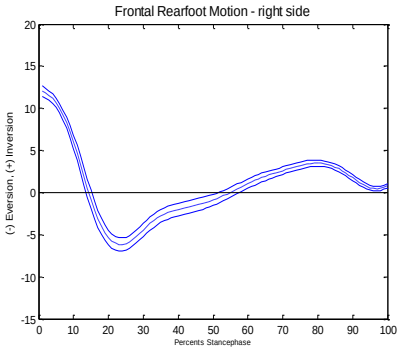


Instable ankle motion frontal





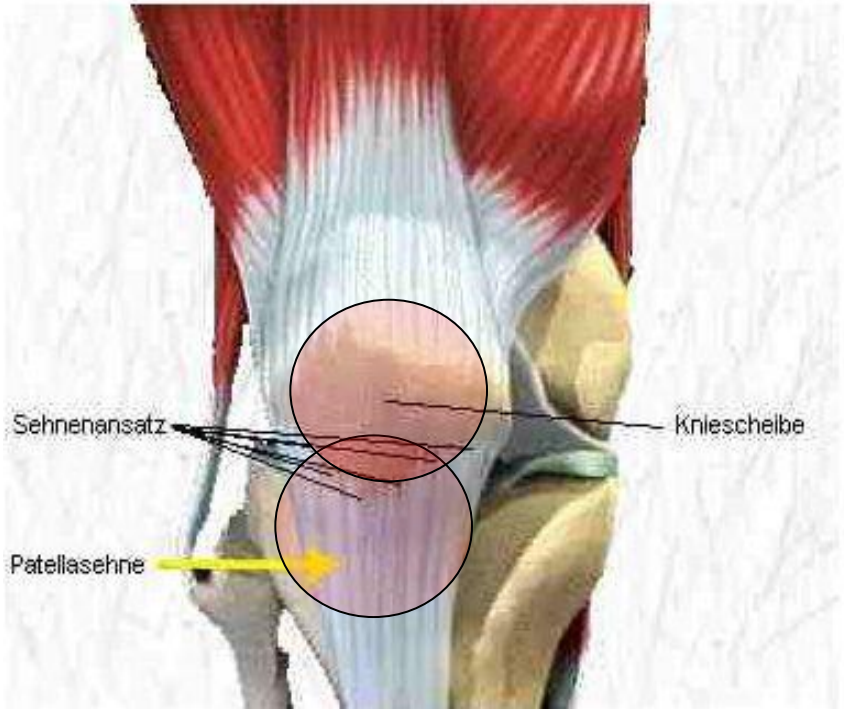




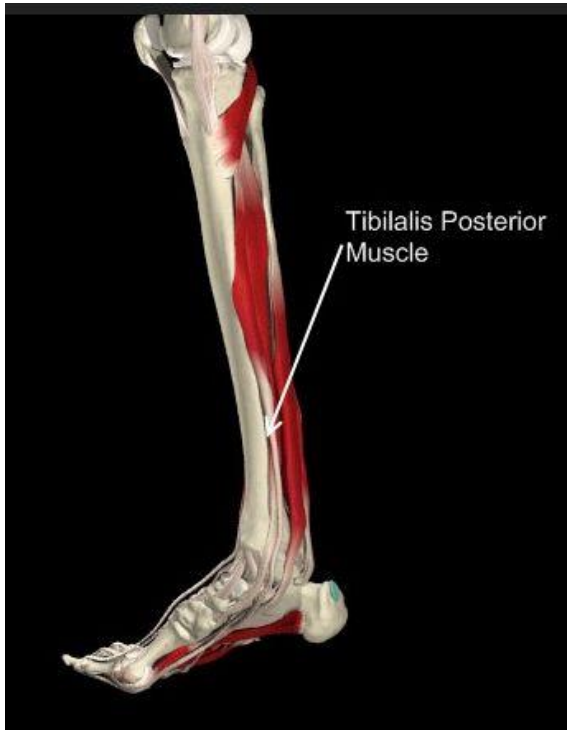
Possible & common localization of pain

Achilles Tendon (Paratendon and Tendon itself)

