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# An Overview of Adult Acquired Flat Foot and Tibialis Posterior Pathology

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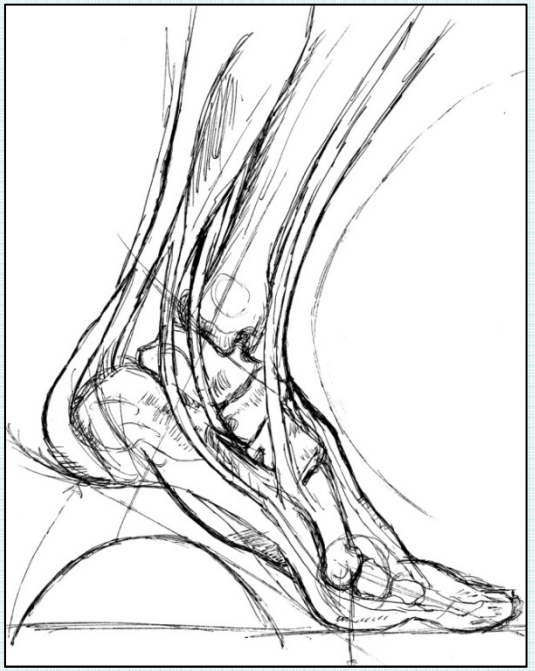

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# Aim

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- Review anatomy and function
- Provide an overview of the presentation, aetiology, pathological features of AAFF and tibialis posterior pathology

- Assist in the recognition of staging the condition for improved clinical decision making
- Improve treatment outcomes through early recognition and appropriate management

# Outline

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- Define
- Overview of Anatomy
- Function
- Clinical Presentation
- Pathology
- Pathomechanics
- Clinical Assessment

# Adult acquired flat foot deformity

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- a progressive, painful deformity resulting from gradual stretch (attenuation) of the tibialis posterior tendon as well as the ligaments that support the arch of the foot
- Classification of different stages of presentation increasing in severity and stiffness (Johnson and Strom 1989)
- Progressive weakness, ligament disruption and subluxation of the rear foot
- Management of each stage with different treatment regimes



Funk et al 1986, Johnsann and Strom 1989, Foster et al 2005

# Why the confusion ?

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Does PTT pathology cause a flat foot deformity

or

do flat feet cause PTT pathology and late sequale AAFF ?

# Literature

- tendon loss, tendon dysfunction
- AAF secondary to TP pathology
- MRI studies - Spring ligament, deltoid, interosseous TC lig
- 70% unilateral TP pathology subjects had contralateral asymptomatic flat foot but xray same
- Revisions of classifications



Kettlecamp and Alexander 1969, Johnson and Strom (1989), Funk et al (1996), Deland et al (2005)Myerson et al (1996), Dyal (1997 Richie (2007)

# Inter related conditions

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- Abnormal biomechanics of foot could result in dysfunction of muscle
- Release of the tendon alone does not reproduce a flat foot.
- Spring lig, plantar aponeurosis, deltoid, talo-calcaneal, long and short plantar need to be released
- TP tendon cannot restore alignment if the ligaments are damaged in experimental conditions



Deland et al 1992, Chu et al 2001, Niki 2001

# Risk Factors

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- Women:men 4,3,2 : 1
- Middle to older age
- Predeposition to flat feet / pes plannus (Dyal et al 1997)
- Obesity, Diabetes, steroid injection and RA, inflammatory arthropathies,
- Acute trauma - chronic progressive
- Hypermobility, inflammatory, DJD, muscle imbalance CP



Myerson et al 1989
Holmes and Mann 1992

# Arch Support mechanisms

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- Mobile adaptor/ Rigid  lever
- Stabilisers
  - Plantar fascia
  - Spring Ligament
  - Medial TNJ Capsule
  - Interosseous talar calcaneal lig
  - Tibialis posterior tendon
    - intrinsics

# A common presentation

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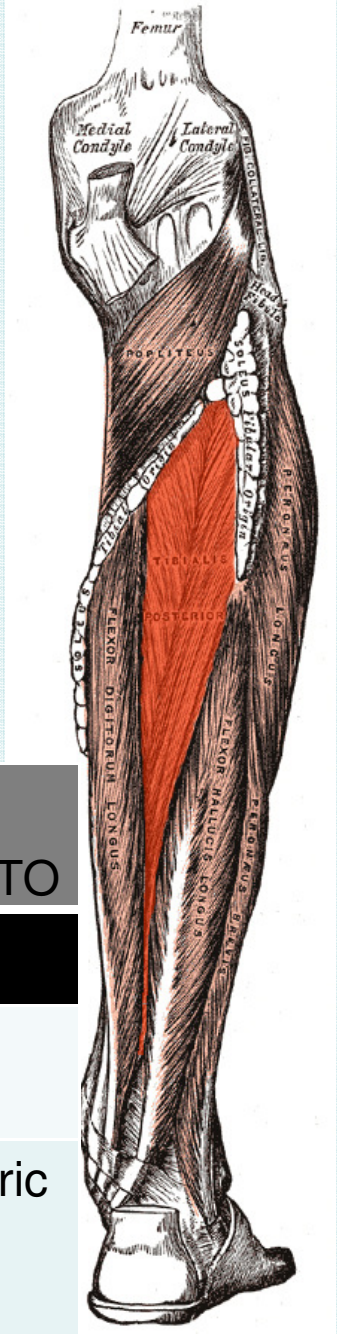
Patient presents with lowered arch profile and functions in a pronated position through gait

Pain in the medial ankle and foot region

MUSCULOSKELETAL DIAGNOSIS

# Anatomy - Tibialis Posterior

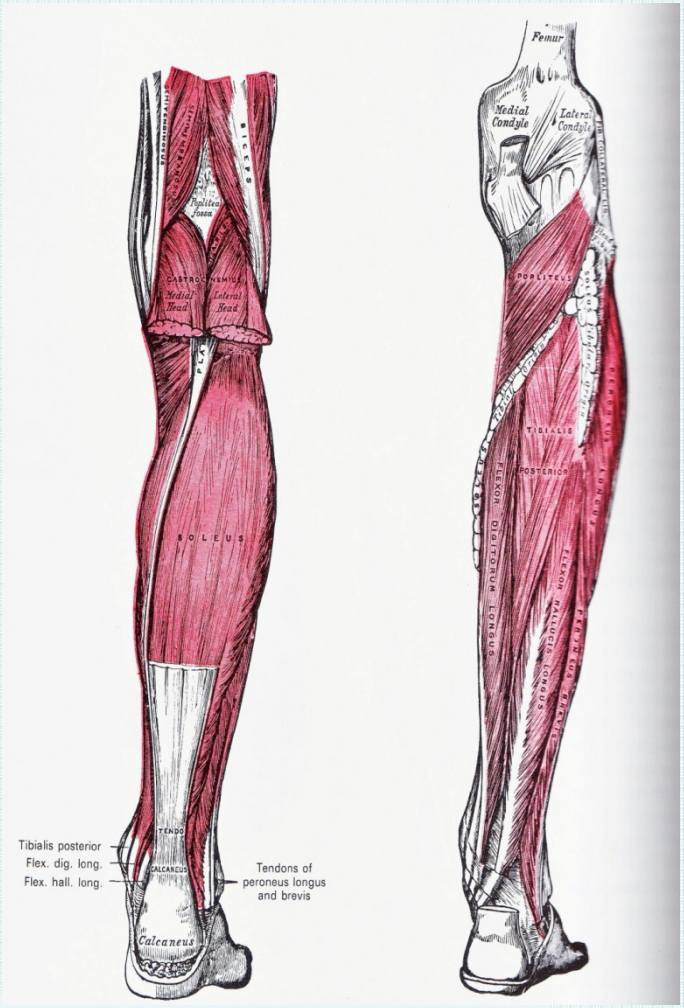
- Origin
- Insertion
- Nerve Supply
- Action
- Function
- Role




| stance | | |
|---|---|---|
| IC FFC | HO | TO |
| [redacted] | | [redacted] |
| Loading Response | Mid stance | Terminal Stance |
| Eccentric | No activity<br><br>?????? | Concentric |

Semple et al 2009

# Posterior Tibial Tendon




- Dynamic stabiliser MLA
- Plantarflexion TCJ
- Supination STJ
- elevate medial long arch
- Increases efficiency of gastrocnemius

