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SPORT
MEDIZINER.AT

PREVENTION IN SPORTS

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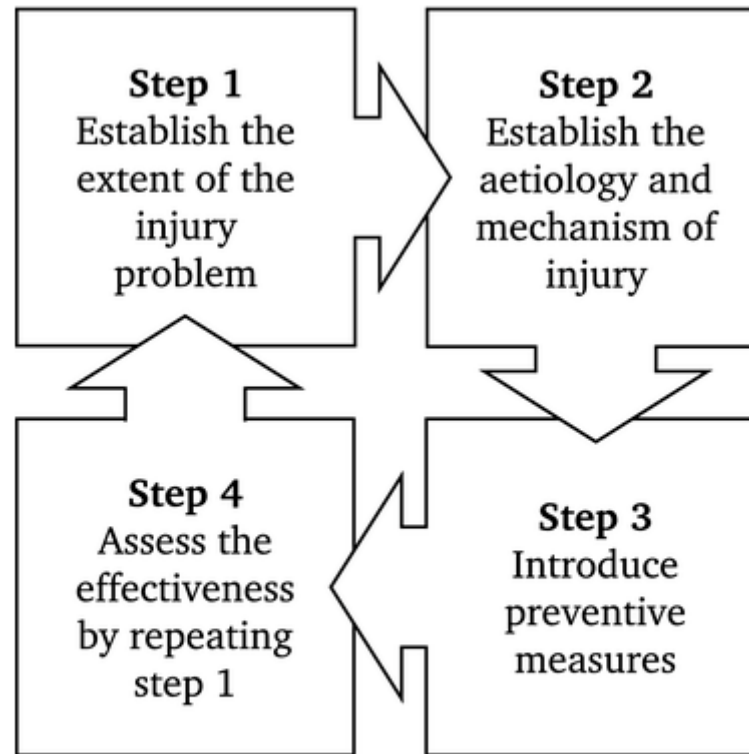
WHAT IS PREVENTION...?

CAN WE REALLY PREVENT
INJURIES...?

DEFINITION ACCORDING WHO:

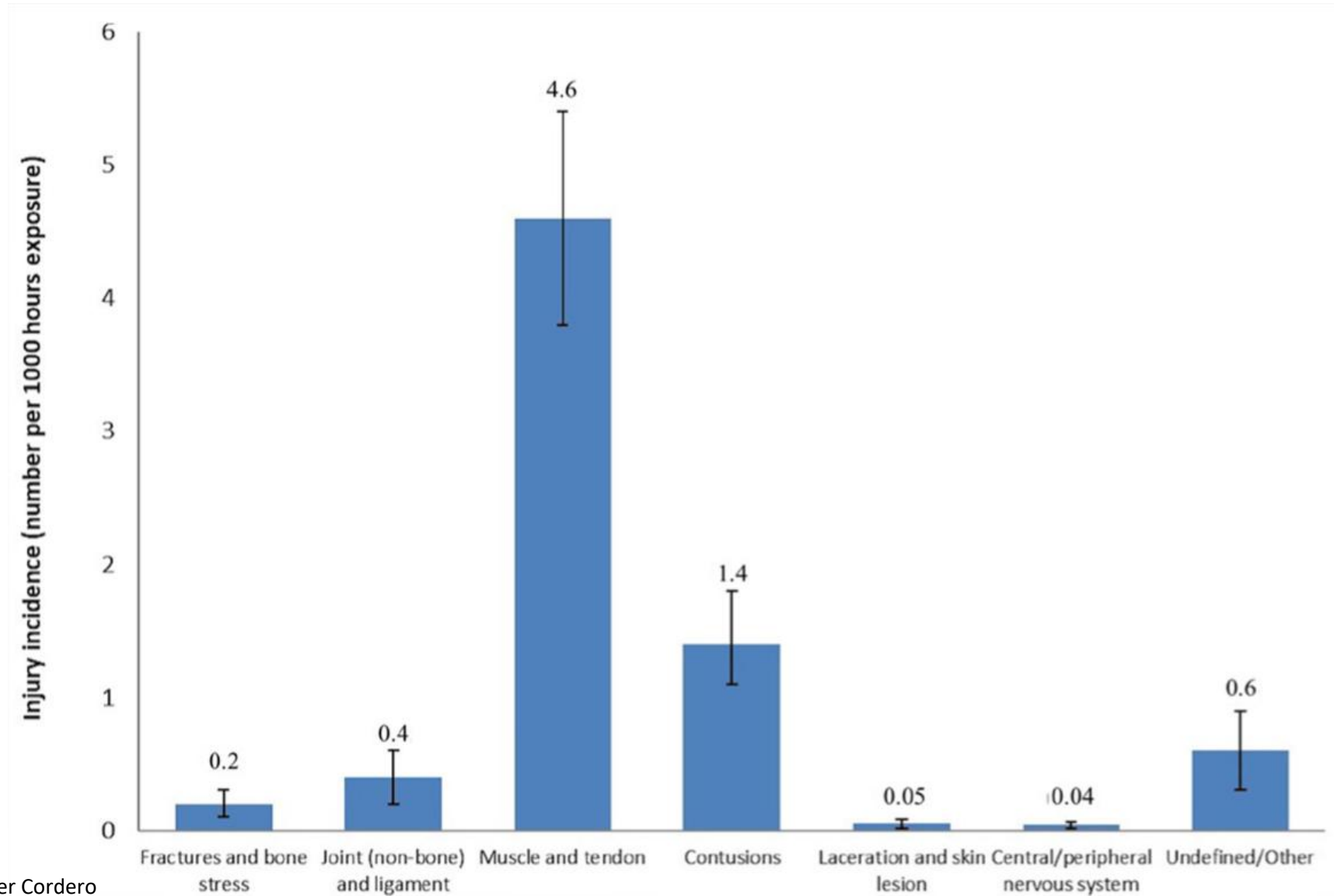
-*Disease* prevention, understood as specific, population based and individual-based interventions for primary and secondary prevention, aiming to minimize the burden of diseases and associated risk factors. (WHO, 1998).

