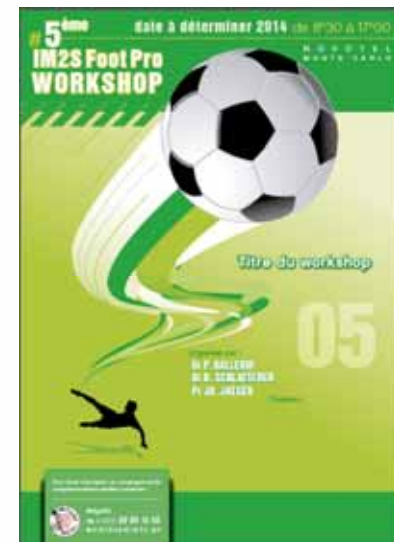


Tendinopathies around foot and ankle

- M Maestro,
- Y Tourné ,J Cazal
- ,B Schlaterer, B Ferré,
- J M Parisaux, P Ballerio



22 nov 2014 Novotel Monaco

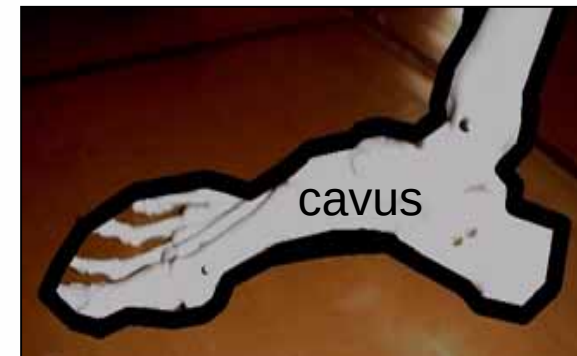
28 muscles – 33 articulations

EVERSION



STABLE

INVERSION

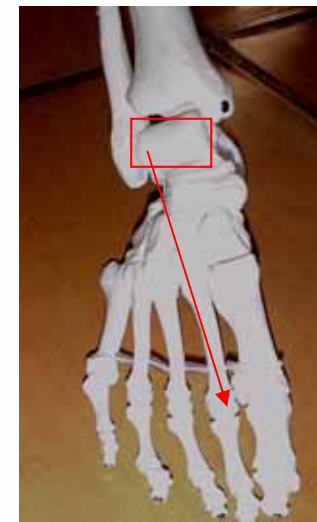


FLEXIBLE

VISCO-ELASTIC STRUCTURE



Stocking



Distribution

ENERGY

pied= COMPLEXITE STRUCTURELLE

Paquets vasculo-nerveux

Muscle

Sd de loge chron.

Tendon → tendinopathies

Jonction myo-tendineuse

Gaine

Zone moyenne
hypovasculaire

Poulie fibreuse

Tunnel ostéo-fibreux

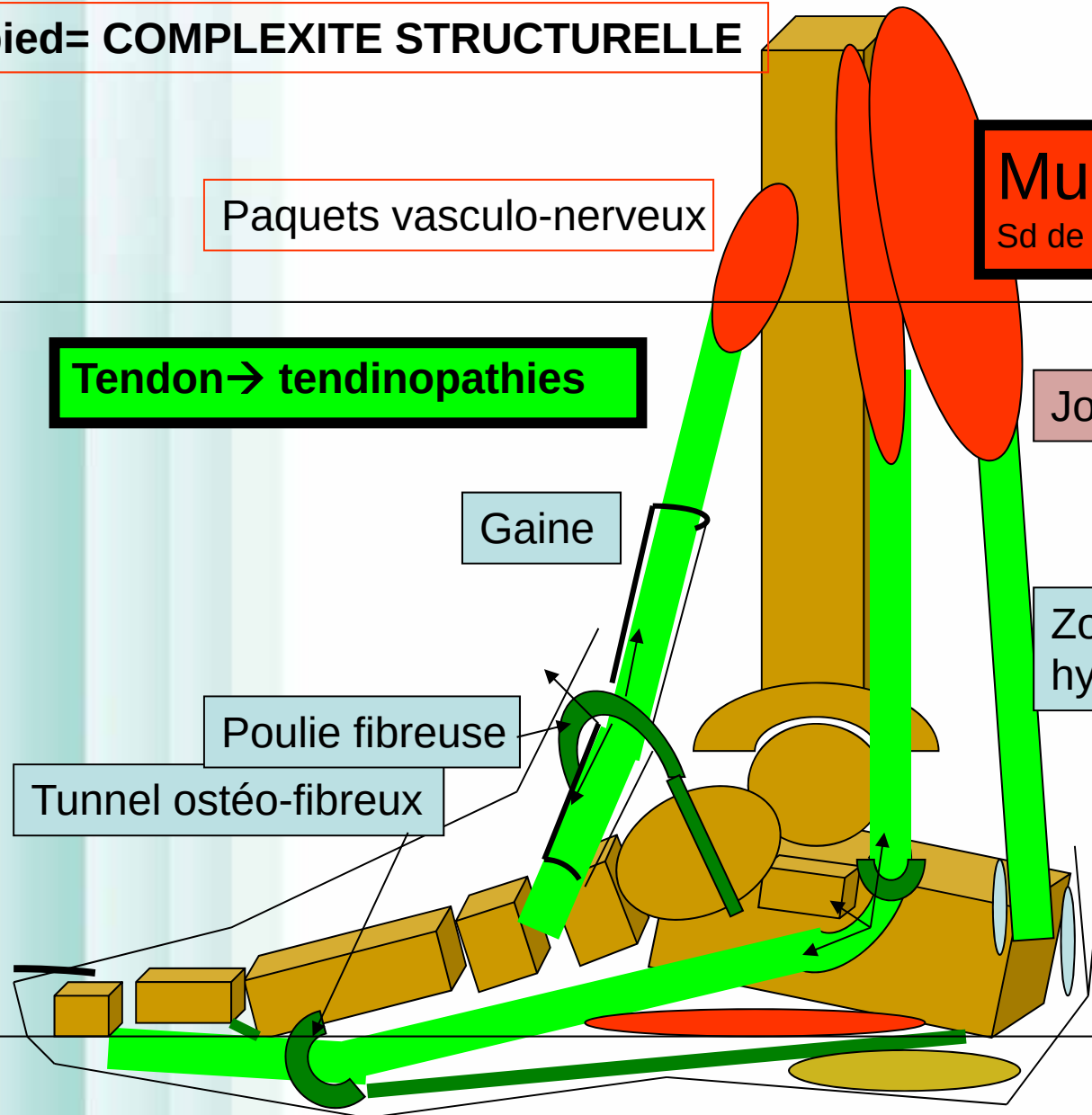
**Insertion osseuse
enthésopathies**

Os et articulations

aponévroses

Peau, ongle, bourses
séreuses

Capiton
graisseux



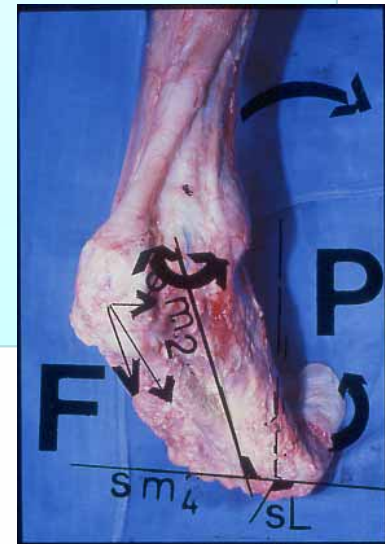
Tendon function is complex

Main function :

- **muscle force transmission,**

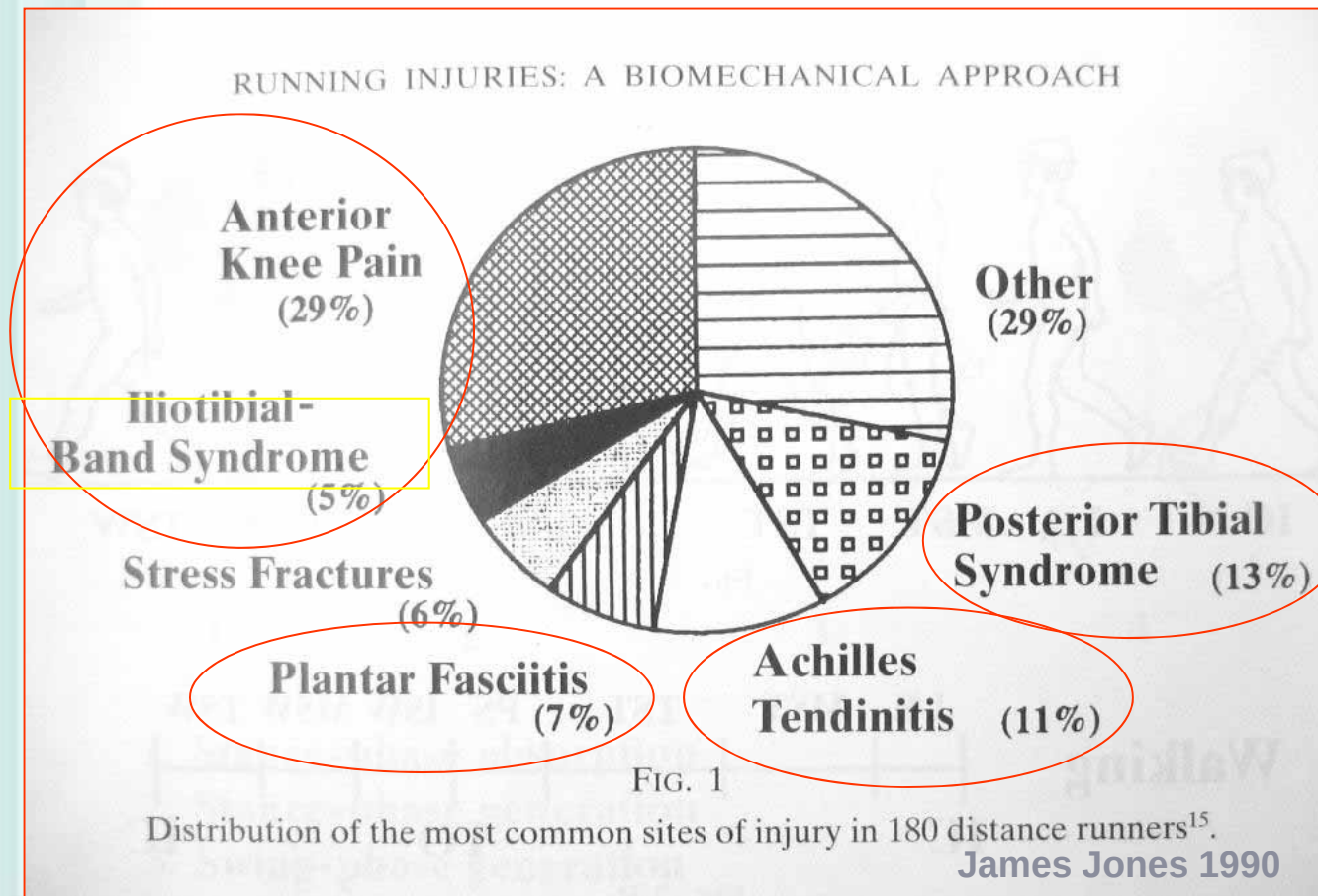
Others properties :