# Stabiliser of MTJ - reverses leg rotation through STJ

re-supination – oblique axis

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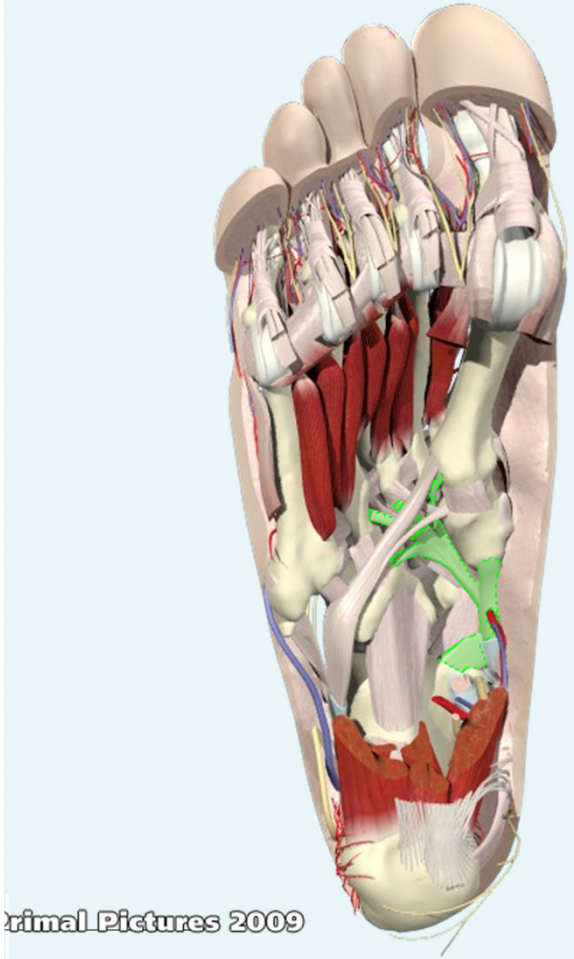


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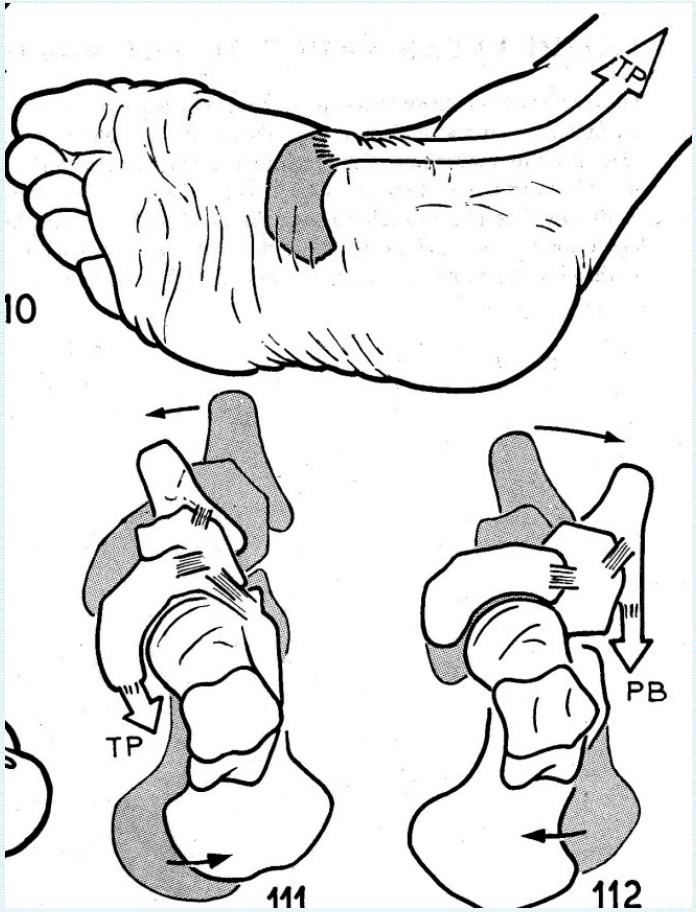
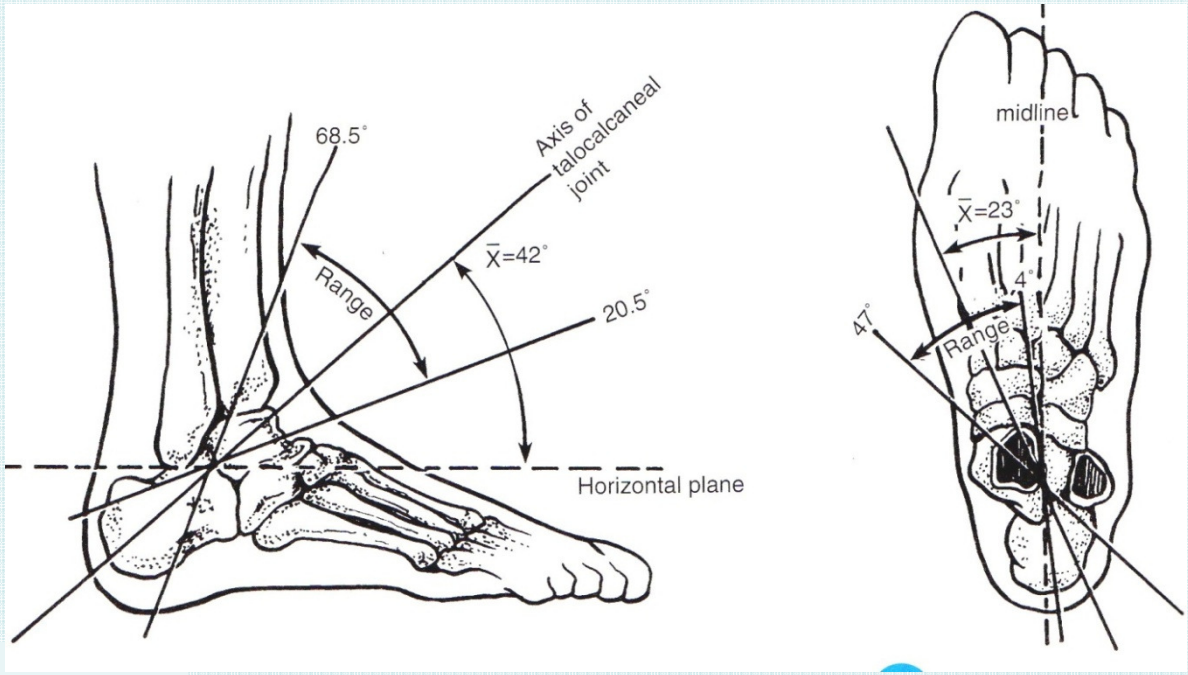
# TP deficient Peroneus brevis is unapposed




- Pulley
- TP contraction pulls navicular posteriorally assists in carrying the load placed on spring ligament
- Fibrocartilagenous sesamoid to aid pressure absorbing and gliding

# Biomechnaics

- Small lever for plantarflexion
- main supinator of foot – dependant on STJ transverse axis position



# Gait

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- Kinematics TPD compared to normal individuals
- Significant alteration in position

Loading response

- Decrease in dorsiflexion and increase in eversion of the rearfoot

Terminal Stance

- Decrease in plantar flexion and increase in abduction shift
- loss of varus thrust of forefoot limited motion of mid foot
- Decrease in ROM dorsiflexion at 1st MTPJ