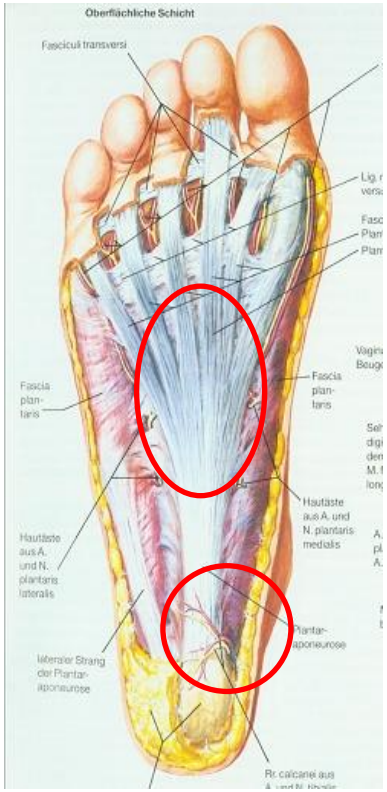
Tip of Patella, retropatellar



Shin medial



Plantarfascia



Causes of Instability

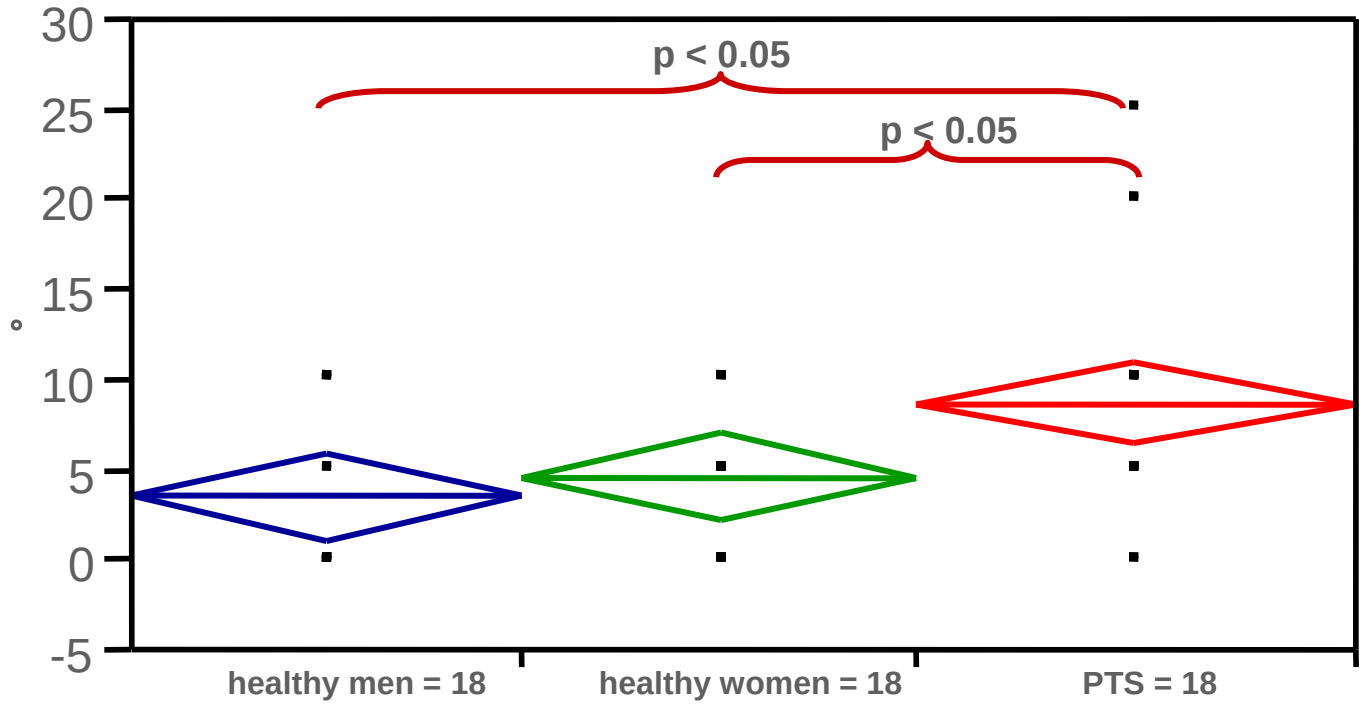
- Deficits or Dysbalances of ankle stabilizing muscles
- Coordination Deficits foot and leg axis
- Hyper- oder Hypomobility at the ankle joint