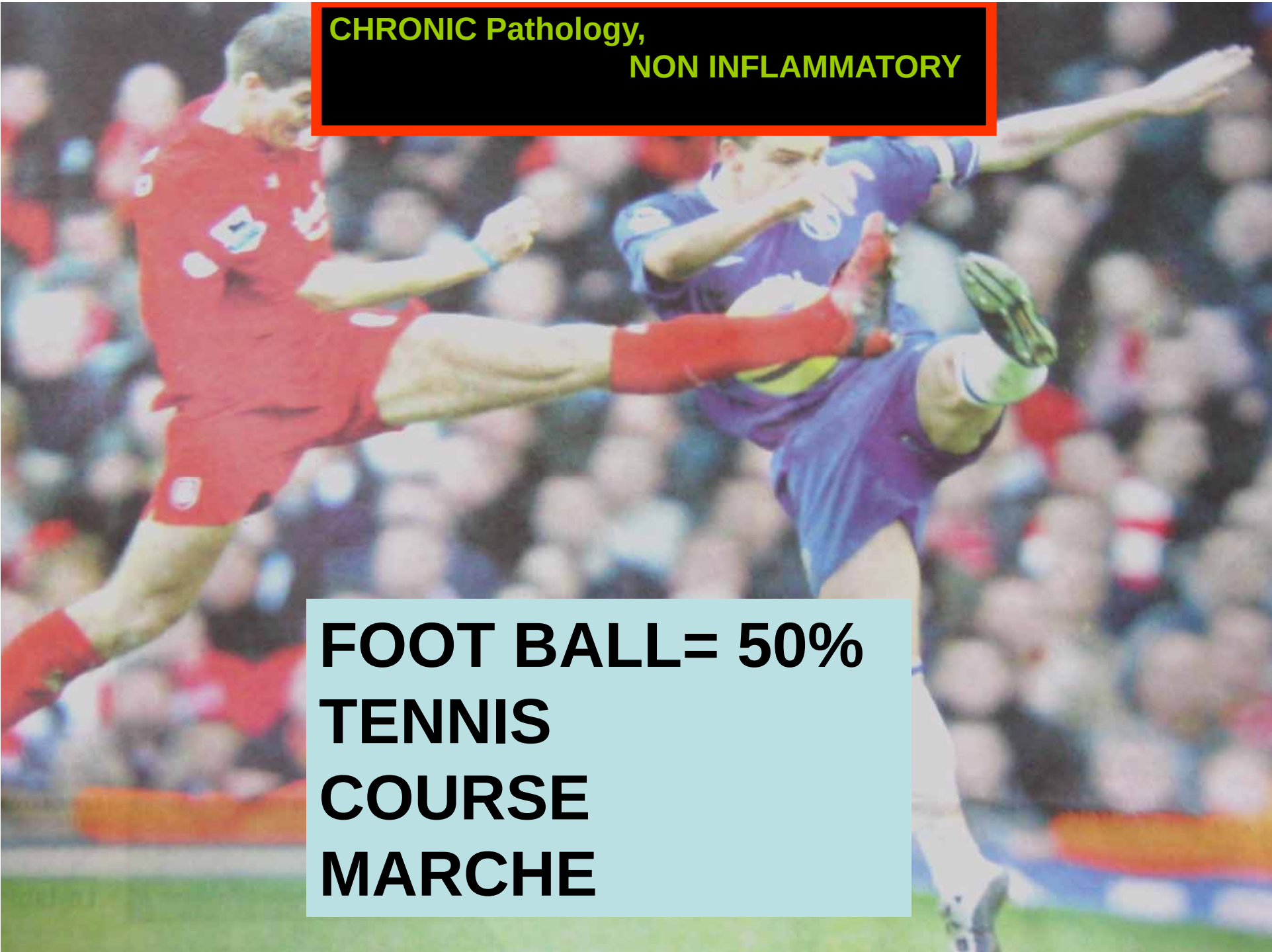
- - Force dissipating;
- - Elastic energy storing;
- - Viscoelasticity (protect the muscle);
- - Stabilizing effect of the joints
- - Articulating surface.



aponeurosis and tendons = 2/3 of lesions

30 to 50% of all sports injury
Renstrom 1991

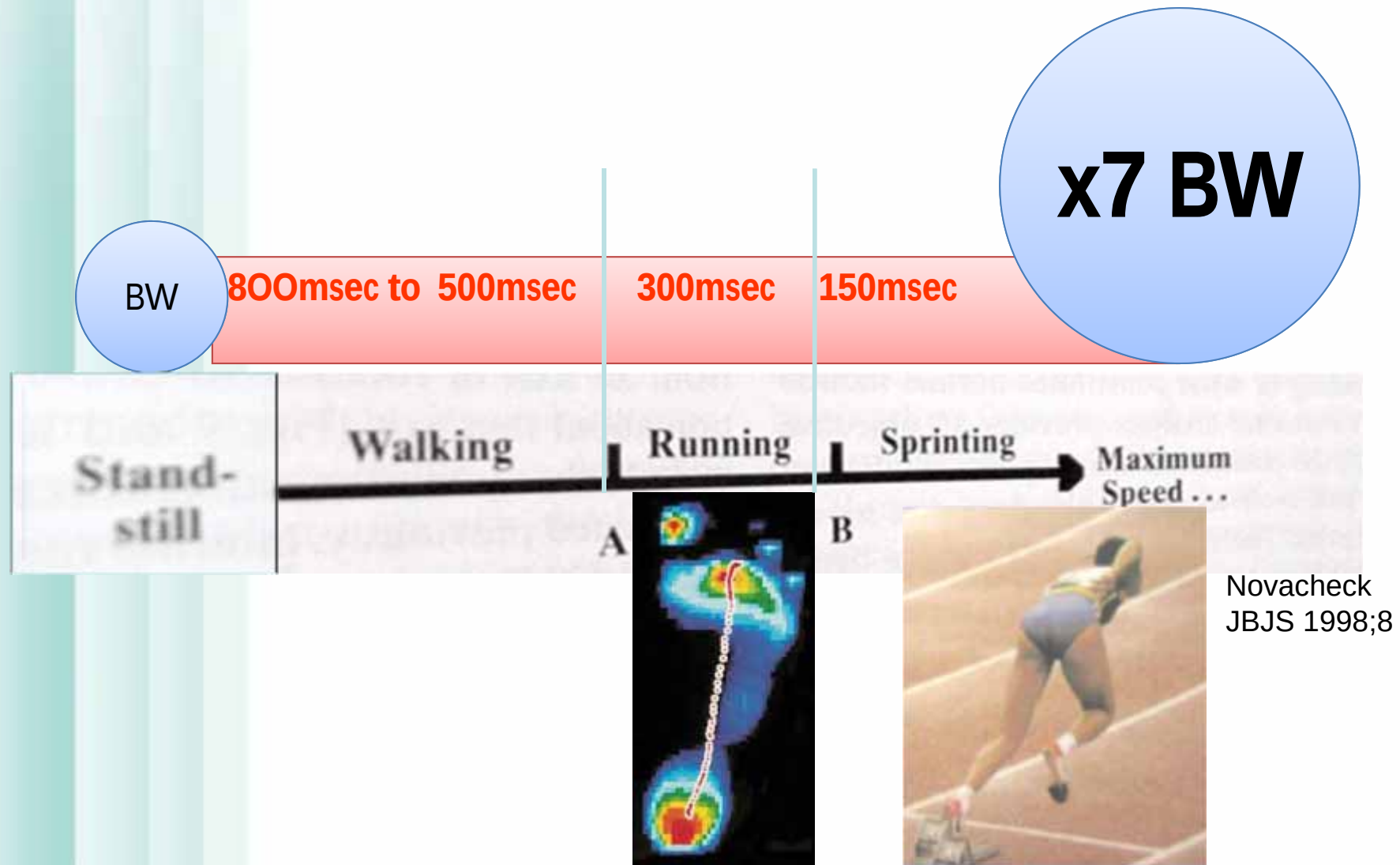


A photograph of two soccer players in mid-air during a match. The player on the left is wearing a red jersey and red shorts, and the player on the right is wearing a blue jersey and blue shorts. They are both reaching for a yellow and green soccer ball. The background is a blurred crowd of spectators.

**CHRONIC Pathology,
NON INFLAMMATORY**

**FOOT BALL= 50%
TENNIS
COURSE
MARCHE**

Speed increases forces , load and ROM



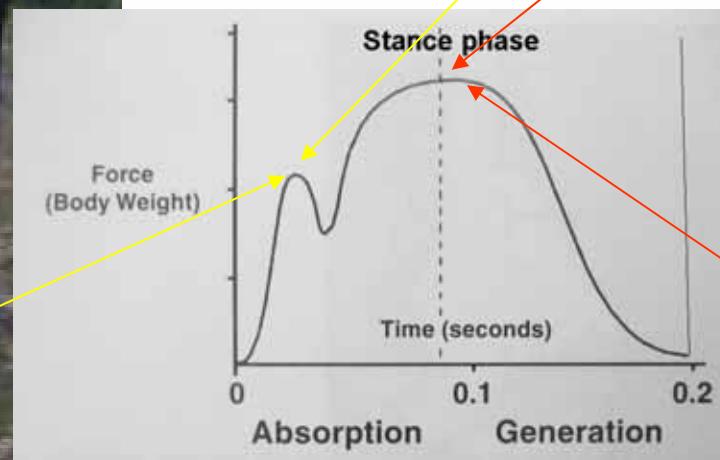
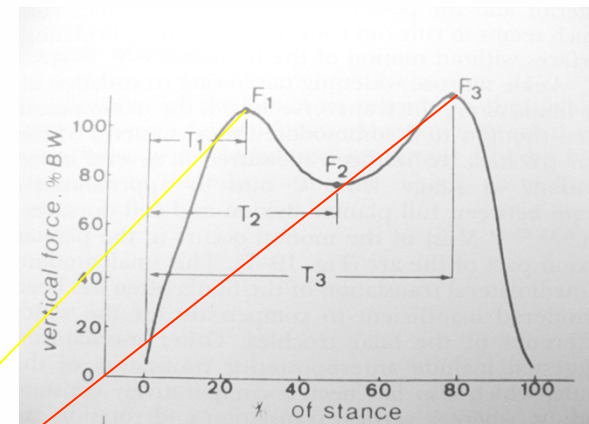
Tendon become stiffer under high stresses in order to absorb energy

Harmfull forces
are not during heel strike,
but just after **during loading response and midstance**