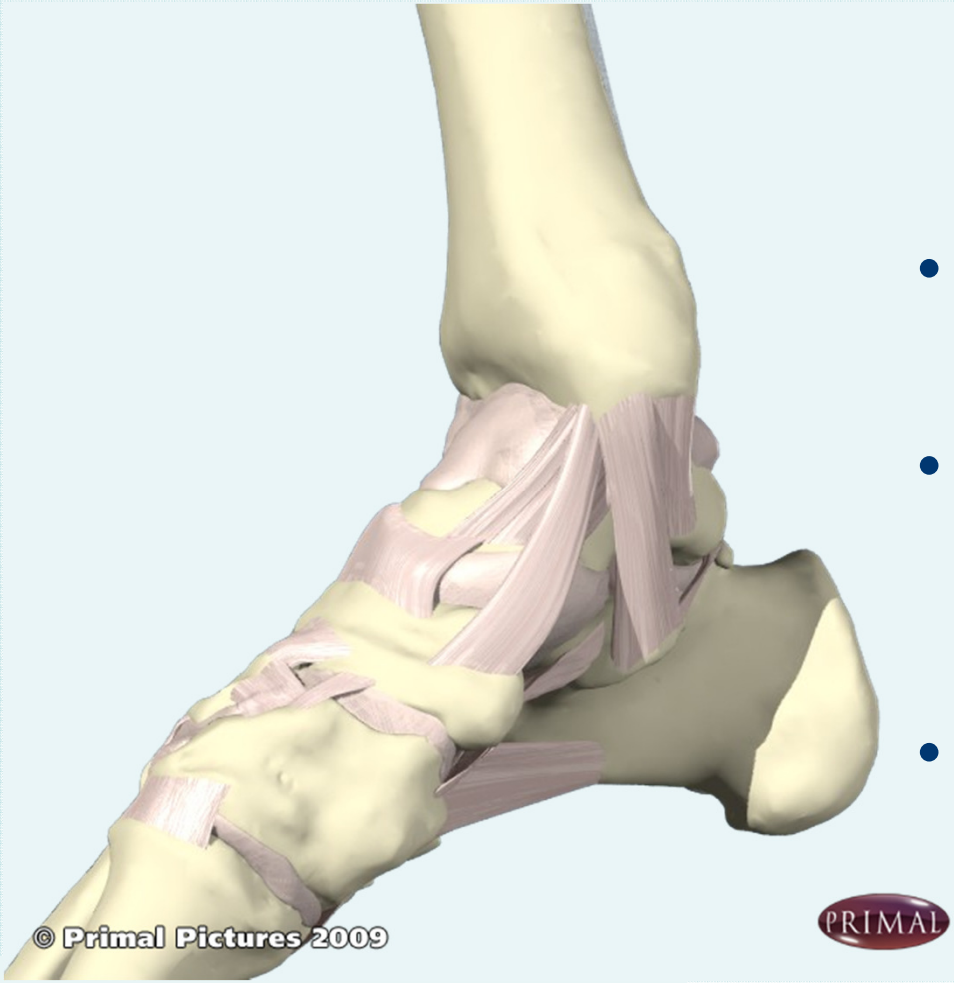


Ness et al 2008

# Ligaments

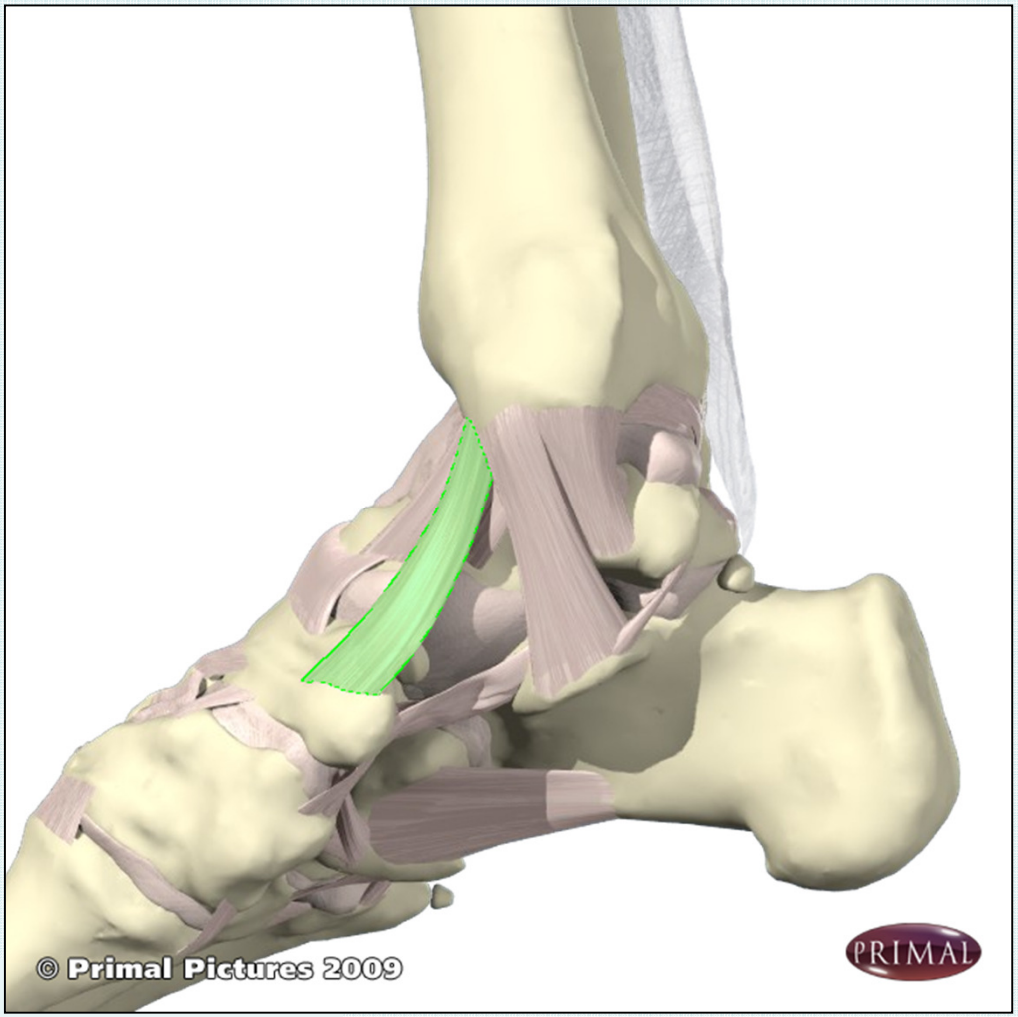
- Support the foot's architecture
- If  muscles are paralysed or weakened by disuse ligaments give way to stress when unprotected by muscular contraction.
- Deltoid
- Deltoid and interosseous
- Foot disconnected fromleg

# Deltoid




- Strengthens ankle joint
- Holds the calcaneus and navicular against the talus
- Fibrous joint capsule TNJ

# Tibio- navicular



# Tibio-calcaneal

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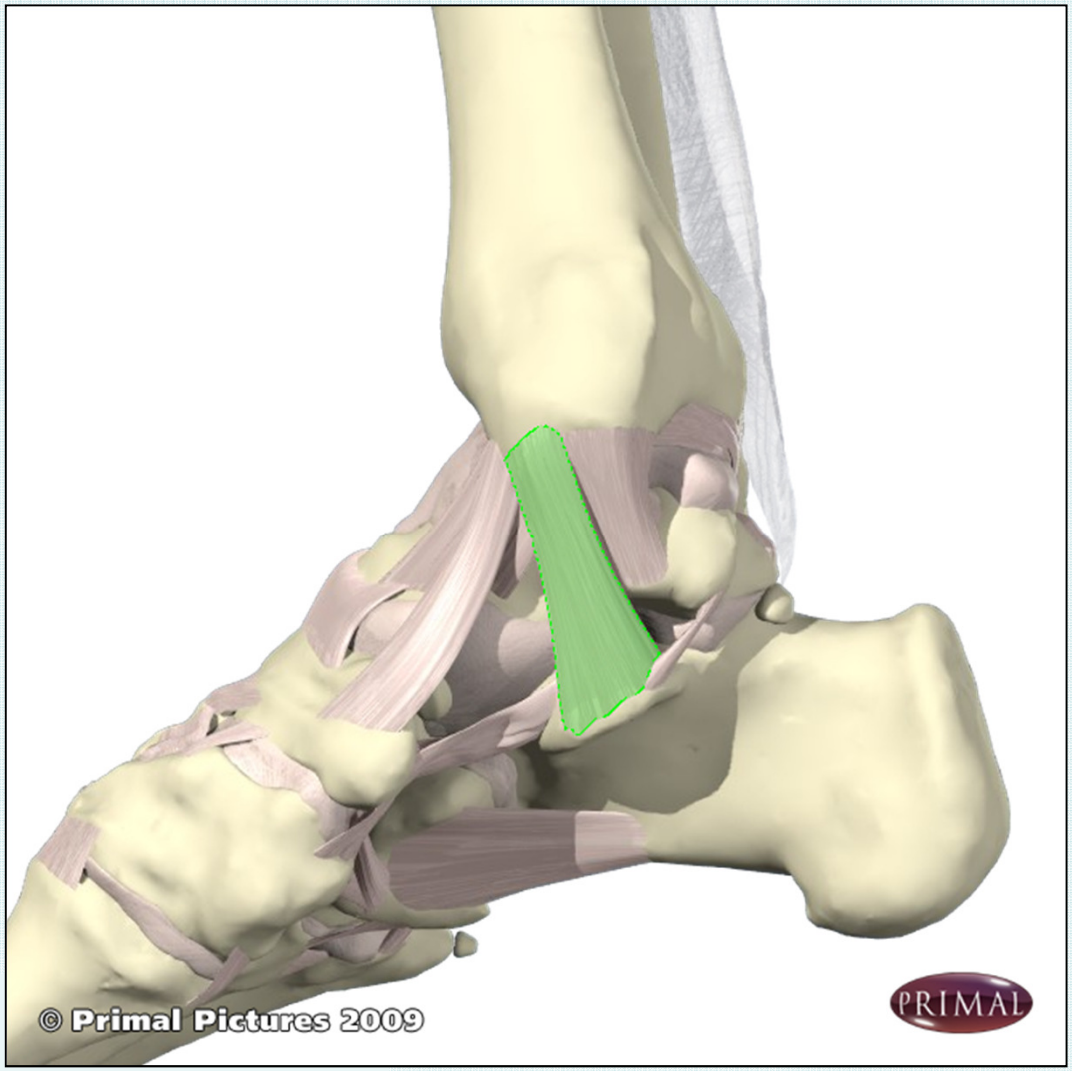