SYSTEMATIC APPROACH

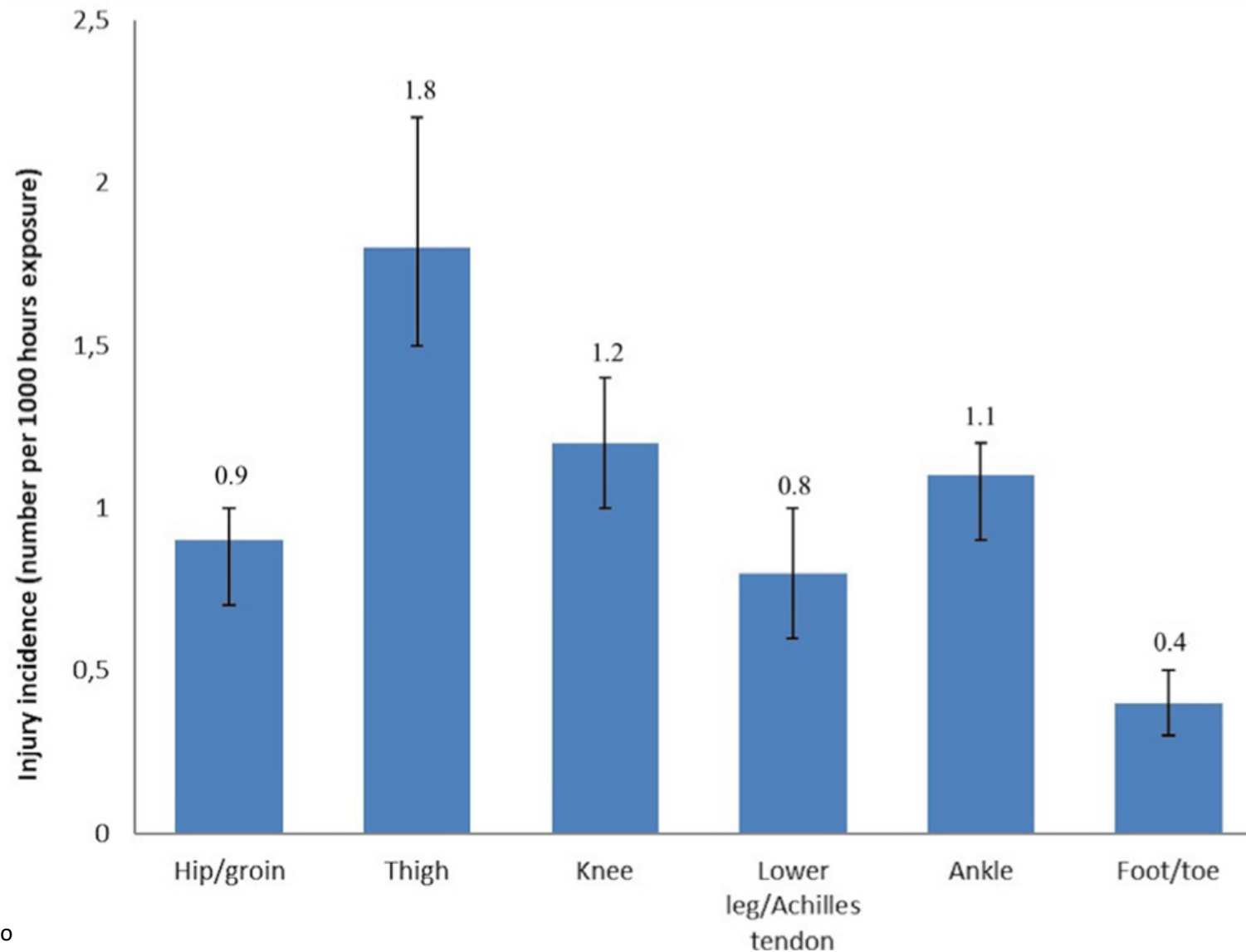


Injury Prevention Model as described by
Van Mechelen

EPIDEMIOLOGY PRO FOOTBALL



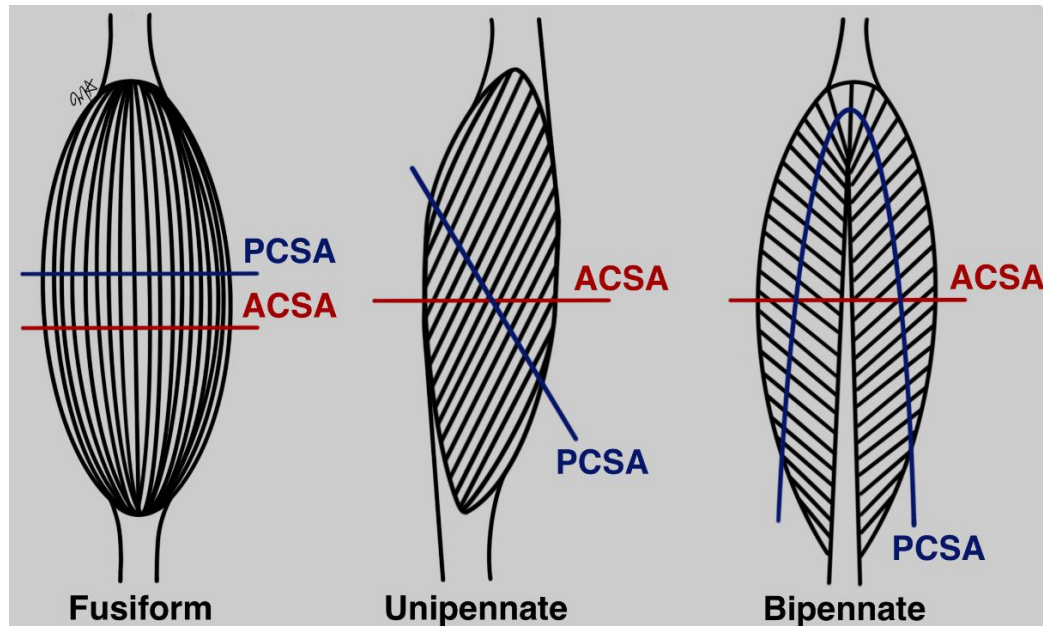
EPIDEMIOLOGY PRO FOOTBALL



CONCLUSIONS

1. A squad of 25 players can thus expect about 15 muscle injuries per season.
2. **Muscle injuries** constituted **31%** of all injuries.
3. **Muscle injuries** caused **27%** of the **total injury absence**.
4. 92% of all muscle injuries affected the 4 major muscle groups of the lower limbs:
 - **hamstrings (37%)**
 - **adductors (23%)**
 - **quadriceps (19%)**
 - **calf muscles (13%)**
5. **16%** of the **muscle injuries** were **reinjuries**.

BIOMECHANIC



Muscle contraction Type:

- High speed [M] – tendency of shortness (> fibers rotation)
- High Force and low speed [M] – tendency of stretching (< fibers rotation and < m. shortness)
- Ecc [M] – Stretch of the UMT

SYSTEMATIC APPROACH

- Affected structure (amount of connective tissue affected):

- Injured Muscle
- Tendon/Aponeurosis
- Myotendinous junction/Musculotendinous
- Intramuscular
- Myofascial (peripheral)

Role of the Extracellular Matrix in Muscle Injuries

Histoarchitectural Considerations for Muscle Injuries
Ramon Balius,^{*†} MD, PhD, Xavier Alomar,[‡] MD, PhD, Carles Pedret,^{†§||} MD, PhD, Marc Blasi,^{¶#},
Gil Rodas,^{**} MD, PhD, Ricard Pruna,^{**} MD, PhD, Jose Peña-Amaro,^{††} MD, PhD,
and Tomás Fernández-Jaén,^{‡‡} MD, PhD

A Histoarchitectural Approach to Skeletal Muscle Injury

Searching for a Common Nomenclature

Study Group of the Muscle and Tendon System from the Spanish Society of Sports
Traumatology^{*†}

Is It All About the Fascia?