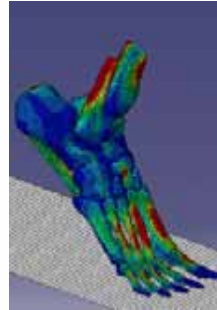
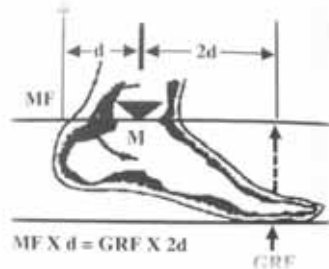
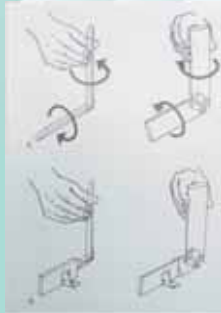
gait

running



Une autre vision de la biomécanique

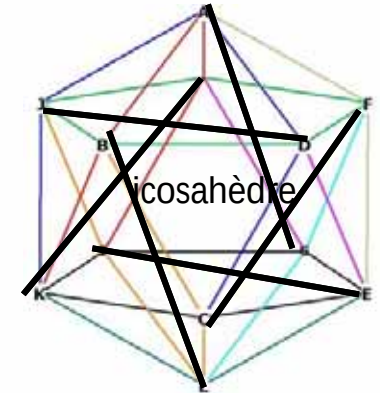
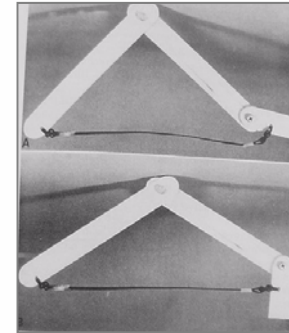
Mécanique des axes et leviers



- Linéaire (retour à zéro)
- Structure discontinue
- Dépendant de la gravité
- Unidirectionnel
- Haute énergie
- Articulation à axe fixe

Biotenségrité

Les os ne se touchent jamais
Ils sont en suspension dans les fascia en assurant leur mise en tension

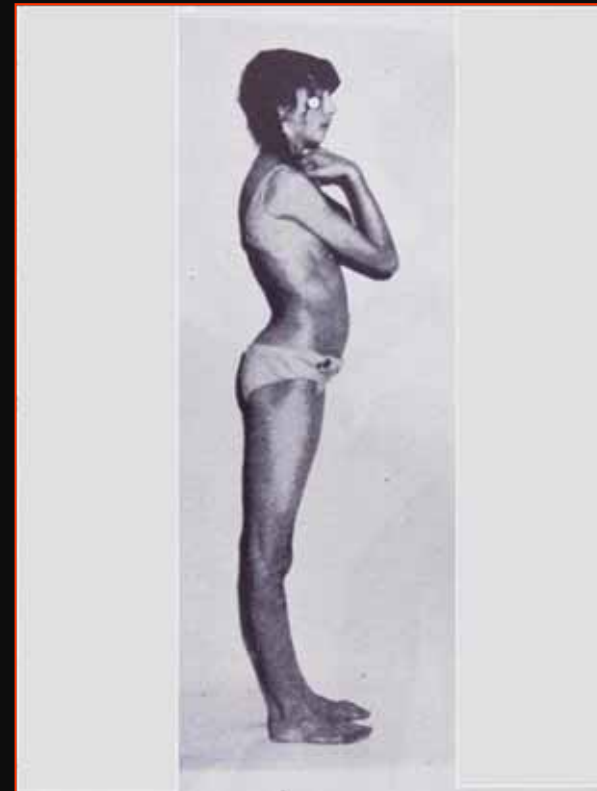


- Non linéaire (tjs sous tension)
- Structure continue
- Indépendant de la gravité
- Pluridirectionnel
- Basse énergie
- Articulations axes évolutifs

Tenségrité= déformabilité sous la
contrainte



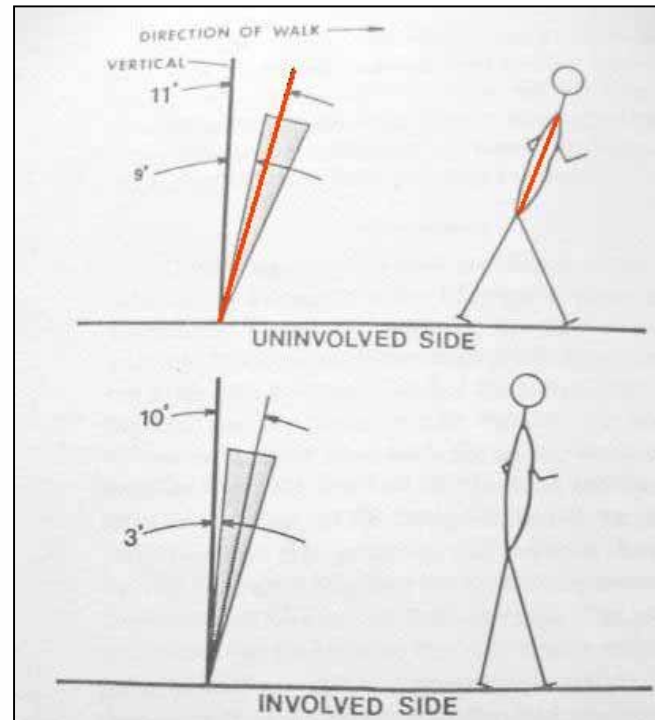
the loss of tensegrity balance
= less deformability
over stressed structures

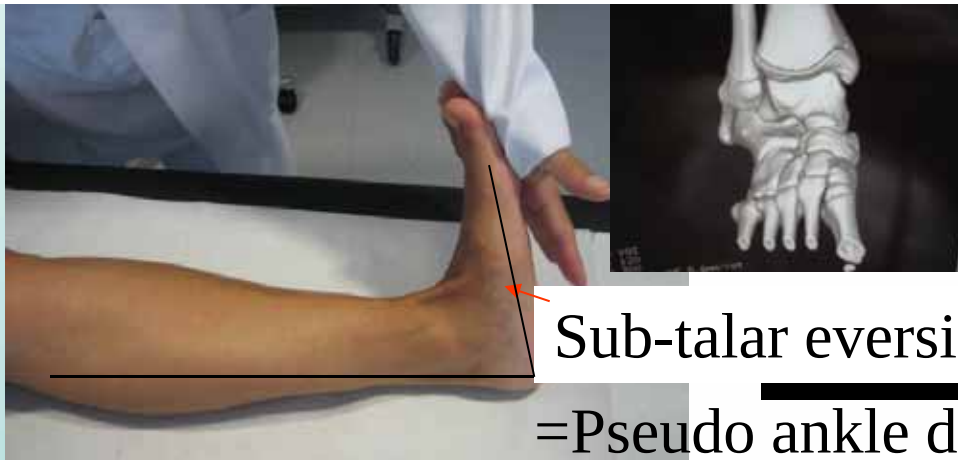


Pe: gastrocnemius tightness

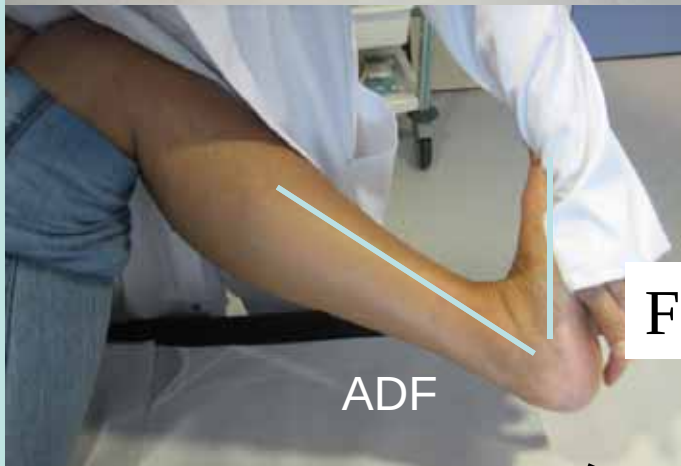


Enability or difficulties for bare foot walking
Lack of endurance
Difficulties of climbing speed
Difficulties to run or accelerate, to jump
Veinous problems