# Posterior tibio-talar

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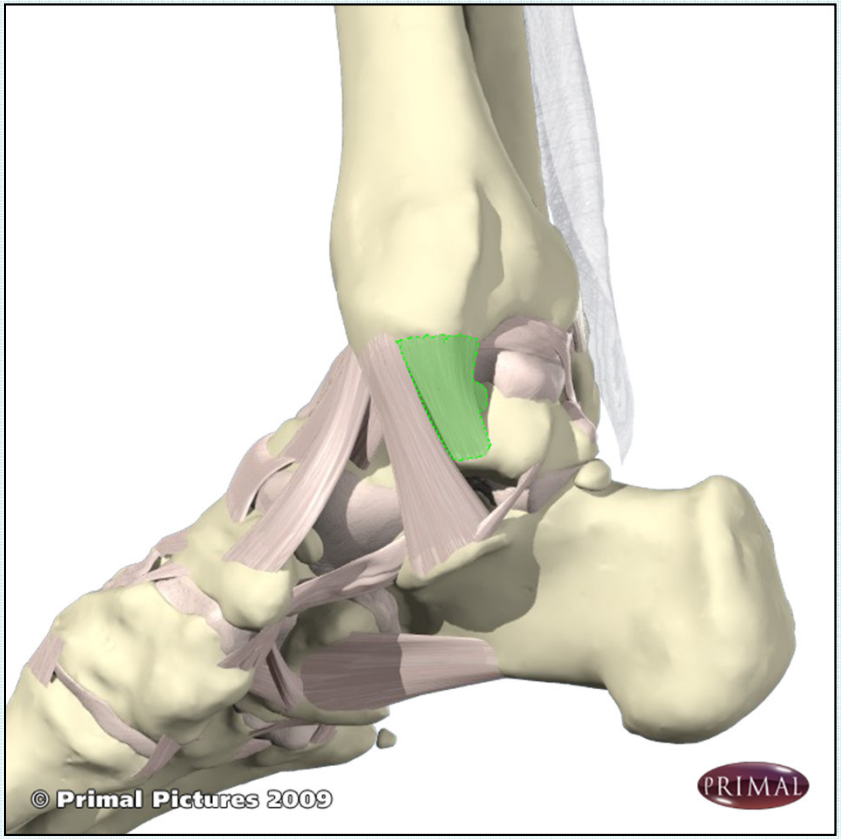