Krauss, I. et al. 2007

Grau, S. et al. 2008a,b,c

Clinical riskfactors (examples)

a) ROM Knee Extension (e.g. PTS)

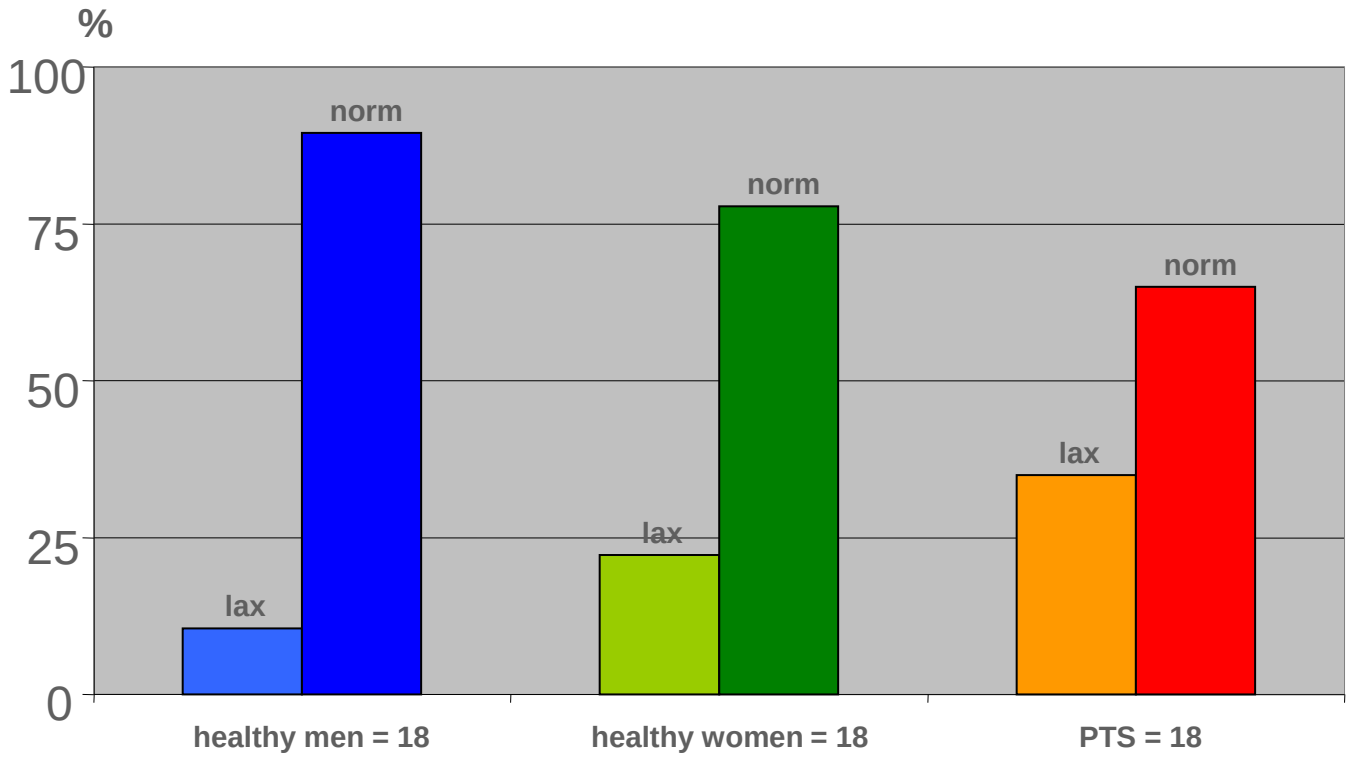


Krauss, I. et al. 2007

Mobility of Patella (e.g. PTS)