A Systematic Review and Meta-analysis of the Prevalence of Extramuscular Connective Tissue Lesions in Muscle Strain Injury

Jan Wilke,^{*†} PhD, Luiz Hespanhol,^{‡§||} PhD, and Martin Behrens,[¶] PhD
Investigation performed at the Department of Sports Medicine,
Goethe University Frankfurt, Frankfurt/Main, Germany

SYSTEMATIC APPROACH

- Structure affected and amount of damage:



SYSTEMATIC APPROACH

- **Injury mechanism:**

- Sprinting (stance, take off, inicial swing, med swing, terminal swing):
- Ball Kick (Back swing, Wind-up, Ball contact)
- Change direction
- Direct contact

DIAGNOSIS

First approach using the US classification that Peetrans suggest:

GRADE	ULTRASONOGRAPHY
	Peetrans (2002)²²
0	Lack of any ultrasonic lesion
I	Minimal elongations with less than 5% of muscle involved. These lesions can be quite long in the muscle axis being usually very small on cross-sectional diameter (from 2 mm to 1 cm maximum)
II	Partial muscle uptures; lesions involving from 5 to 50% of the muscle volume or cross-sectionaldiameter. The patient often experiences a "snap" followed by a sudden onset of localized pain. Hypo-and/or anechoic gap within the muscle fibers
III	Muscle tears with complete retraction.

CLASSIFICATIONS

- According THE LONDON INTERNATIONAL CONSENSUS and DELPHY STUDY on Hamstrings Injuries (2023):
- Most commonly, experts used the ***British Athletics Muscle Injury Classification*** (**BAMIC - 2015**) : **58%**
- Followed by: **Munich Consensus - 2012** : **12%**
- And the last: **Barcelona - 2017** : **6%**

INTERNATIONAL CLASSIFICATION:

MUNICH CONSENSUS STATEMENT: CLASSIFICATION OF ACUTE MUSCLE DISORDERS AND INJURIES

INDIRECT MUSCLE DISORDER/INJURY:

DIRECT MUSCLE INJURY:

FUNCTIONAL MUSCLE DISORDER

Type 1 Overexertion-related muscle disorder

Contusion

Type 1A: Fatigue-induced muscle disorder

Type 1B: Delayed-onset muscle soreness (DOMS)

Type 2 Neuromuscular muscle disorder

Type 2A: Spine-related neuromuscular Muscle disorder

Type 2B: Muscle-related neuromuscular Muscle disorder

STRUCTURAL MUSCLE INJURY

Laceration

Type 3 Partial muscle tear

Type 3A: Minor partial muscle tear

Type 3B: Moderate partial muscle tear

Type 4 (Sub)total tear Subtotal or complete muscle tear

Tendinous avulsion

INTERNATIONAL CLASSIFICATION:

BRITISH ATHLETICS MUSCLE INJURY CLASSIFICATION

GRADING	ANATOMICAL SITE	COMBINED CLASSIFICATION
Grade 0: Negative MRI	a. Myofascial	0a: MRI normal
	b. Musculotendinous	0b: MRI normal or patchy HSC throughout one or more muscles.
Grade 1: "Small injuries (tears) to the muscle"	c. Intratendinous	1a: HSC evident at the fascial border <10% extension into muscle belly. HSC of CC length <5 cm. 1b: HSC <10% of CSA of muscle the MTJ. HSC of CC length <5 cm (may note fibre disruption of <1 cm).
Grade 2: "Moderate injuries (tear) to the muscle"		2a: HSC evident at fascial border with extension into the muscle. HSC CSA of between 10%-50% at maximal site. HSC of CC length >5 and <15 cm. Architectural fibre disruption usually noted <5 cm. 2b: HSC evident at the MTJ. HSC CSA of between 10%-50% at maximal site. HSC of CC length >5 and <15 cm. Architectural fibre disruption usually noted <5 cm.
Grade 3: "Extensive tears to the muscle"		2c: HSC extends into the tendon with longitudinal length of tendon involvement <5 cm. CSA of tendon involvement <50% of maximal tendon CSA. No loss of tension or discontinuity within the tendon.
Grade 4: "Complete tears to either the muscle or tendon"		3a: HSC evident at fascial border with extension into the muscle. HSC CSA of >50% at maximal site. HSC of CC length of >15 cm. Architectural fibre disruption usually noted >5 cm 3b: HSC CSA >50% at maximal site. HSC of CC length >15 cm. Architectural fibre disruption usually noted >5 cm 3c: HSC extends into the tendon. Longitudinal length of tendon involvement >5 cm. CSA of tendon involvement >50% of maximal tendon CSA. May be loss of tendon tension, although no discontinuity is evident 4: Complete discontinuity of the muscle with retraction 4c: Complete discontinuity of the tendon with retraction