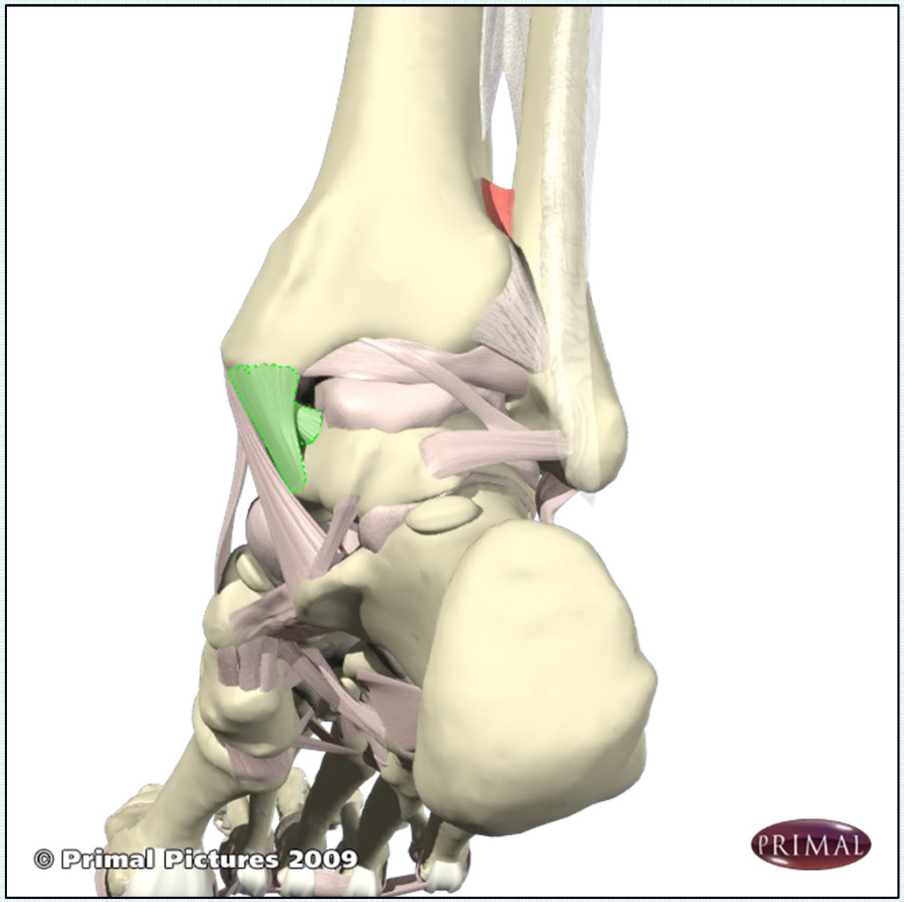

# Plantar calcaneo-navicular ligament (spring lig)

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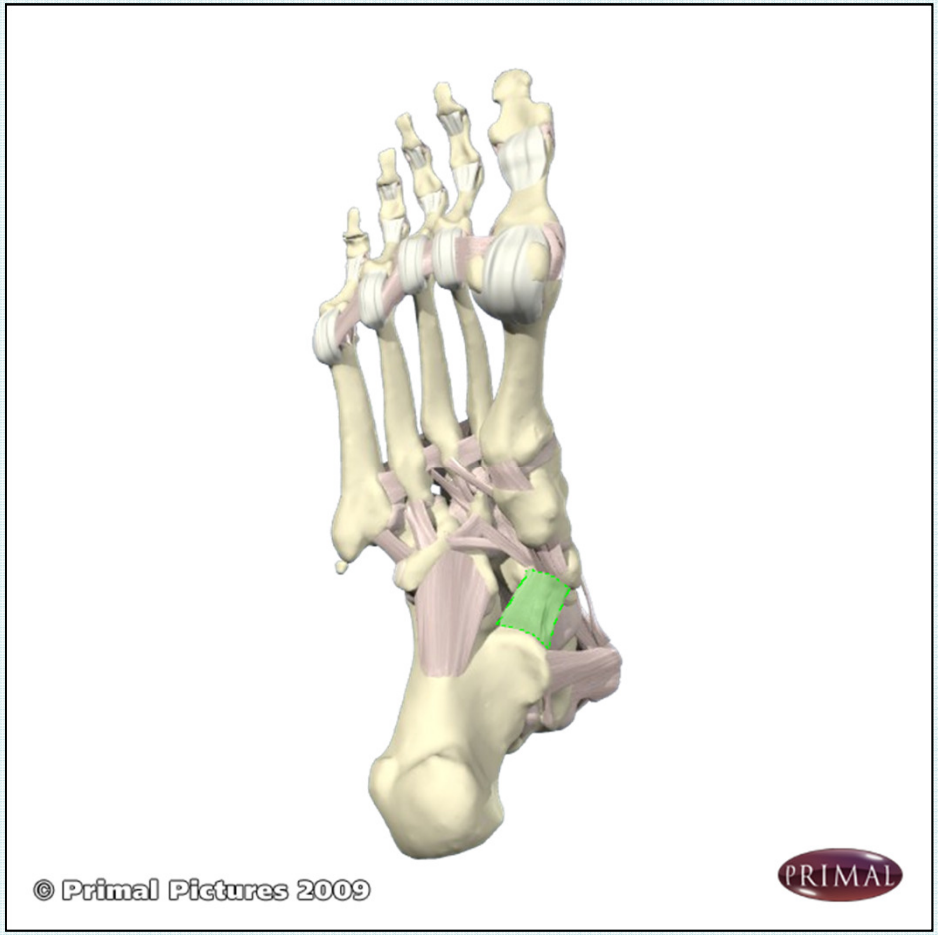
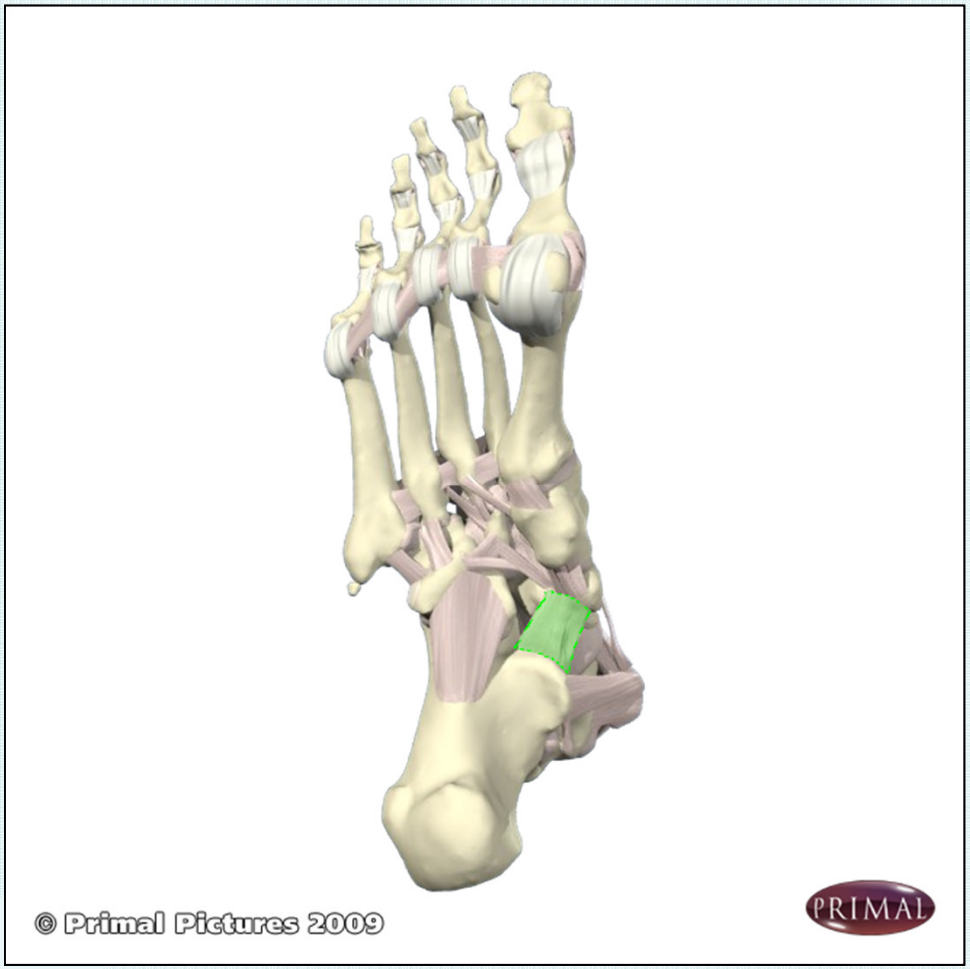
- Important role in stabilising the arch
- Completes tyhe socket
- Prevents drifting apart



# Calcaneo-cuboid (short plantar lig)

- Strengthens calcaneocuboid joint



# Long plantar lig

- Maintain lateral longitudinal arch of foot
- Passes inferiorly to short ligament
- Larger attachment more proximal on the calcaneus

# Interosseous talar calcneal ligament

- Total loss of movement

# Interosseous talar calcaneal

Total loss of movement hintermann 1998

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# Plantar aponeurosis

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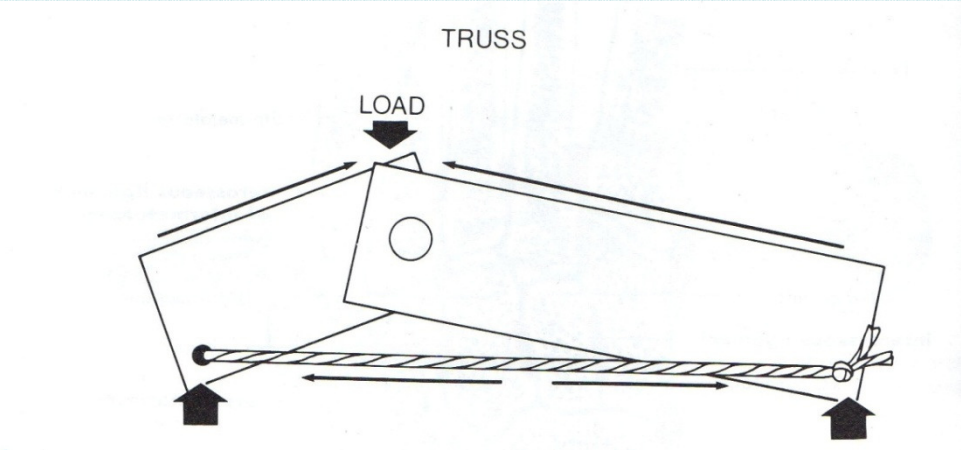
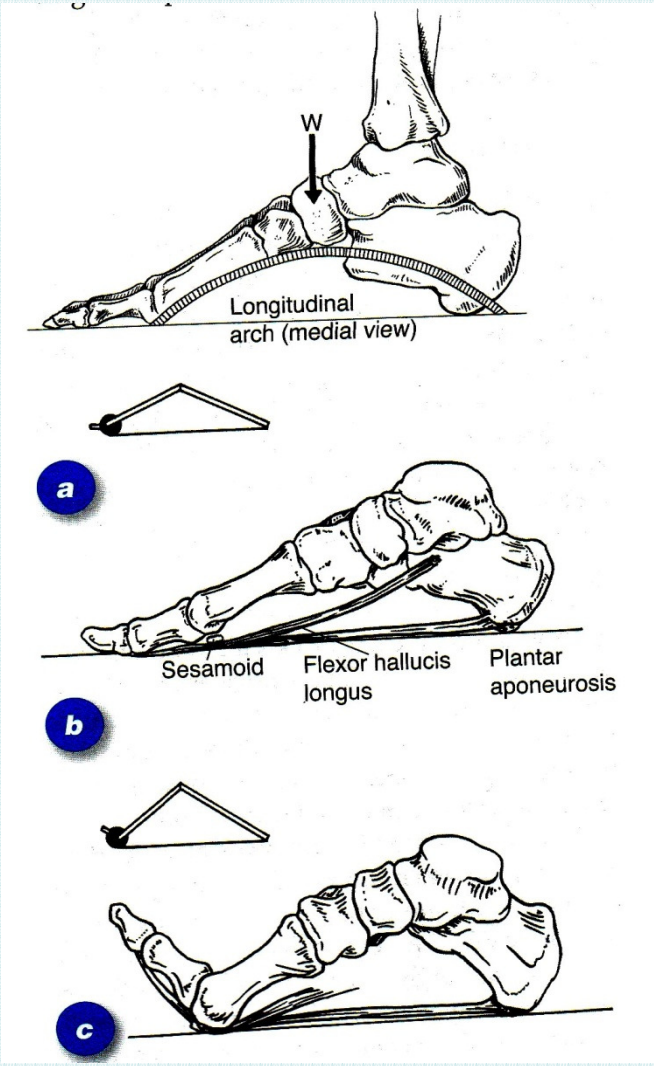
- Tie beam
- Slips curve over toe sides of flexors
- dorsally insert plantar lig mtpj and flexor sheath
- Pulls arch together when dorsiflex forms rigid structure for push off

# Windlass


TRUSS
LOAD


W
Longitudinal arch (medial view)
a
Sesamoid
Flexor hallucis longus
Plantar aponeurosis
b
c

# Adult acquired flat foot deformity

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- a progressive, painful deformity resulting from gradual stretch (attenuation) of the tibialis posterior tendon as well as the ligaments that support the arch of the foot.
- Can be a disabling condition
- Strong assocciation with falt feet (Hirano et al 2009)
- Co exsisting DJD, RA, neurological weakness