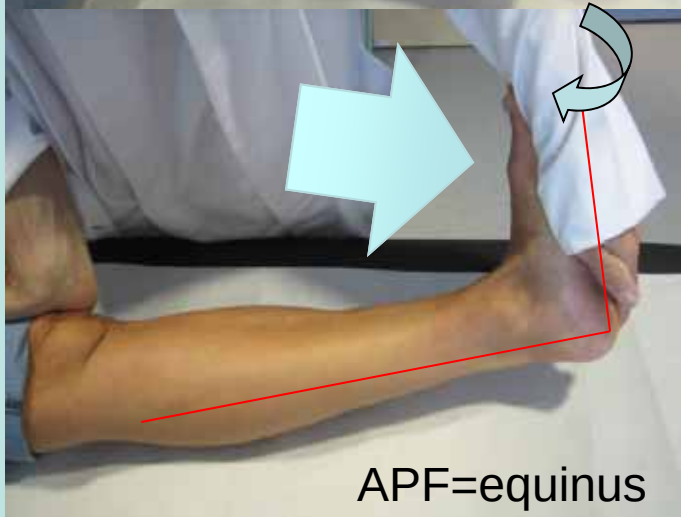




Sub-talar joint movement
Masks the gastrocnemius
Equinus



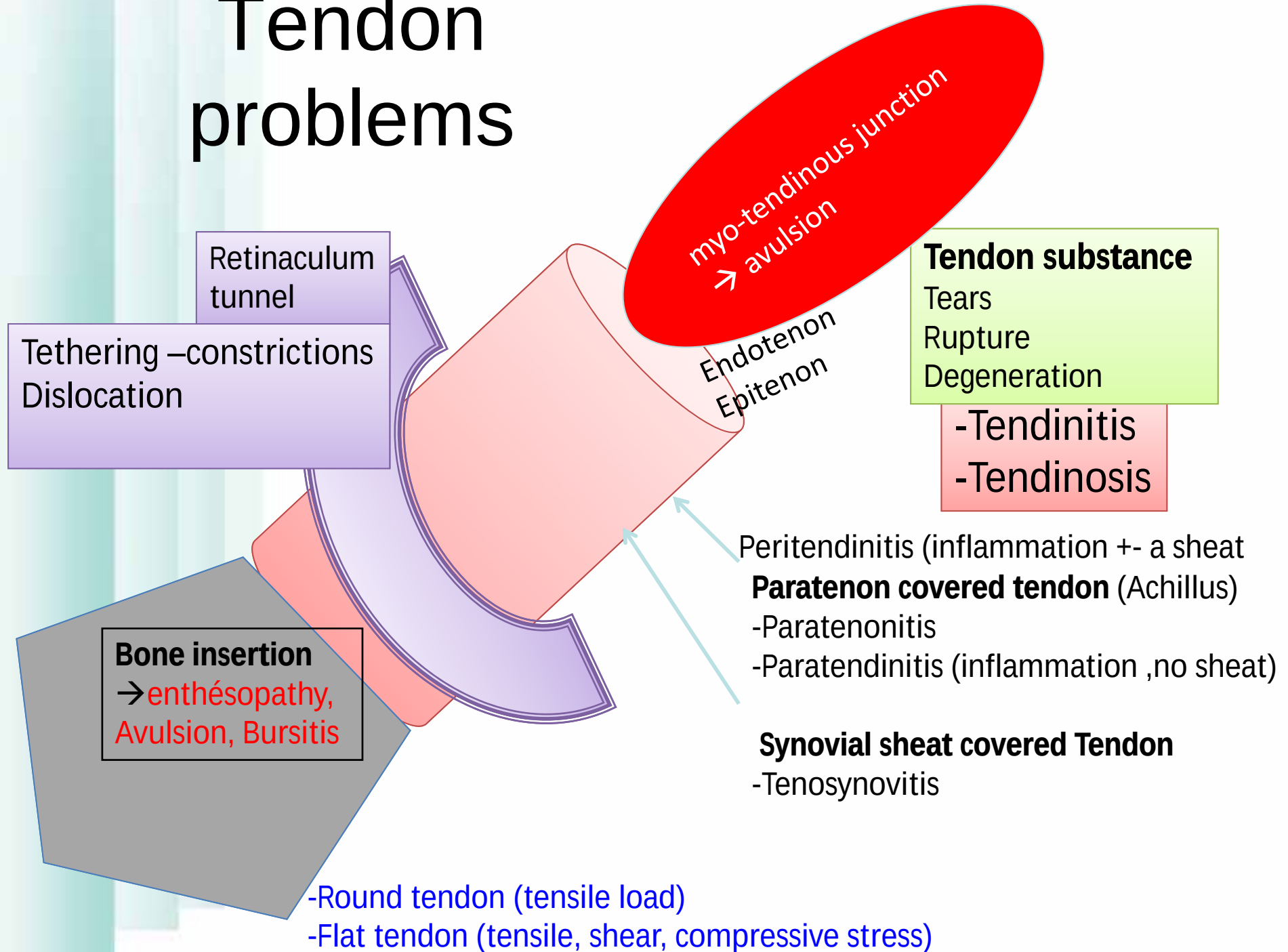
Flexed knee



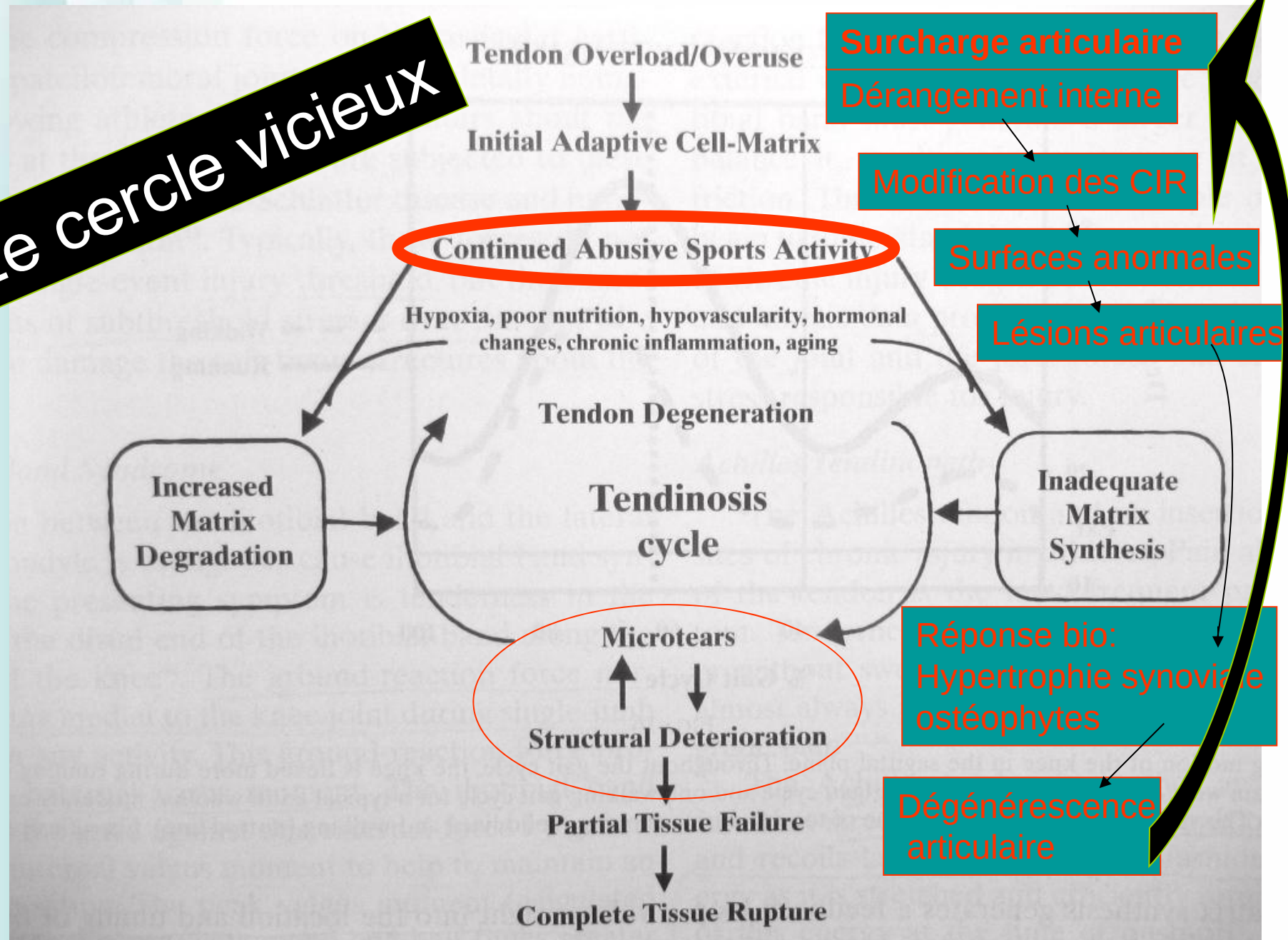
Extended knee
Stretch the inverted foot



Tendon problems



Le cercle vicieux



Leadbetter 1992, Novacheck 1998

Frankel 1971



overuse

- **TENDINOSIS**
- degenerative process
- **absence of inflammatory cells,**
- fibers desorientation
- collagene degeneration,
- hypercellularity and vascular nerve ingrowth

Non symptomatic-

Ethiologic factors

Imbalance

Excess of contrains: extrinsic F

- **Training errors**
- **Ground structure (hard)**
- **Shoes** (pronation control)
- **Iatrogenic**
(fluoroquinolones
steroids ...)

Tendon weakness: intrinsic F

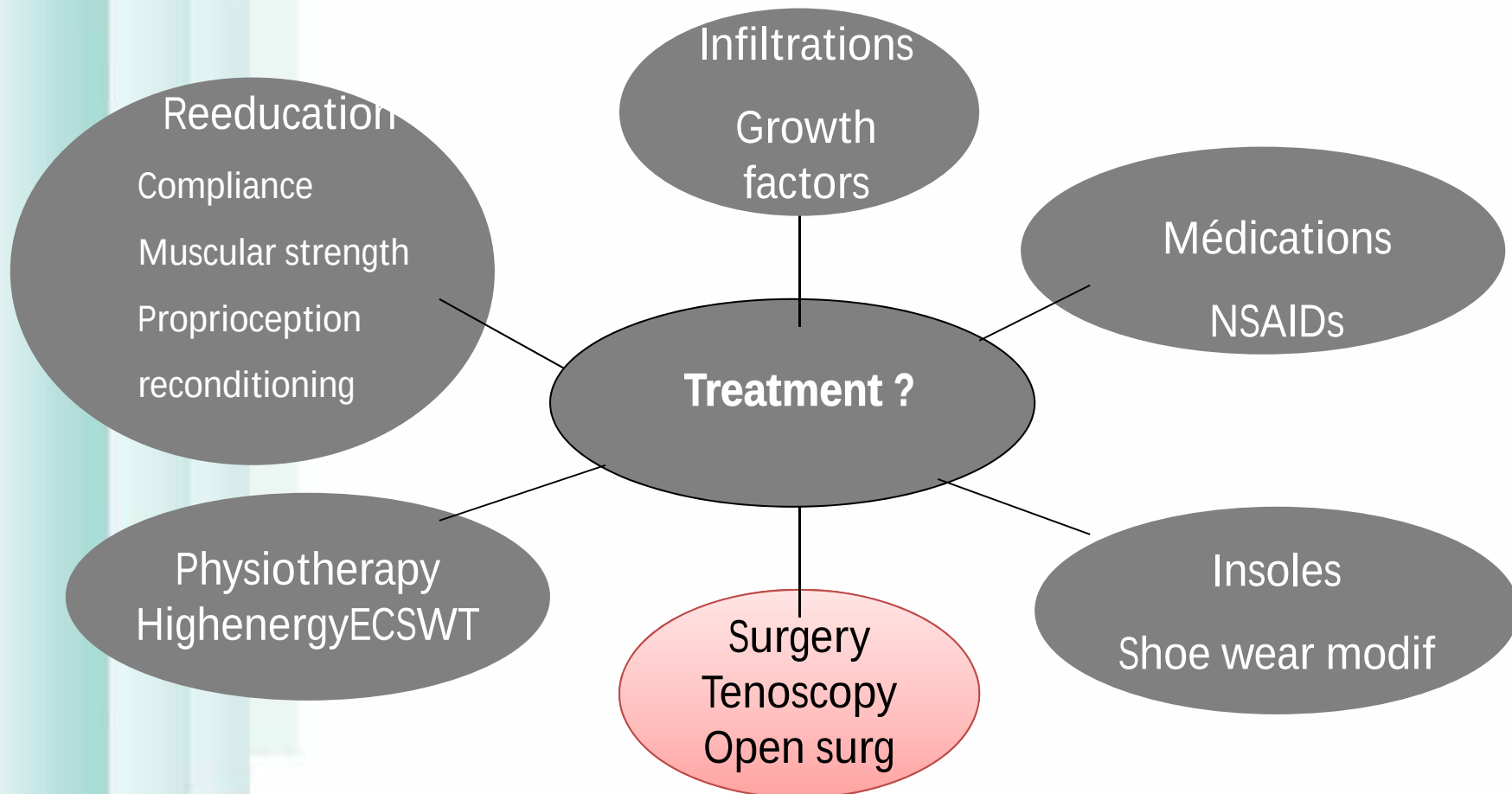
- **Age, weight**
- **Compliance and length**
- **Anatomical particularities**
- **Lower extremity malalignment**
- **Leg length discrepancy**
- **Metabolic factors** (ph, H₂O)
- **Fatigue, muscular weakness**

Combination of extrinsic and intrinsic factors

Tendinopathy

Their treatment are challenging problems

Careful evaluation prior to embarking on a specific treatment



1970's
immobility



1990's
active approach



No study to date provide
Consensus Treatment trend

Healing process: Inflammatory—Proliferative (fibroblastic)--Remodeling

Clinical assessments

➤ patient history

- Sprain
- Injuries
- swelling
- fluoroquinolones abs

➤ physical examination

- Joint laxity
- provocative pain maneuver
- Loss of power

Imaging assessments

➤ conventional X-Rays of foot and ankle

- in WB position and bilateral
- AP, lateral and AP oblique views: achitecture,, avulsion fractures...
- Meary's view
- stress views

➤ MRI: *modality of choice*

- multiplanar imaging
- + soft and bone tissues
 - cartilage

➤ US

- competitive for tendons
- but operator-dependent

➤ CT scan

- choice for ankle laxity : lig & cartilage damages, associated tears of PT
- limited use with teno-sheath injection