DIRECT MUSCLE INJURY

GRADE	ACTIVE KNEE FLEXION (°)	GAIT PATTERN	TYPICAL PRESENTATION
MILD (Grade I)	<90°	Normal	May or may not remember incident Can usually continue activity Sore after cooling down or next morning Minimal pain w/resisted knee straightening Might be tender with palpation Full prone ROM +/- Effusion +/- Increased thigh circumference
Moderate (Grade II)	45-90°	Antalgic (slight limp)	Usually remembers incident, but can continue activity, although may stiffen up with rest (half-time or full-time) Mild/moderate swelling Pain w/palpation Pain w/resisted knee straightening Limited ROM +/- Effusion +/- Increased thigh circumference
Severe (Grade III)	>45°	Severe limp	Usually remembers incident. Assisted ambulation, difficulty with full weight-bearing Severe pain Immediate swelling/bleeding Pain with static contraction +/- Bulge in the muscle +/- Increased thigh circumference

Con- tusion	Direct injury	Direct muscle trauma, by blunt external force, leading to diffuse or circumscribed intramuscular hematoma leading to pain and loss of motion	Dull pain, possibly increasing due to hematoma.	Dull/diffuse pain, swelling, decreased ROM, tenderness to palpation, athlete may continue activity	Any muscle, mostly vastus intermedius and rectus femoris	Diffuse or circumscribed hematoma in varying dimensions, potentially more than one muscle	2-3 weeks (highly variable)
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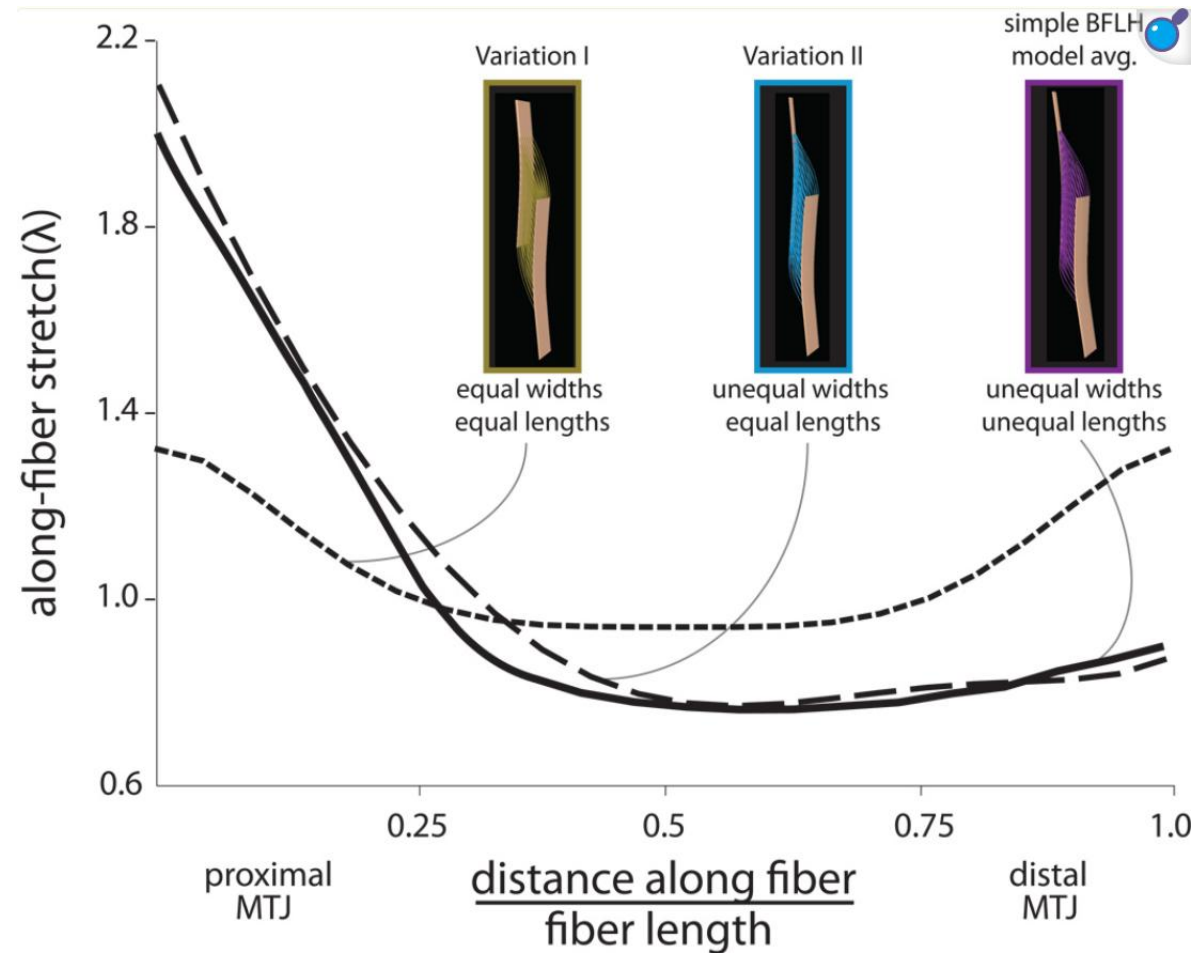
RISK FACTORS