# DDx – pathological flat foot

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- CVT
- TC
- Trauma
- Tumour

# Unilateral pathology - mechanical

# Clinical Signs and Symnptoms

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**symptoms**

- Postero medial foot and ankle, heel and arch pain
- Medial ankle pain and swelling
- Tarsal Tunnel symptoms
- Lateral foot pain
- Worse with increased activity
- Insidious onset
- Fatigue
- Difficulty going up stairs

**signs**

- Plano valgus deformity
- Appropilsive
- Impaired function
- Pathological flat foot
- Excessive over pronation
- Weakness
- Difficulty rising onto toes
- Positive findings for tendinopathy / ligament
- Tenosynovitis
- Tear

# Acute onset symptoms

- Decrease pain and oedema
- Early diagnosis
- Improve mobiliy and prevent deformity

# Classification

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**Progression through stages (Myerson)**

1. little structural change
2. Lowering of arch abduction of forefoot
3. Rigidity of the rearfoot
4. Severe valgus deformity

**Truro**

1. Little structural change
2. Fully correctable deformity
   a. varus < 15 degrees
   b. varus > 15 degrees
   c. forefoot rigid
3. Rigidity of the rf and ff with no correction
4. Rigidity of the rf and ff with no correction- talar tilt on Xray



Johnson and Strom 1989

| Stage | Presentation | Tendon | Joints | Tests |
|---|---|---|---|---|
| 1 | Minimal structural change | Inflammation<br>Tendon still functional | flexible | Heel raise with resistance<br>weaker endurance<br>All tests - ve |
| 2) a b | Lowering of arch, abduction of forefoot | Tendonopathy<br>Functionally impaired<br>Incompetence<br><br>Or partial rupture | Correctable RF<br>Too many toes sign | Difficult to perform single heel raise<br>Positive sup lag<br>positive 1st met rise<br>Positive Hubscher manoeuvre |
| 3 | Rigidity of the rear foot | Tendon rupture<br><br>Dysfunction tendon rupture | fixed<br>Moderate DJD<br>Posterior facet STJ<br>Subchondral bone talar navic | unable to manipulate foot<br>all tests -ve |
| 4 | Severe valgus deformity | Tendon rupture | DJD ankle / rearfoot joints<br># fibular malleolus | rigid deformity<br>all tests +ve |



Johnson and Strom, Myerson et al1996, Richie

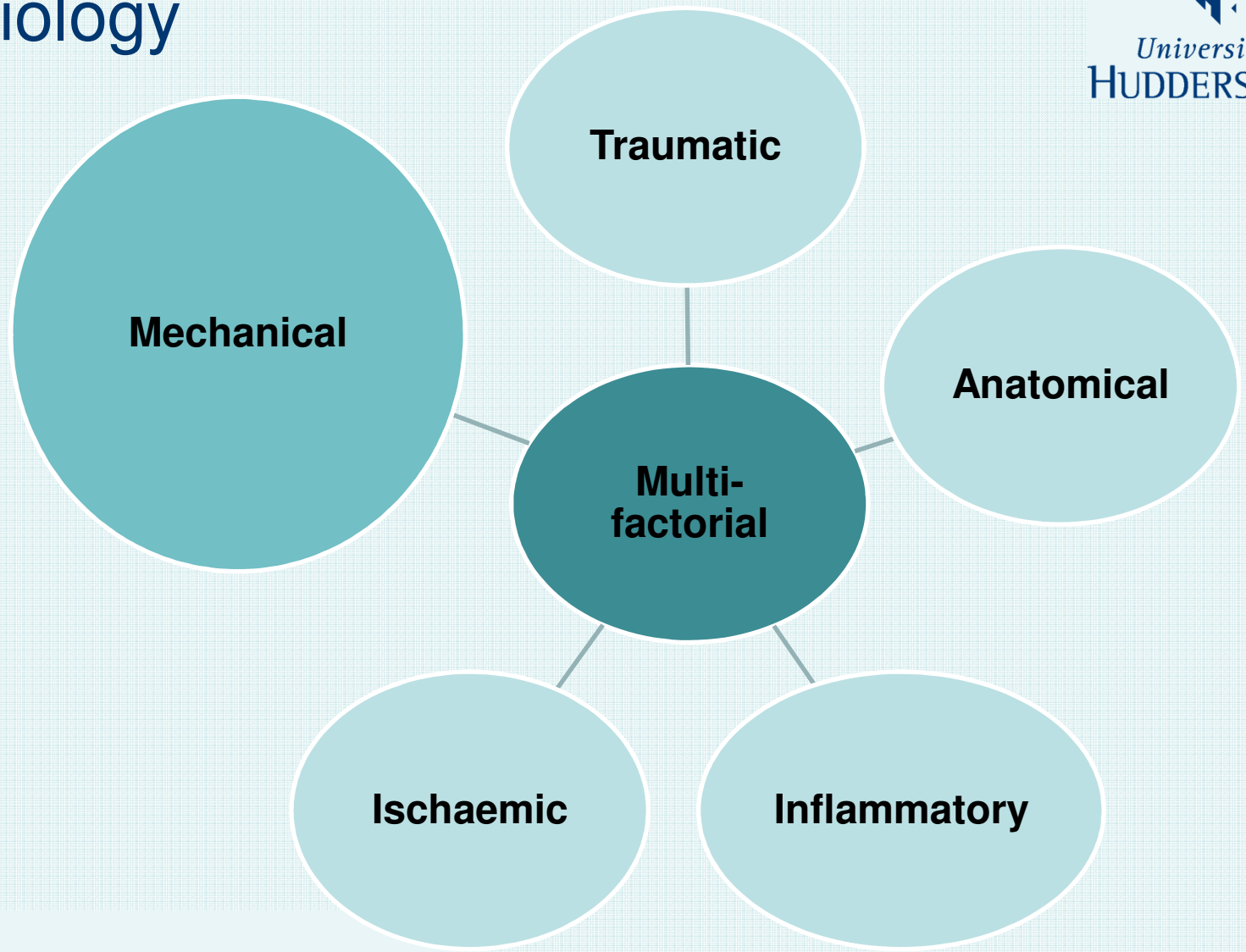
# Sub stages

| Sub stage | deformity | rearfoot | Forefoot supination | correction |
|---|---|---|---|---|
| 2a | mild | mobile | <15 degrees | mobile |
| 2b | mod | mobile | >15 degrees | mobile |
| 2c | severe | mobile | severe | rigid |



Parsons et al, 2009

# Aetiology






Uchiyama et al 2006, Hirano 2009
friction

# Abnormal flatfooted position creates resistance on PTT and increases friction

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- INCREASED LOAD PTT
- DECREASES STRENGTH
- DIMINISHED CIRCULATORY SUPPLY
- INFLAMMATION AND OR DEGENERATION
- INCREASED FORCES