Tibialis Anterior

➤ Insertional tendinopathy

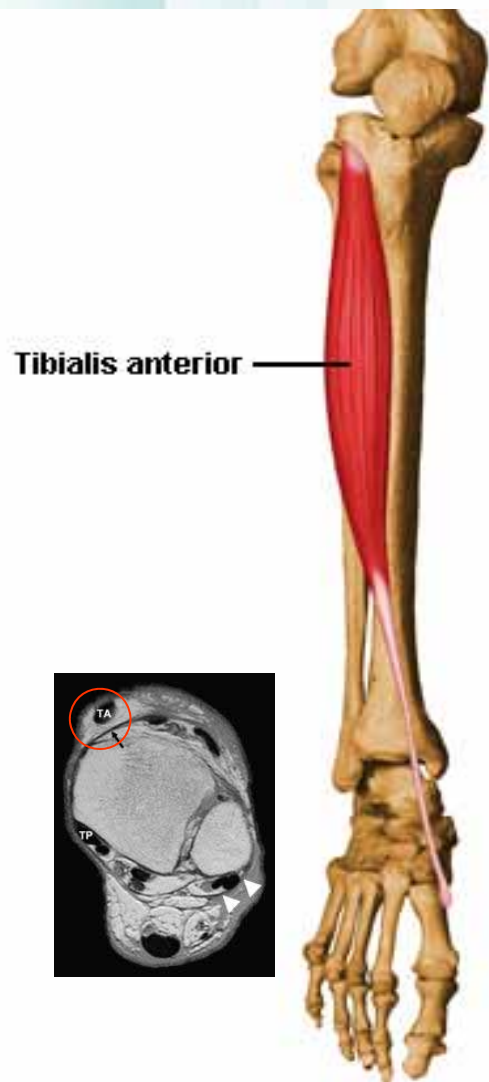
- Sports with pulse (danse, ballet, jump, skating...)
- medial cuneiform pain
- gait abnormality (heel strike-initial loading, swing)
- Pain with passive stretching+isometric contraction

➤ Spontaneous rupture

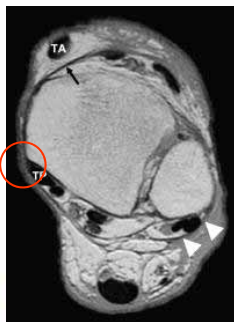
- **rare**, aging
- Foot drop

➤ Tenosynovitis (stenosing, crepitans)

- **Windsurf, treck, marathon**
- Relatively rare



Tibialis Posterior ++



> Mechanical Tenosynovitis
> Insertional

> Degenerative Tendinopathy

- frequent, evolutive

- Pes valgus ++

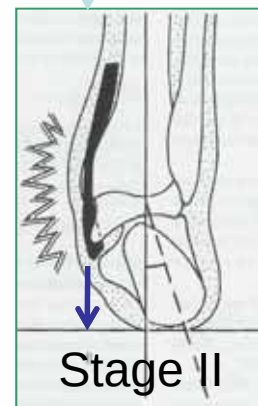
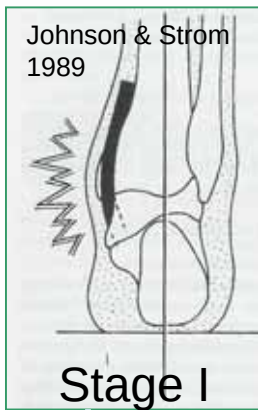
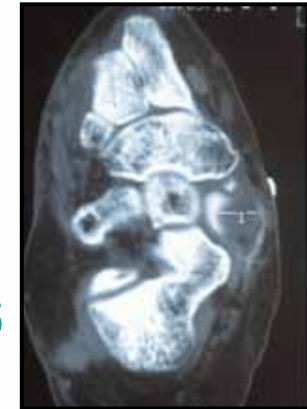
- Gait abnormality: stance

> Spontaneous rupture

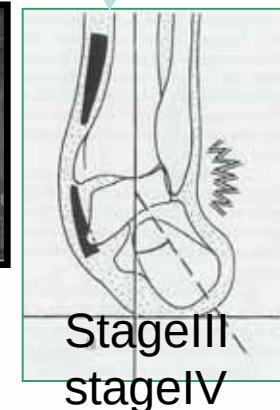
- Frequent : 2/3 women,

> 40 years

- Chronic insidious



Jhonson & Strom
Clin Orthop 1989



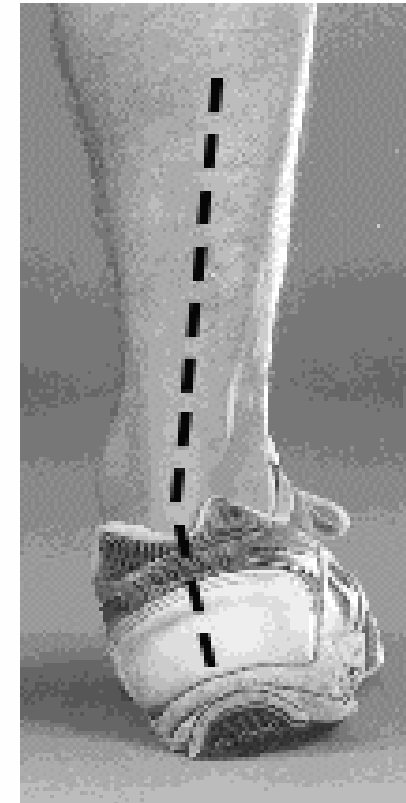
Foot pronator is at risk.

Bussenil C. et Coll.

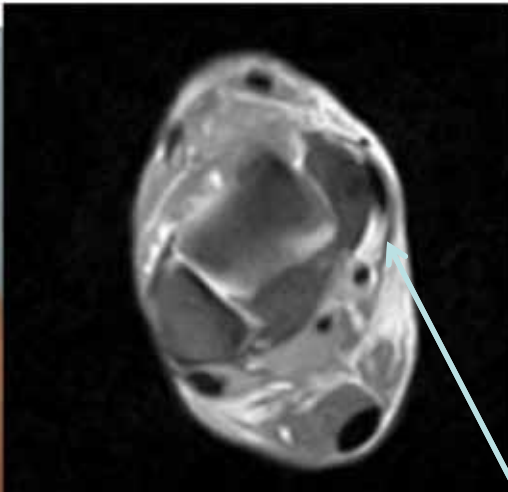
Rearfoot – forefoot orientation and traumatic risk for runners.

Foot and Ankle Intern 1998 ; 19 (1) : 32 – 37

Gastrocnemius
Retraction associated++



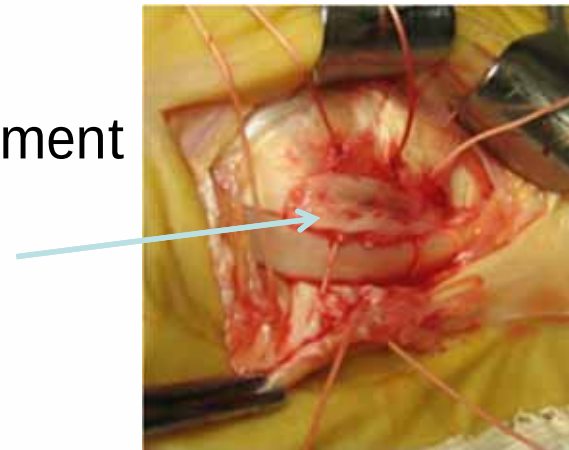
Tibialis Posterior luxation



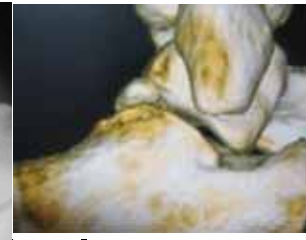
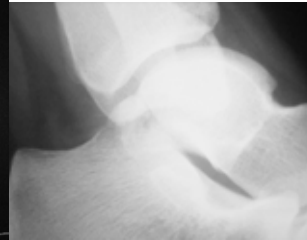
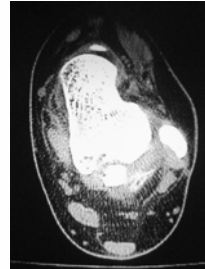
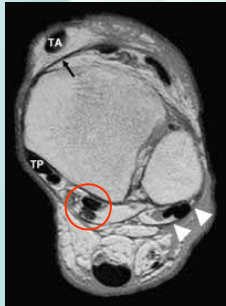
Sheat and retinaculum lesion

- Rare, inversion painfull trauma
- X ray : possible fracture
- MRI++
- surgical treatment

PRF



Flexor Hallucis Longus partial tethering



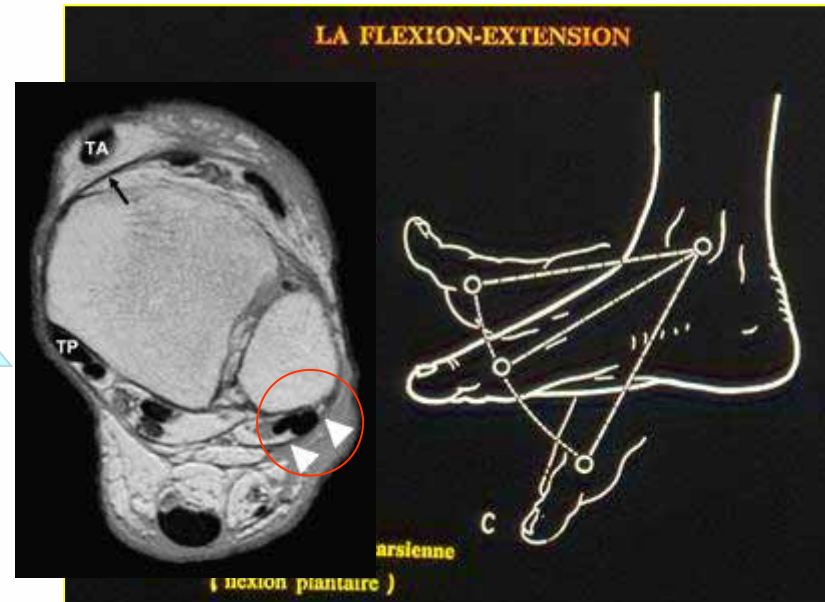
- Pain at the posterior aspect of the medial malleolus
- Tenderness just posterior to tibial artery when up and down moving hallux
- **Hallux limitus and rigidus**
- Ballet dancer, runners, 20-35 years of age
- Tight sheath compressed by an hypertrophied os trigonum
- Some times low-lying bulging muscle
- After medical trt failure Flexor hallucis longus tenolysis