- *Age* (increase 1,78 the probability of Injury per year)
- Capacity condition → Fatigue
- Flexibility → Mobility
- Strength Deficits
- *Old muscle Injuries.* (Increase from 2-6 times more the risk to get reinjured)
- Inadequate Warm up
- Early RTP
- Sleep quality



RISK FACTORS

The width and the length of the aponeurosis, predict changes on the stretch distributions.



RISK FACTORS

Biceps Femoris Aponeurosis Size: A Potential Risk Factor for Strain Injury?

Pavlos E Evangelidis ¹, Garry J Massey, Matthew T G Pain, Jonathan P Folland

Conclusion

BFlh proximal aponeurosis size exhibits high variability between healthy young men, and it was not related to BFlh muscle size or knee flexor strength. Individuals with a relatively small aponeurosis may be at increased risk of hamstring strain injury.

PREVENTIVE MEASURES:

- Basic endurance & resistance Training.
- Individual Prevention plans for muscular imbalances:

Example:

- ADD:ABD Ratios $<0.9 \rightarrow$ Risk (forceframe)
- HQ Ratio $\pm 60\%$ normal in football (isokinetic)

- Apply Mobility sessions to work of ROM deficits:

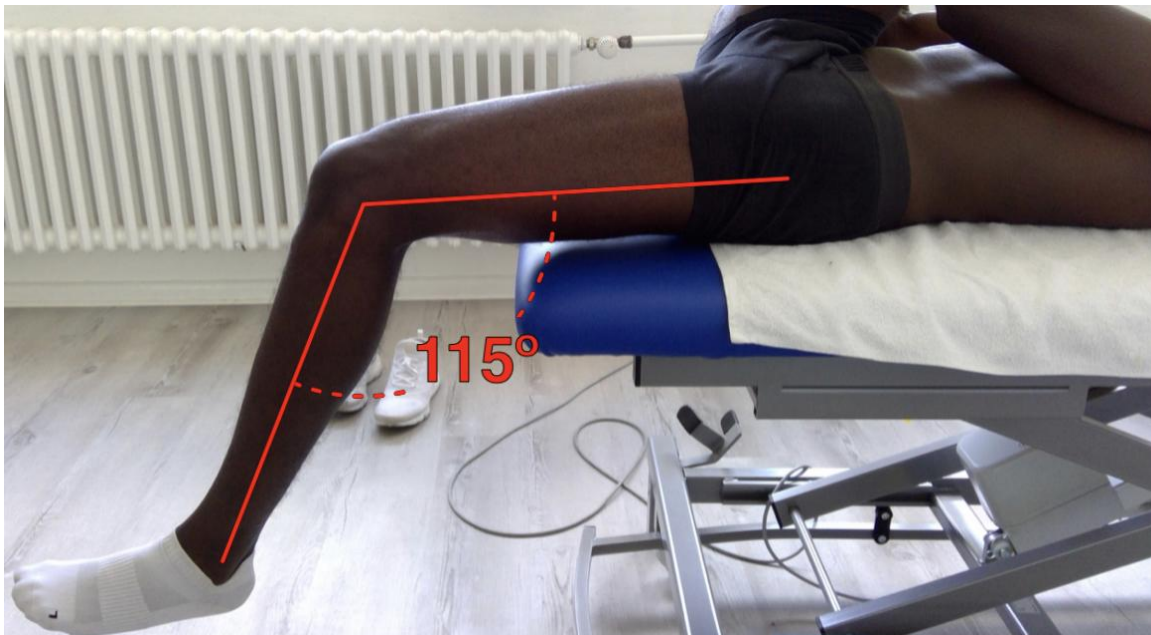
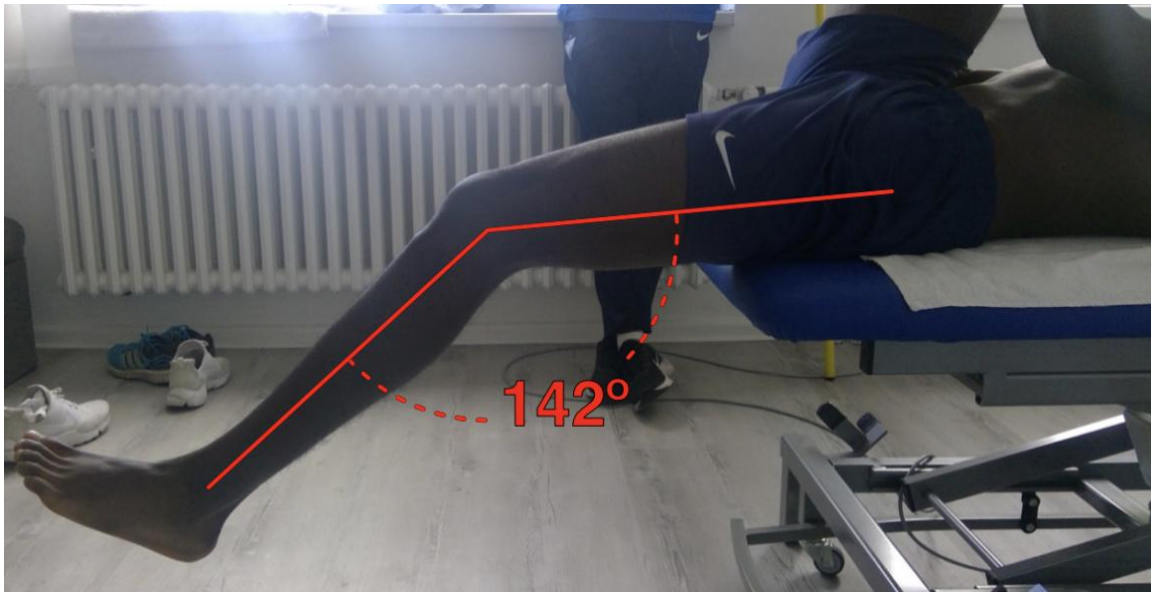
Example:

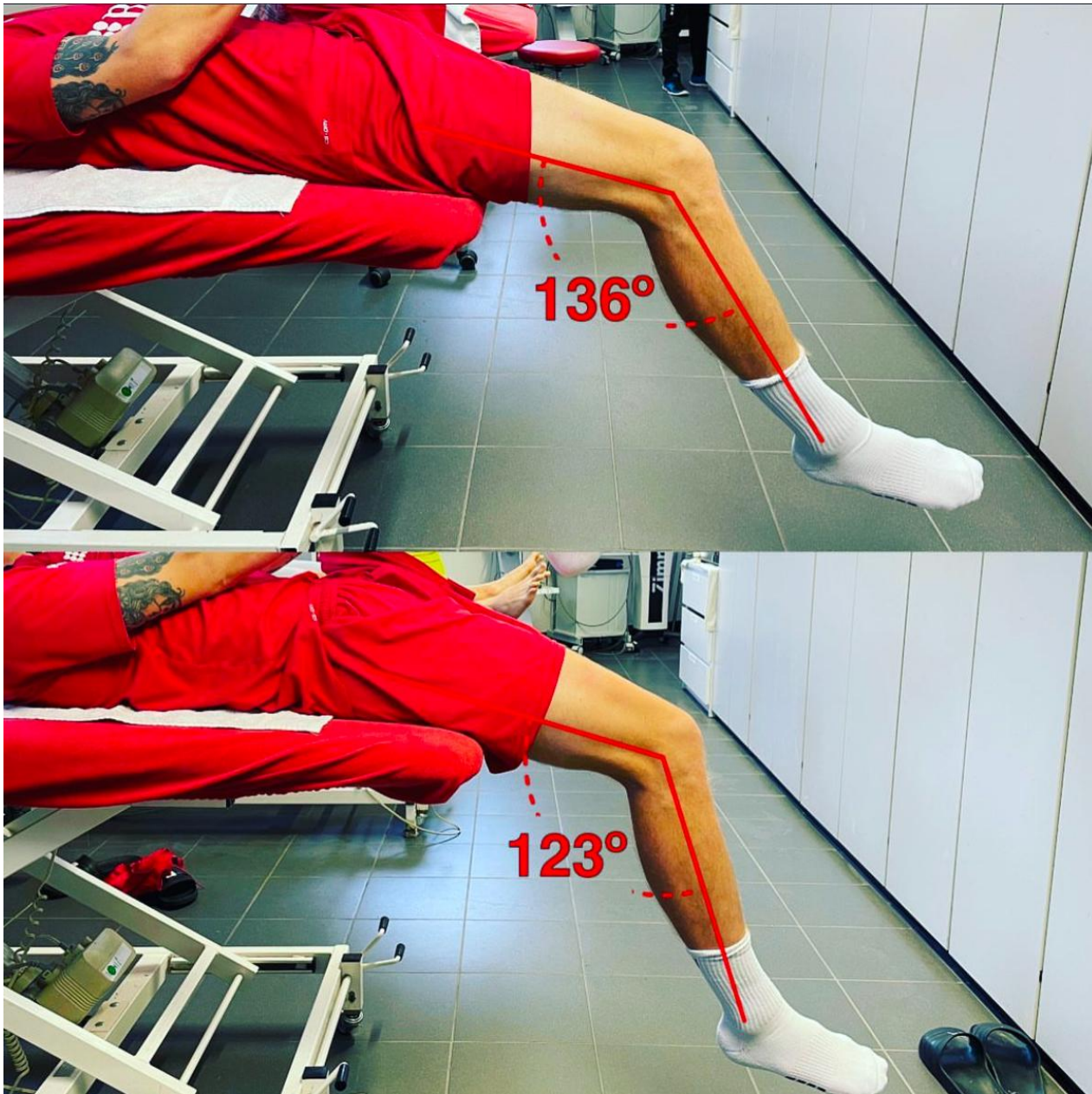
- ASLR; for each degree of mobility loss the likelihood of injury increased by 1.29.