# = LOSS OF ARCH STRUCTURE ---→ Subluxation

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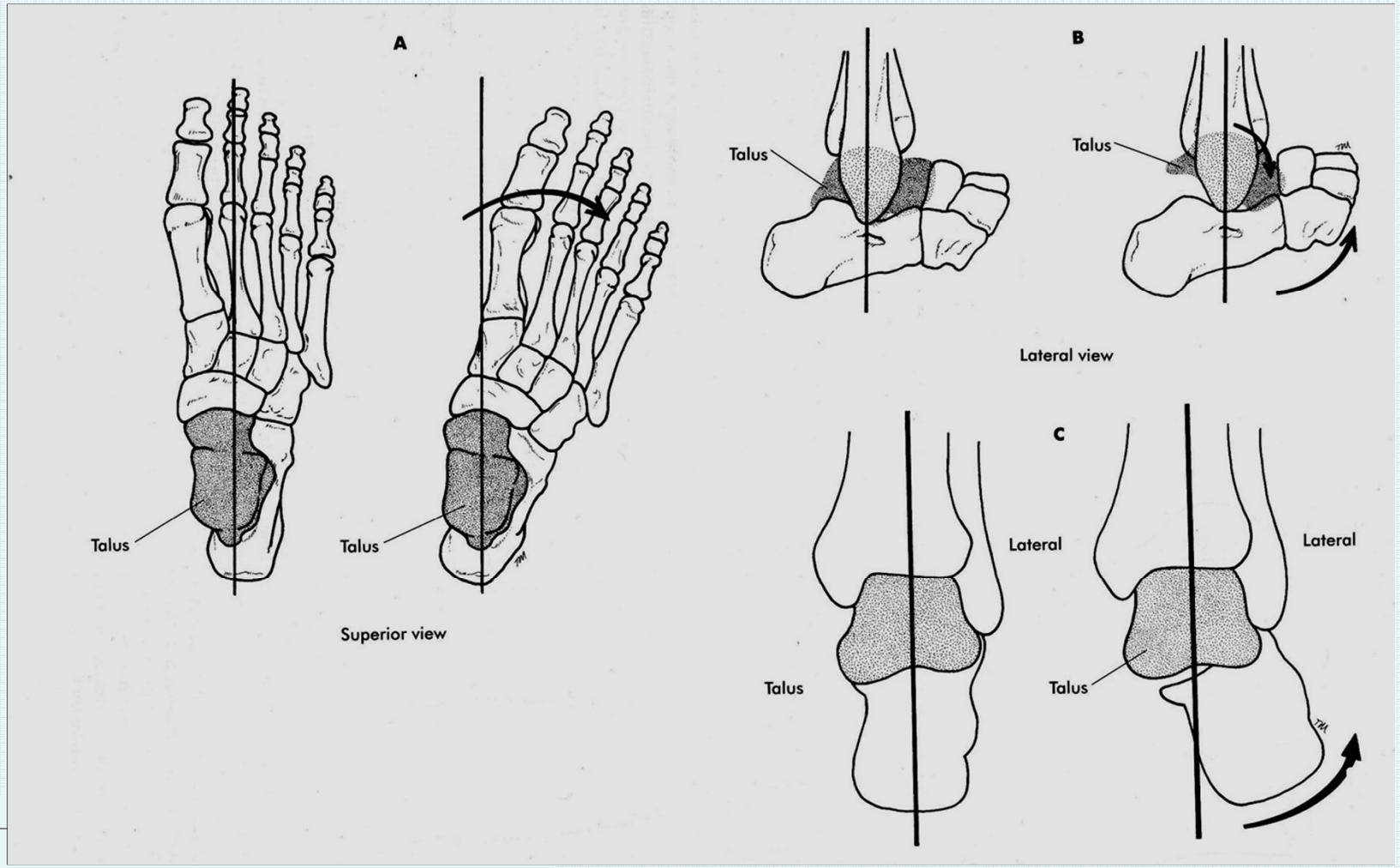


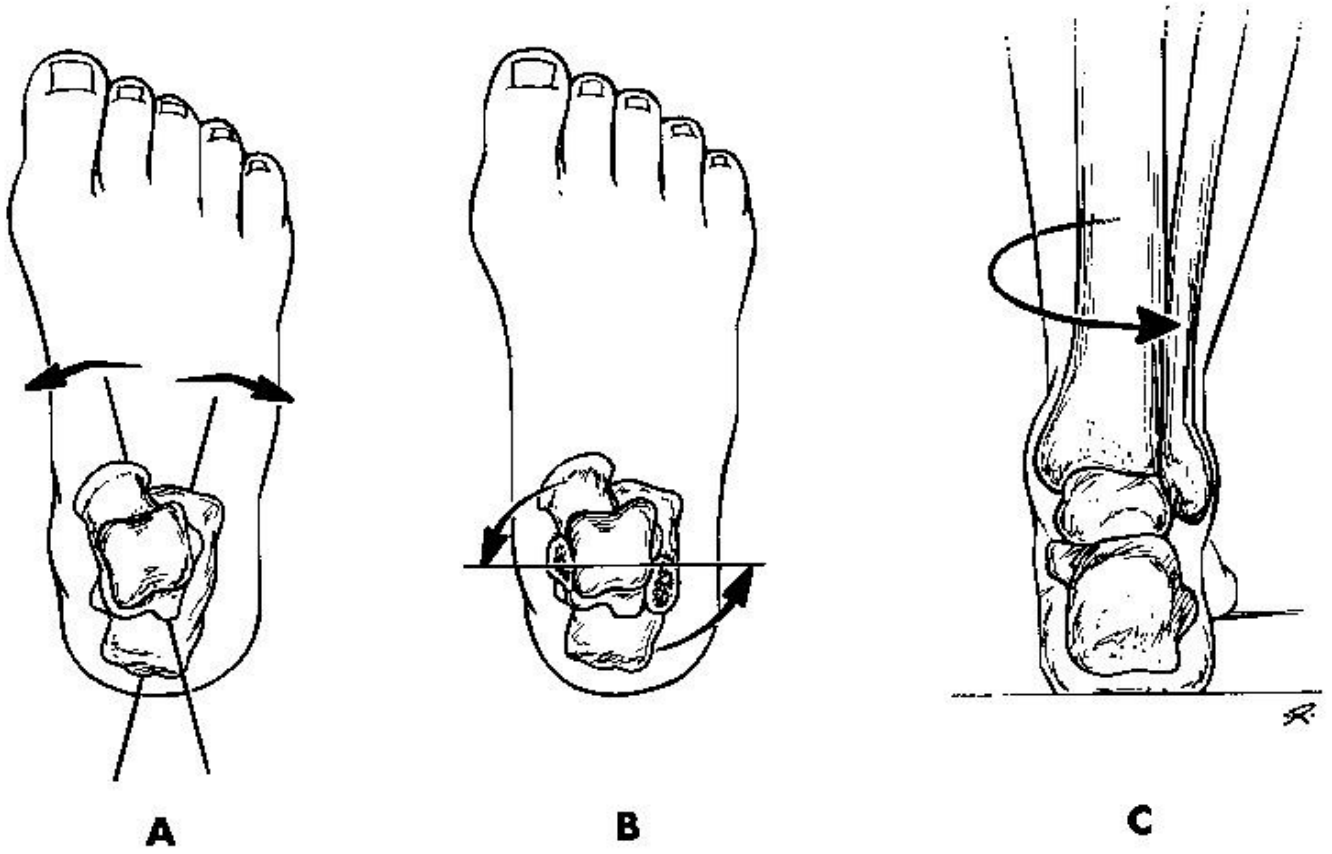
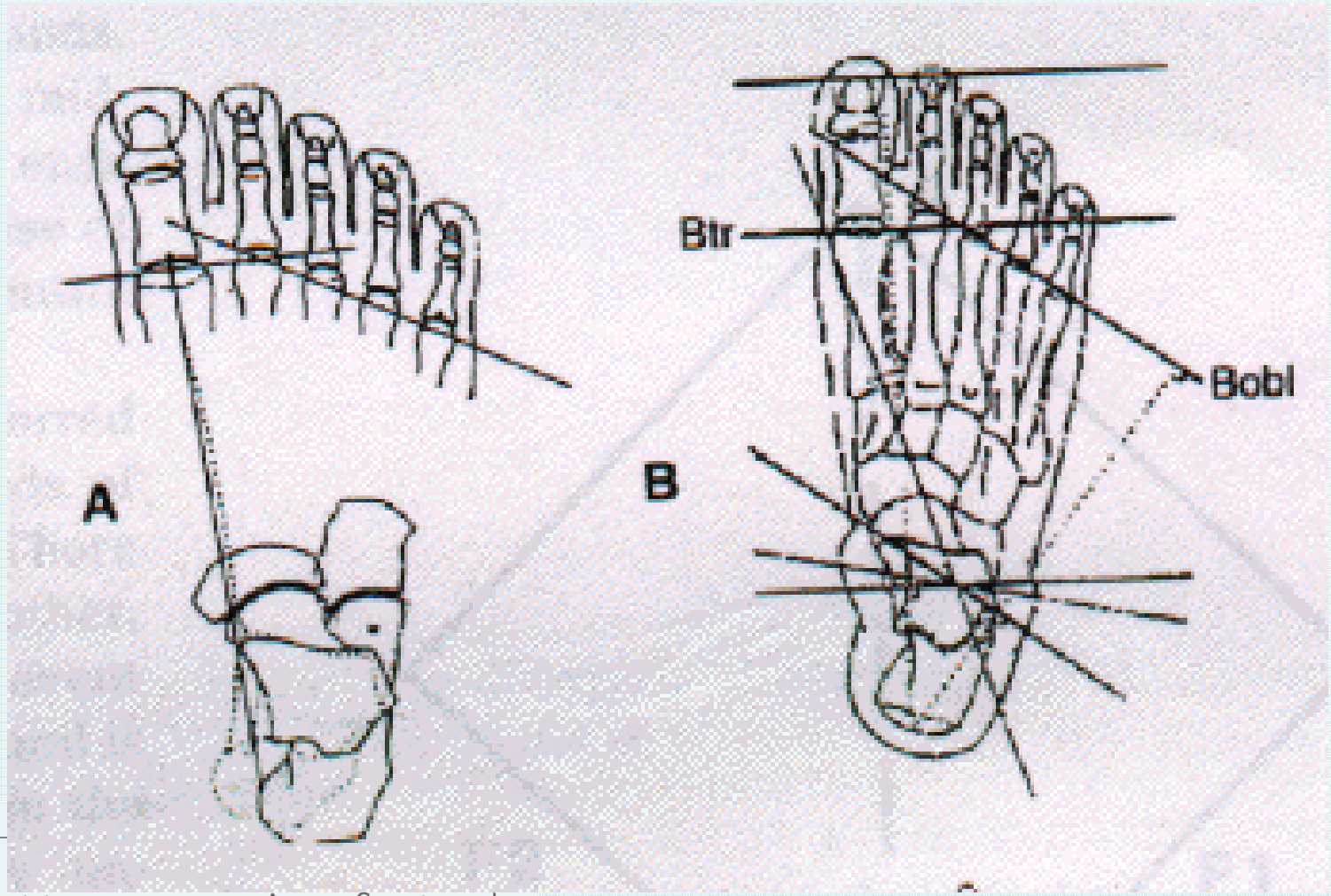
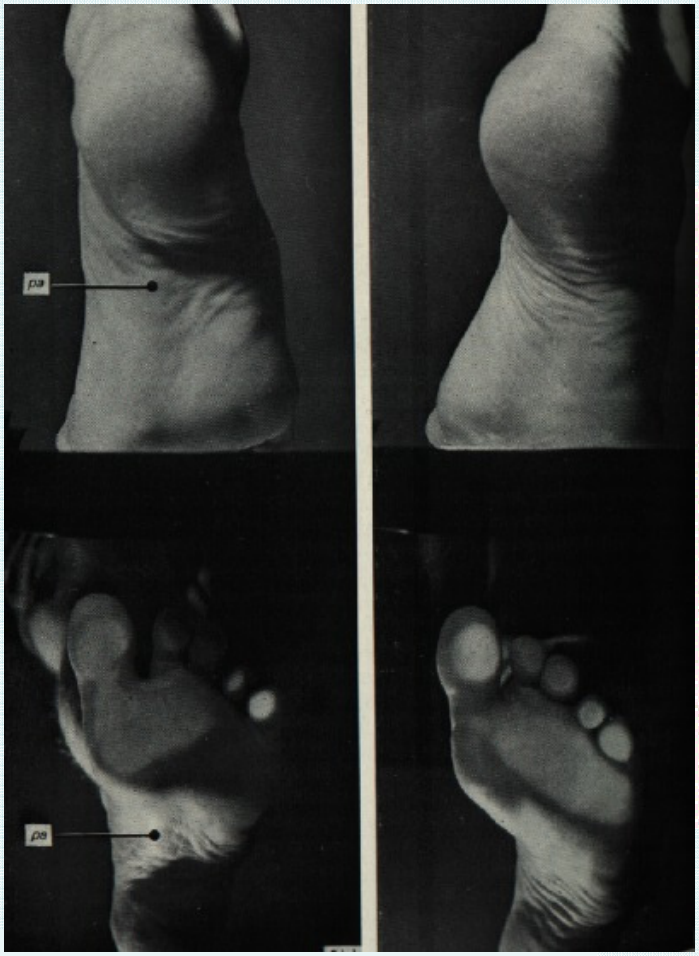