Is generally successful



Peroneal tendons

anatomy and biomechanics



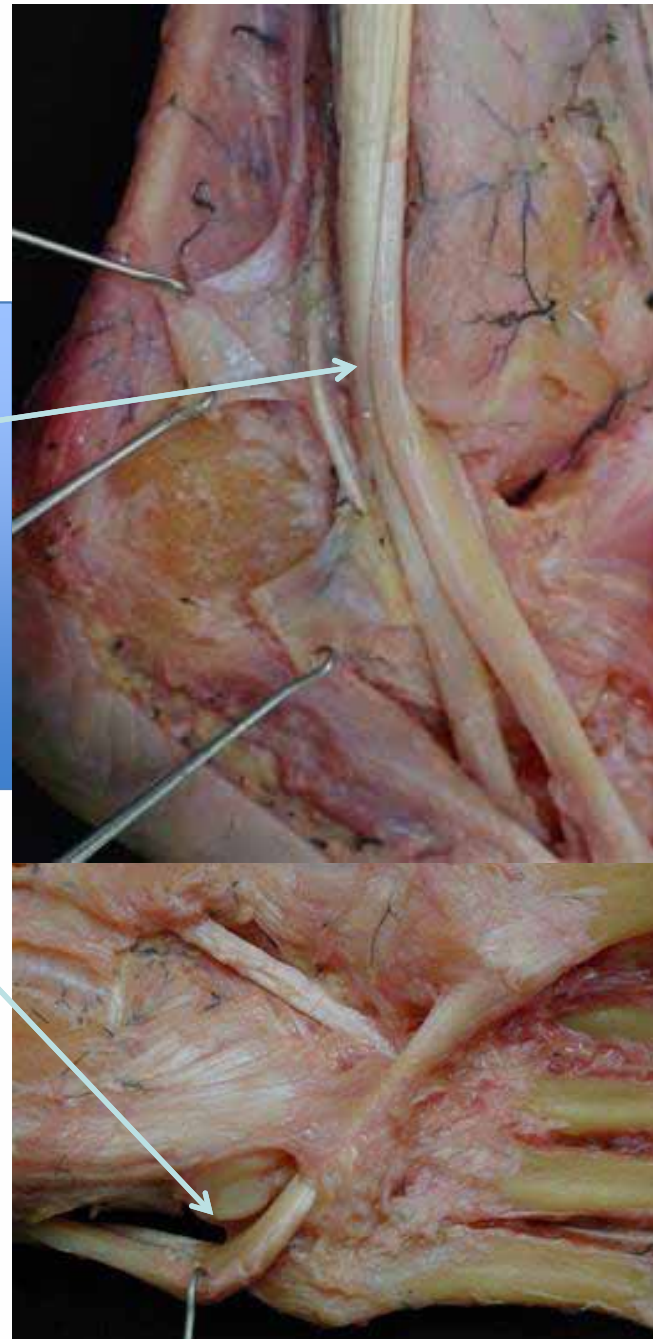
- *both the tendons evert the hind foot and plantarflex the ankle*
- *the PL lock the transversal arch and plantarflex the first ray.*

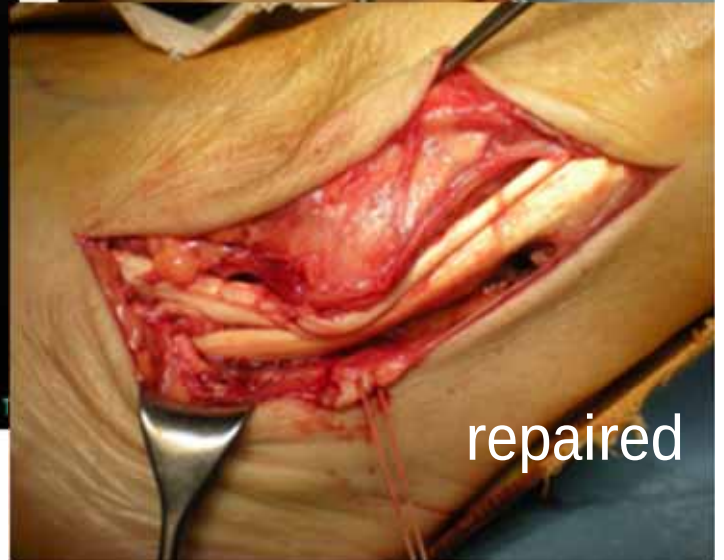
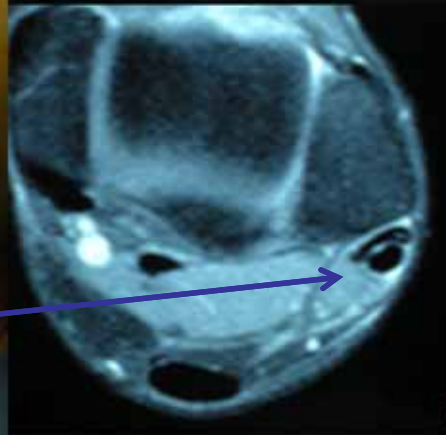
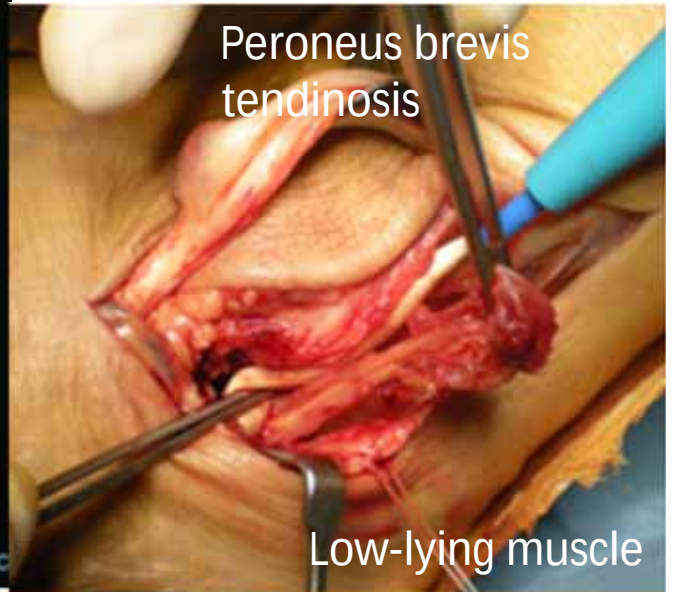
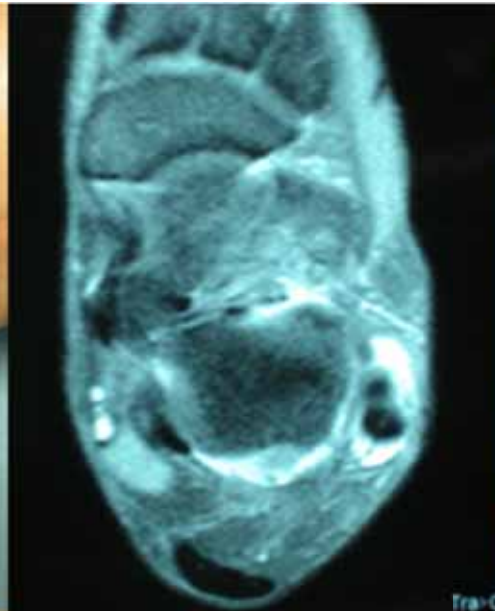
Peroneal tendon disorders

- Clinical conditions are numerous: pain in the postero lateral aspect of the ankle+++
- **Hindfoot in varus and ankle instability** must be pointed out, predisposing factors
- MRI remains mandatory to achieve a precise diagnosis
- Surgical procedures must be combined
- Return to maximal function after surgery is prolonged
- Early ROM with protected ambulation to prevent adhésions

Critic point

- *avascular zones are behind the lateral malleolus And cuboid bone*
- *: most frequent location of tendinosis*





tendinosis

Lateral tubercle hypertrophy
Strain mechanism



Low-lying
Muscle belly

tears & ruptures

classification

- **Grade I** Flattening of the tendon
- **Grade II** Partial split
- **Grade III** Rupture 1-2 cm long
- **Grade IV** Rupture >2 cm long

Sobel M, Gesppert MI et al
Foot and Ankle 1992; 13: 413

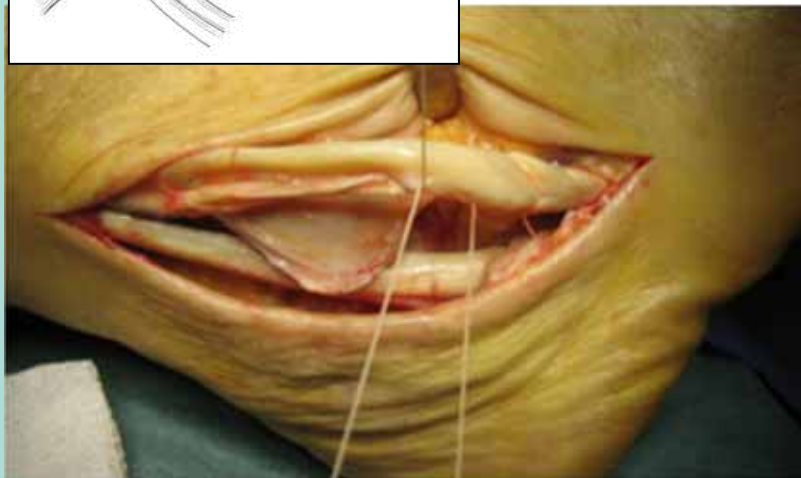
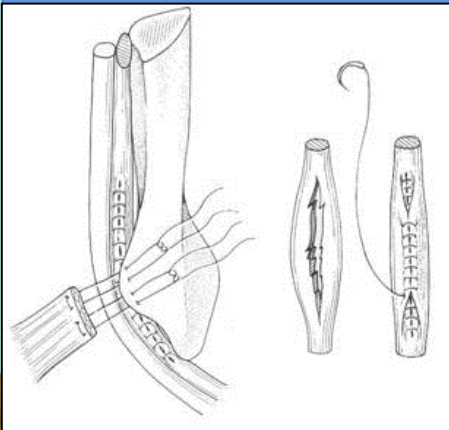


tears & ruptures

surgical treatment

edges refreshing

- excision of necrotic areas
- suture of the tears with
- tubulization of splayed tendon



Krause and Brodsky

Foot & Ankle Intern. 1998;19:271

Cross sectionnall area after
debridement for Per Brevis
>50%: repair

<50%: tenodesis

Redfern and Myerson

Foot & Ankle Intern. 2004;25:695

Scarring-fibrosis

Tendon excursion

+ tenodesis, - **graft or transfert**
FDL

associated procedures

- careful excision of os peroneum
- ligamentoplasty
- lateralizing calcaneal osteotomy

Insertional tendinopathy enthesopathies

- overuse on the insertion
- tendoperiosteal microruptures and calcifications

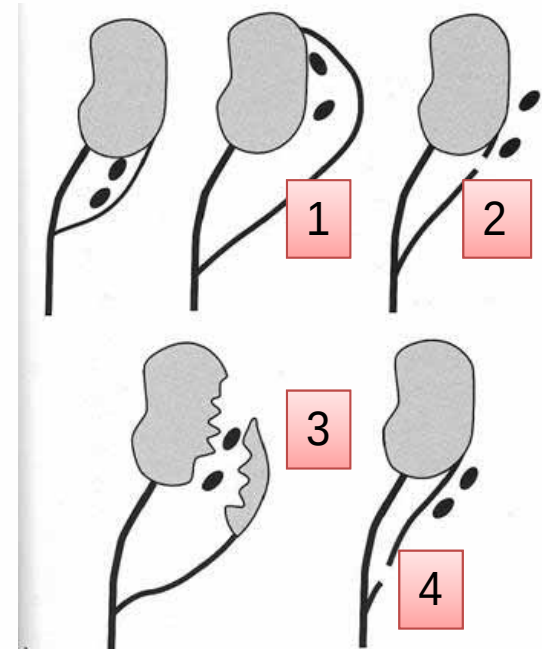


dislocation

clinical conditions

➤ pathomechanics

- disruption of the retinaculum
- eversion and dorsiflex of the ankle
- combined with a forceful contraction of PT
- elective lesion in downhill skiers (slalom, bumps)