Krauss, I. et al. 2007

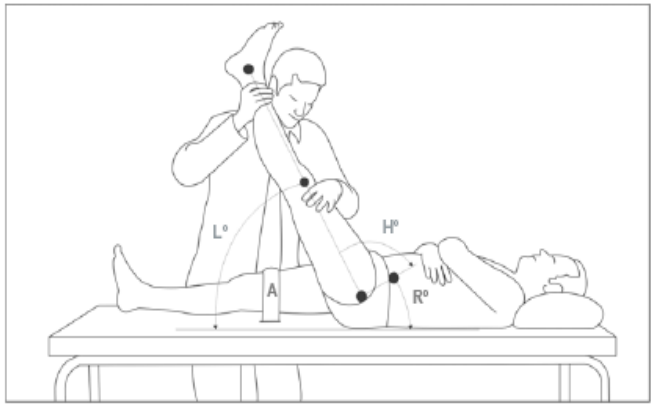
Laxity of Ligamentum Collaterale (e.g. PTS)



Krauss, I. et al. 2007

- Shortened muscles, mostly hamstrings & hip flexors (rectus & iliopsoas)

Hamstrings



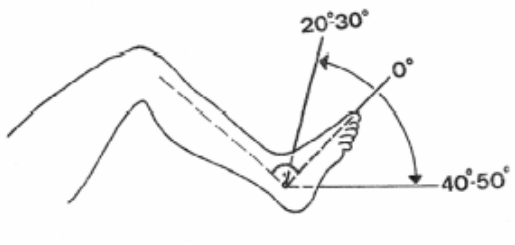
Normal: 90 degree to bench

Hip flexors (Thomas Test)

Normal: no lift thigh, no extension shank

- Decreased DExt ankle joint

Ankle Dors./Plan.



Normal: Dext: 20-30

Plan: 40-50

Training risk factors (examples)

Training variables (all overuse injuries, here PTS)

	T-amount (Km/w)	T-Velocity (km/h)	T-Units (week)	T-Time (h/week)
KO (n=18)	26	11.1	3.1	3.0
PTS (n=18)	37	11.3	3.4	3.4

Grau, S. et al. 2008c

Sport surface hard (PTS, ITBS), soft/uneven (AS, SS, PF)

	Soft (uneven)	Medium (slightly uneven)	Hard (even)
KO (n=18)	27%	37%	36%
PTS (n=18)	15%	40%	45%

Grau, S. et al. 2008c

Prevention and/or Therapy

a) Stabilization Leg axis

Active:

- Stabilization Training Ankle (e.g. theraband balance pad) and leg axis

Prevention and/or Therapy

a) Stabilization Leg axis

Active:

- Stabilization Training Ankle (e.g. theraband balance pad) and leg axis
- Strengthening of muscle deficits (hip abductors, quadrizeps), concentric and eccentric
- Reduction of muscular dysbalances

Active und passive (Physiotherapist):

- Improvement of Mobility/Flexibility (if decreased ROM) and Stretchung (if shortened muscles), typically hip flexors and hamstrings

Active:

- Muscle Detoning („Myofascial Release“, blackroll), typically
  Tractus iliotibialis, Gluteal/piriformis, Quadrizeps, Lumbal area, Calf

Passive (Physiotherapist):