- Strength Training.
- Plyometrics \rightarrow Neuroreactivity RFD

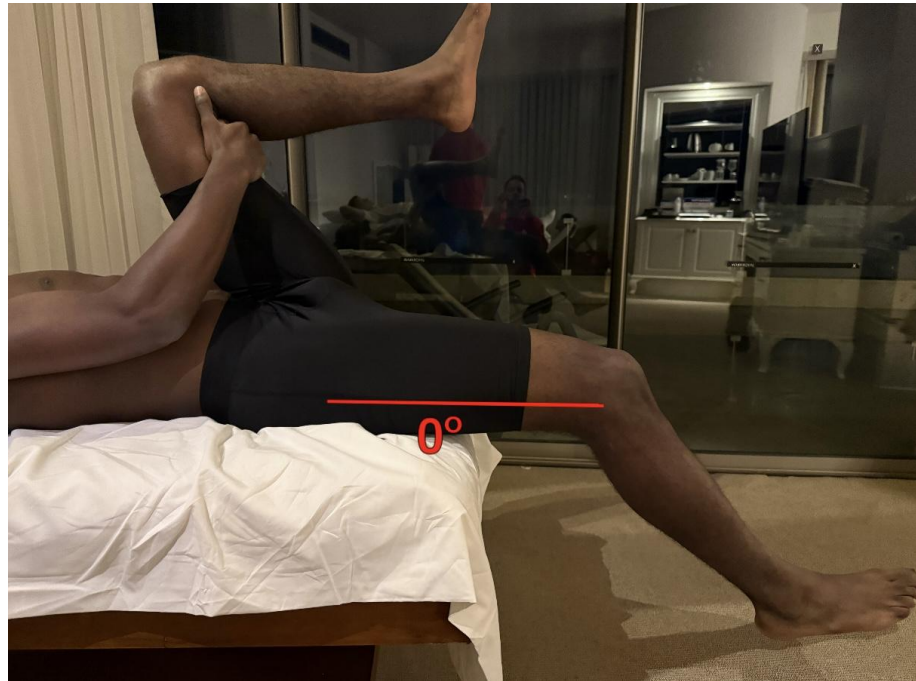
SYSTEMATIC APPROACH:

4. **Record** data to find correlations & asses effectiveness.









WHAT IS PREVENTION...?

CAN WE REALLY PREVENT
INJURIES...?

ULTRASOUND TRAINING:

- **Identification of the 4 muscle groups of the lower limb:**
 - *Hamstrings. (ST (RAPHE), SM, BF_{lh}, BF_{sh})*
 - *RF (CT)*
 - *ADD (CT)*
 - *Gastrocnemius & Soleus (MA, CT, LA) & Pennation angle.*
- **Dynamic US Testing. (Ciatic Nerv. Glide)**

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