Eckert and Davies ' staging

➤ acute conditions: diagnosis the more often missed

- « severe ankle sprain-like » but no laxity

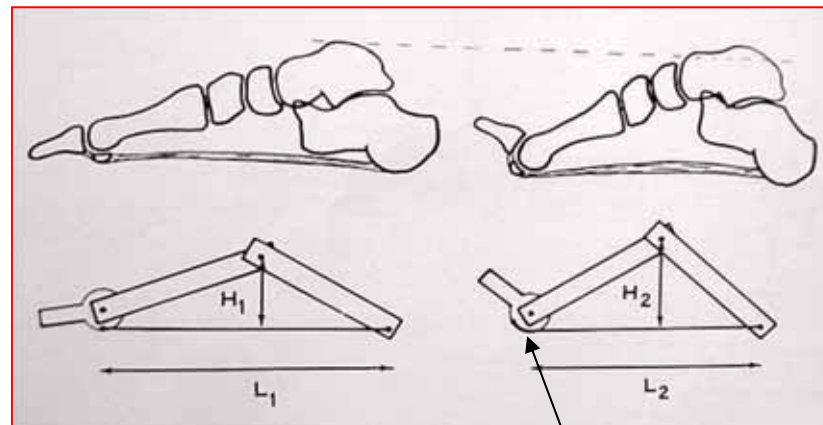
➤ chronic conditions

- « lateral chronic instability of the ankle-like » but no laxity

ACHILLUS TENDON

POWER= TRICEPS (Gastrocnemius+soleus)

TRANSMISSION=achilleo-calcaneo-plantar system



Windlass mechanism
Mécanisme du treuil



ETUDE DE LA MARCHE APRES TEST DE FATIGUE ET TRAITEMENT AU LPG CHEZ 18 GOLFEURS PROFESSIONNELS

RIVET J.J. MAISETTI O. MAESTRO M.



A.F.C.P. 11 nov. 2000 Paris SOFCOT

Chez les sujets ayant tendance à la **rétraction des jumeaux** : **Les pics d'appuis talonniers lors de la marche sont tous latéralisés** .
Ils migrent vers le centre calcanéen après fatigue , puis reviennent à leurs données initiales après LPG.⁽¹⁾

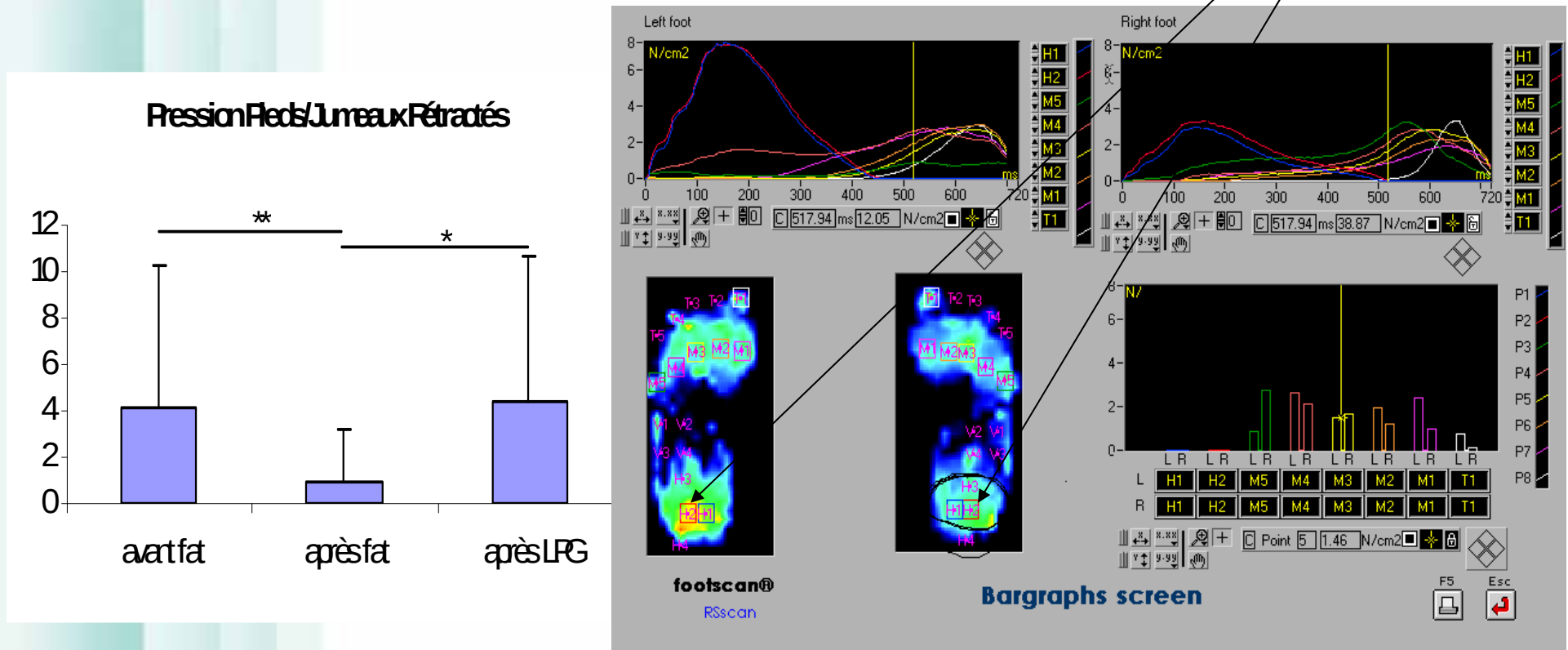


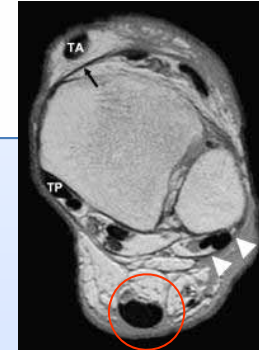
Figure 2 : médialisation des appuis calcanéens après fatigue.
 (** pour significatif à $p = 0.01$ - * pour significatif à $p = 0.05$

CONCLUSION

Chez un groupe de sujets sportifs professionnels, ayant tous des pieds considérés normaux sans callosités plantaires, cette étude permet de dégager 2 groupes de sujets :

- Un groupe qualifié de normal : 10 sujets soit 54%
- Un groupe ayant une tendance à la rétraction des muscles jumeaux représentant 8 sujets soit 46%
- Cela est en accord avec l'étude Kowalski sur la rétraction des gastrocnémiens .

Achilles tendon



-Acute ruptures:

- early trt, anatomic restoration,
- meticulous attention to detail to avoid wound complications,
- early rehabilitation to minimize recovery time and maximize function and strength

Chiodo and Den Hartog, Foot & Ankle Intern. 2008;29:114

-Non insertional tendinopathy

- Non operative trt 6 months
- Age and long term duration less favorable
- Percutaneous_ open debridement_ transfert FHL augmentation

Scott et al. Foot & Ankle Intern. 2008.29:759

-Insertional tendinopathy

- Direct posterior approach
- Early weight bearing and mobilisation if less than 50% tendon excised
- If more FHL tranfert

Deorio and Easley Foot & Ankle Intern. 2008;29:542



TM junction: 14,5%

Body: 75%



Insertion: 10,5%

30 Y_50Y: sports activity

>50Y: degenerative

Evaluation:

- Site
- -gap (echo)
- -degenerative lesions



Trt

- **NON OPEN: rerupture 10%**
- **OPEN: complications**
(infection, adhernce, nerve)
- PER-CUT**

→ **Early MOB**

Surgery: infection, skin necrosis, sural nerve damage

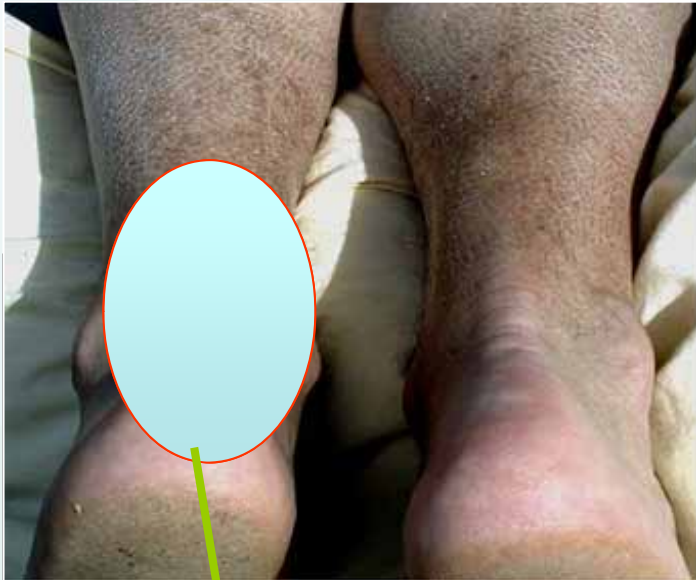


Augmentation reinforcement



Shoe shape and lateral movements (Hoffmann 1997)