- Muscle Detoning (Triggerpoints), typically

Tractus iliotibialis, Gluteal/piriformis, Quadrizeps, Lumbal area, Calf

b) Stabilization Ankle Joint

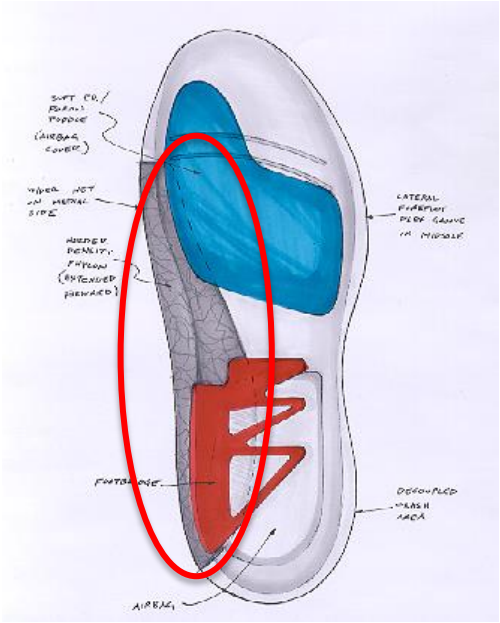
Active:

- Stabilization Training Ankle (e.g. auf Theraband Mat) and leg axis
- Strengthening of supinators (Tibialis Posterior, Soleus, Flexor hallucis longus, if possible also eccentrically) reduction of muscular dysbalances (left vs. right, Agonist vs. Antagonist)
- Barfoot Walking, walking in „Barfoot Shoes“ (e.g. Nike Free)

Passive:

Sport shoes, Running shoes

- Little torsion midfoot area
- Dual Density (running) not helpful



Heel cups

Firm and large heel cups (attached to binding)

Passive:

Sport shoes, Running shoes

Low rearfoot height (Spring Offset e.g. 10mm)

Rounded heel (only running)

Medial

Lateral

Crash-pad (only running)

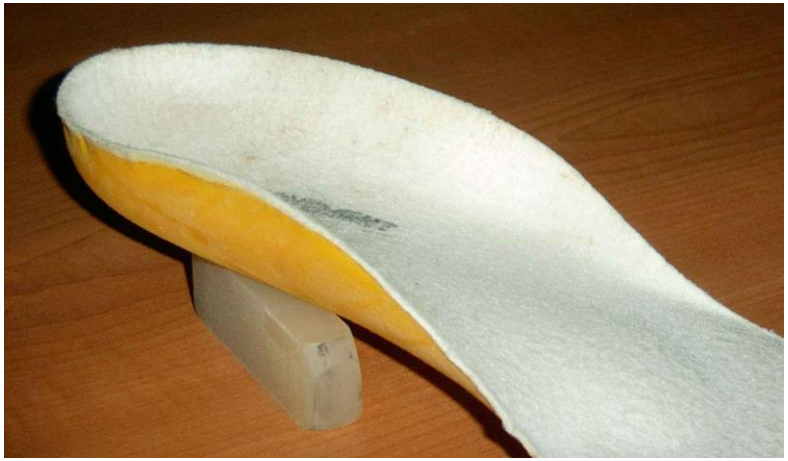
Passive:

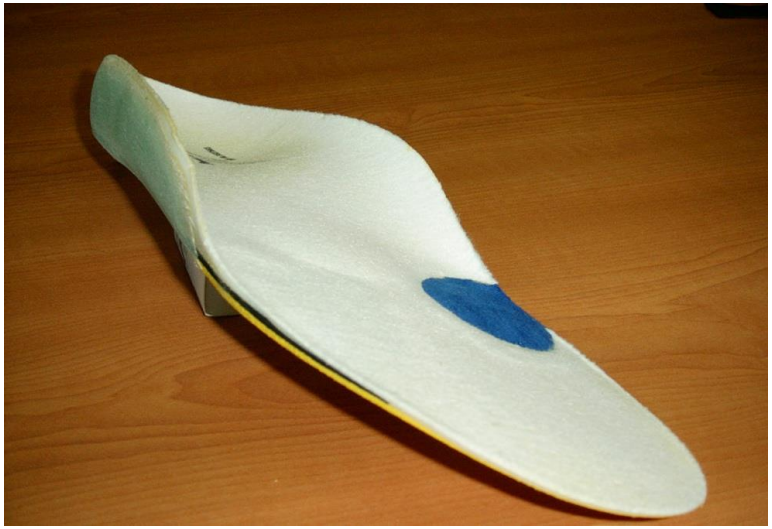
• Orthotics

- Heelcuped orthotics (plus firm material)

- Longitudinal arch support

- Detorsion Wedge





Passive:

- Orthosis
  - medio-lateral stability

  (fixation as in taping)

Muscle Detoning:

c) Optimization of Training

- Running-/Sport Surface (choose carefully)
- Amount of running/Training/loading within individual threshold
- Increase of Amount of running/Training/loading slowly
- Reduced downhill running (at least slowly)

Conclusion Overuse Injuries (take home message)

Decisive for prevention of overuse injuries (but also for performance enhancement), additionally to running

1. Strengthening of muscles (also eccentrically)
2. Stretching of muscles (before AND after training) and „Myofascial Release“ (afterTraining; blackroll)
3. Improvement of mobility/flexibility and coordination
4. Appropriate sport shoes (orthotics , if necessary)
5. Development of overuse injuries typically complex combination of biomechanical, clinical and trainings specific causes

	Training-Variables				Biomechanical Variables				
	T- Age	Km/week	Downhill/week	Surface (hard)	HAD_{max}	AEV_{max}	$AVEL_{EV}$	$KVEL_{FL}$	Total
CO 1	M	M	L	L	L	M	M	L	0,4,4
CO 2	L	L	L	M	M	H	M	L	1,3,4
CO 3	H	M	M	M	L	M	M	M	1,6,1
CO 4	H	L	L	M	M	L	L	M	1,3,4
CO 5	L	L	L	L	M	M	M	M	0,4,4
CO 6	L	L	L	M	M	M	M	L	0,4,4
CO 7	M	L	L	M	H	L	L	M	1,3,4
CO 8	M	M	M	L	L	L	L	L	0,3,5
CO 9	L	M	L	M	L	L	L	M	0,3,5
CO 10	L	M	L	M	L	L	L	L	0,2,6
CO 11	M	H	M	L	M	M	M	M	1,6,1
PTS 1	H	H	L	L	M	L	M	M	2,3,3
PTS 2	M	H	H	M	M	M	H	M	3,5,0
PTS 3	**M**	**H**	**H**	**M**	**H**	**M**	**H**	**M**	**4,4,0**
PTS 4	M	L	L	M	H	M	H	M	2,4,2
PTS 5	M	M	M	M	M	M	H	H	2,6,0
PTS 6	**M**	**M**	**M**	**M**	**H**	**H**	**H**	**H**	**4,4,0**
PTS 7	M	L	L	L	H	H	M	H	3,2,3
PTS 8	L	M	M	H	M	M	H	M	2,5,1
PTS 9	**H**	**H**	**M**	**H**	**M**	**H**	**M**	**M**	**4,4,0**
PTS 10	**M**	**H**	**H**	**M**	**M**	**H**	**M**	**H**	**4,4,0**
PTS 11	M	M	H	H	M	M	M	M	2,6,0

What can we offer to Athletes/Association/Clubs?

1. “Comprehensive” analysis and evaluation of clinical, biomechanical and training specific variables, with overuse injury or healthy (preventive aspect)
   a) In the Lab (prefered)
   b) In the field (Elite athletes)
2. Recommendations for additional training (e.g. strength, flexibility) and equipment (shoes), either preventive or rehab;
3. Research project “Prevention of overuse injuries and performance enhancement”
4. Performance related biomechanical measures (Jump-Tests, Acceleration,…)

Any questions??