Intratendinous micro-tears

thickness

Nodules



Plantaire
grele →



JL Besse

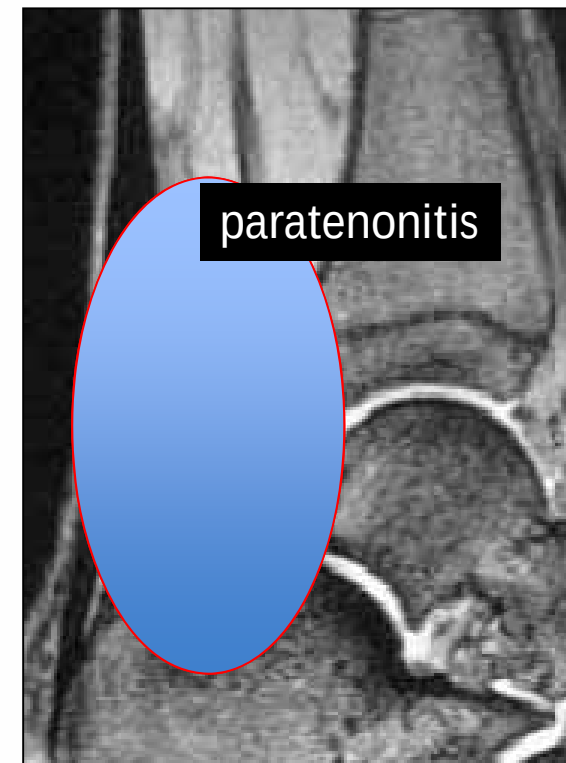
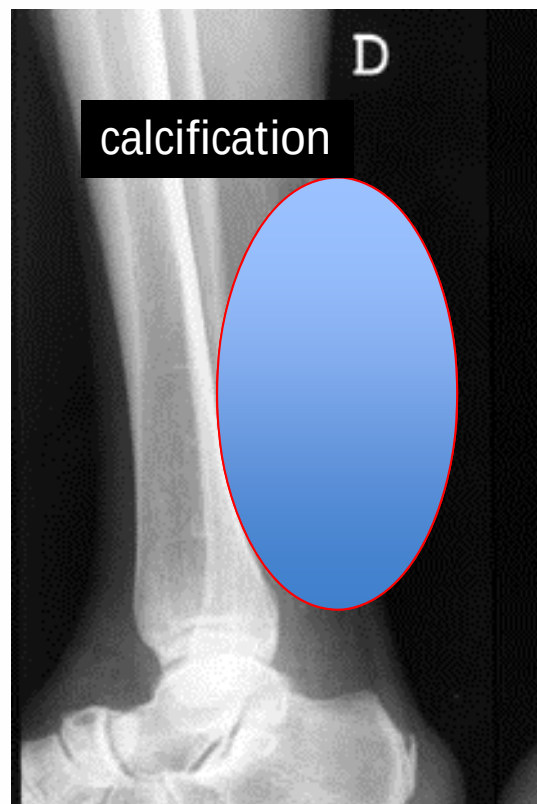
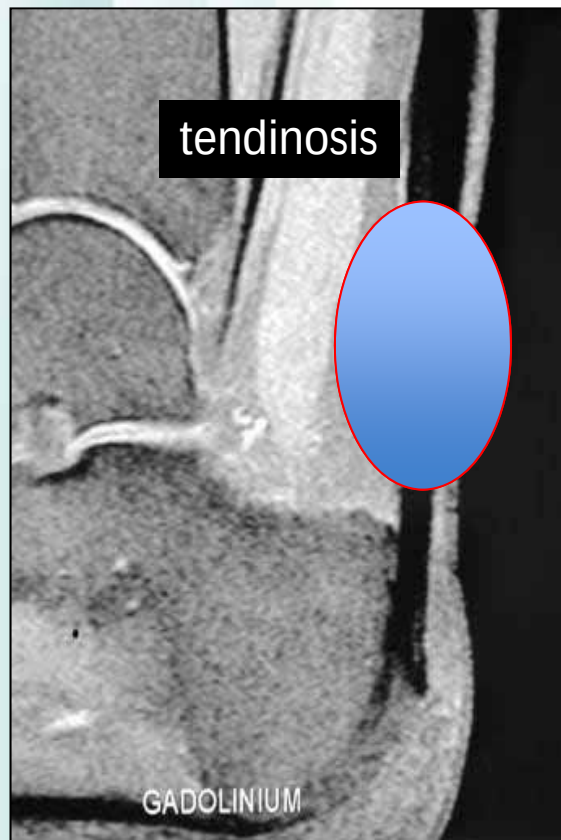
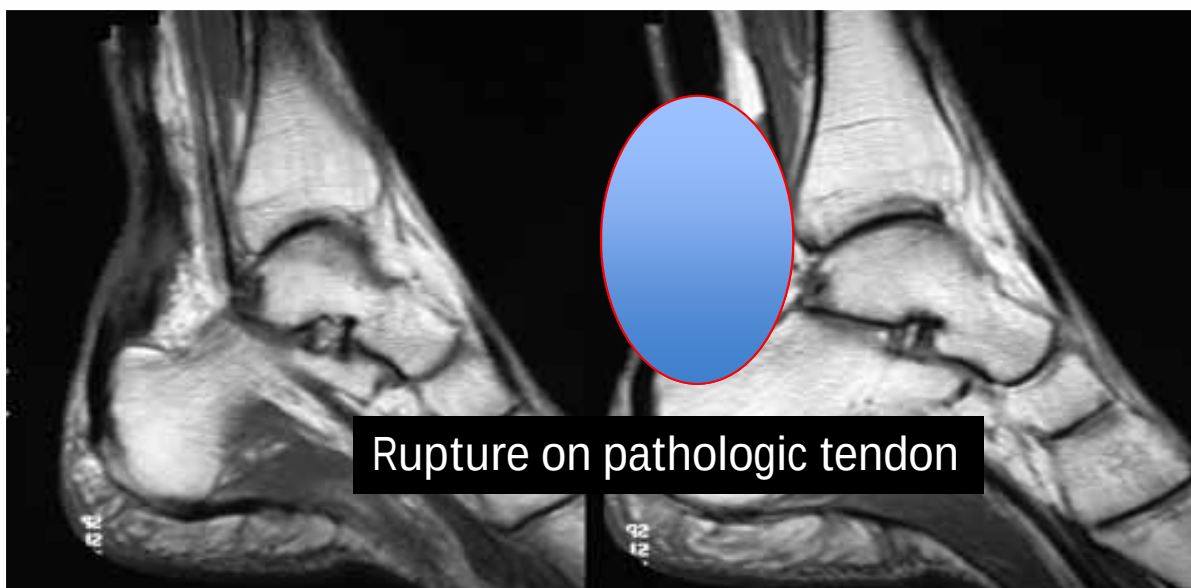
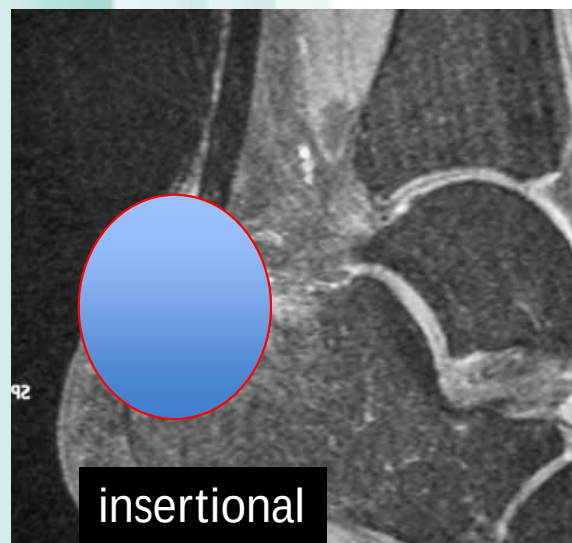


Photo JL Besse



Functional training program stability= mobility

Phase I: **recovering**

- Mobility
- Length
- Flexibility



Phase II

Strength-balance control **Powerfull contractile action**

- Gradual process
- Proprioception (compensation can occur for up than 1 year)
- Repetitive movment to replicate functional movt
- Close kinematic chain exercises+++

Age +++
Assessment
Pain
Inflammation
Tendon irritability
=progression of
program

Phase III

Aerobic reconditioning

- Treadmill, stairmaster, elliptical unit
- Options: swimming, walk-jog,
- posture and reflexes
- reinforcement



Phase IV

Return to activity

- Maintenance strength-flexibility
- Reinforcement, aerobic exercises
- Activity modification
(Bernstein concept)



Mvts systems as dynamical systems

Bernstein's pb (1967)

« maîtriser la redondance des DOF »

Malgré des années de pratique et d'entraînement , les athlètes sont incapables de répéter un mouvement



Variabilité intra et inter individuelle des performances

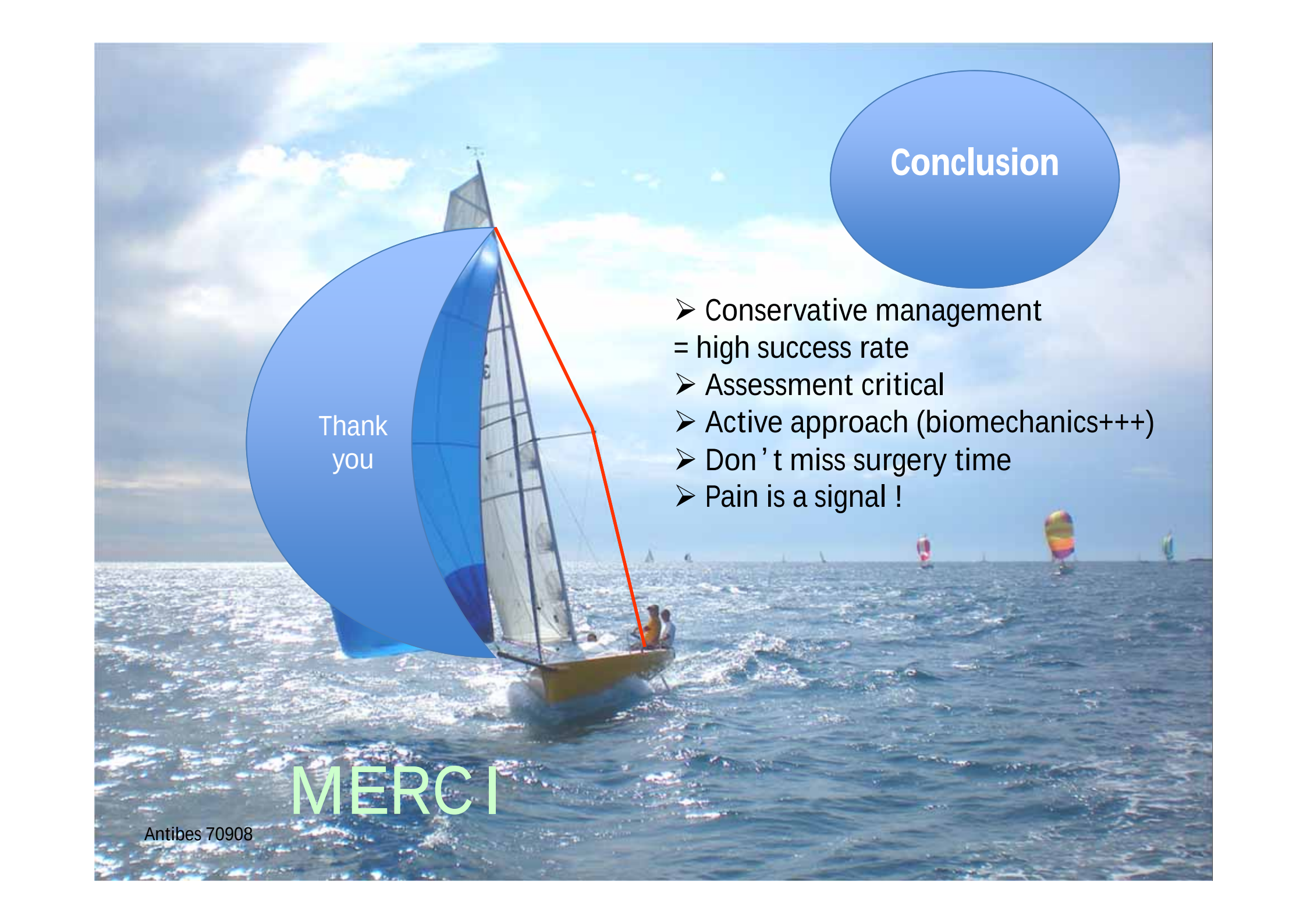
Skill
Physical fitness
Tactile sensing
Psychology
meteorology

Tendon-
Muscular-bone
unit

Winning
shot!



Monte-carlo 230406



Conclusion

- Conservative management
= high success rate
- Assessment critical
- Active approach (biomechanics+++)
- Don't miss surgery time
- Pain is a signal !

Thank
you

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