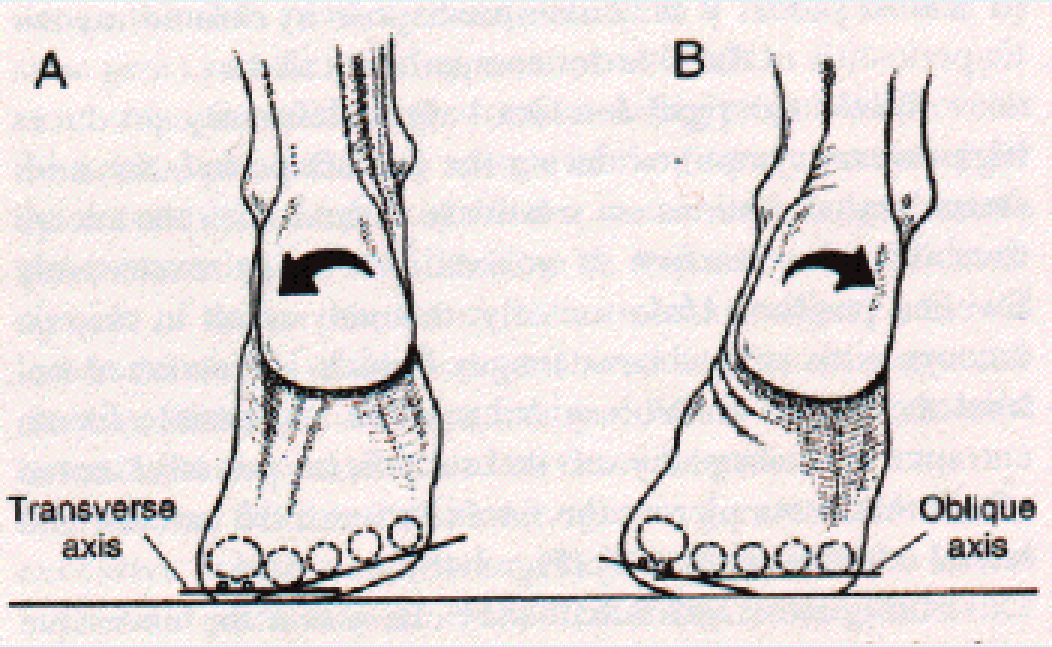

**Fig. 1-18.** Loading response of the subtalar joint. **A,** Adduction of the talus with foot pronation. **B,** The ankle axis *(solid line)* rotates medially *(arrows)* as the talus displaces with foot pronation. **C,** The tibia internally rotates with the talus.

# High gear / low gear propulsion



# High gear / low gear propulsion





# Pathogenesis – Degeneration/ Vascular

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- Tendinosis rather than tendinitis – alignment of collagen fibres lost
- Zone of ischaemia – ff position increases gliding resistance of tendon
- Fibroblast hypercellularity, degeneration and neovascularisation by repeated microtrauma
- Thickening irregular structure
- Synovial effusion
- Overpronation – Mobile medial column
- Achilles tightness



Mosier 1998

# Examination

- MSK assessment - diagnosis
- Lower leg frontal plane
- Calcaneal alignment / foot posture Index
- Regional assessment of media ankle – palpation observation
- Tip toe test – mid foot breech
- 10 unsupported heel rises on each leg
- Resisted manual muscle testing inversion and plantar flexion
- Reafoot Forefoot flexibility /stiffness
- Malleloar position

# Foot Posture Index

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Pronated (+2)

Pronated (+2)

Pronated (+2)

Pronated (+2)

Pronated foot (+2)

# Clinical Predictors

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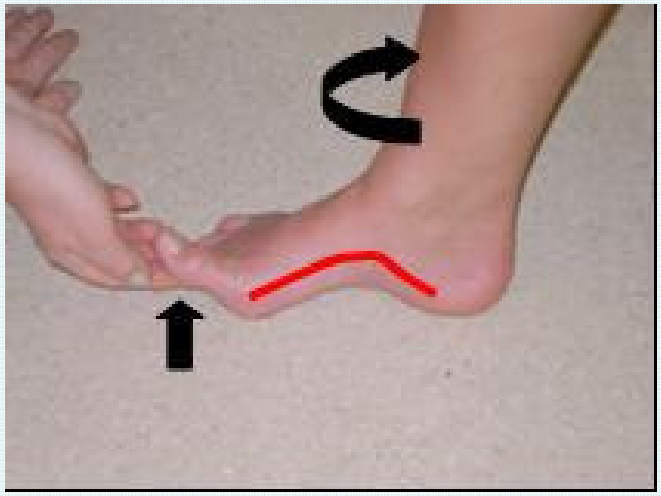
- Single heel raise
- Hubschner Manoeuvre
- Supination Lag
- 1st metatarsal Rise

- Tests positive if ligaments not intact

# Test for ligamentous stability



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# Tip toe test

- Fatigues
- Persistent pronation
- Impossible
- Too painful

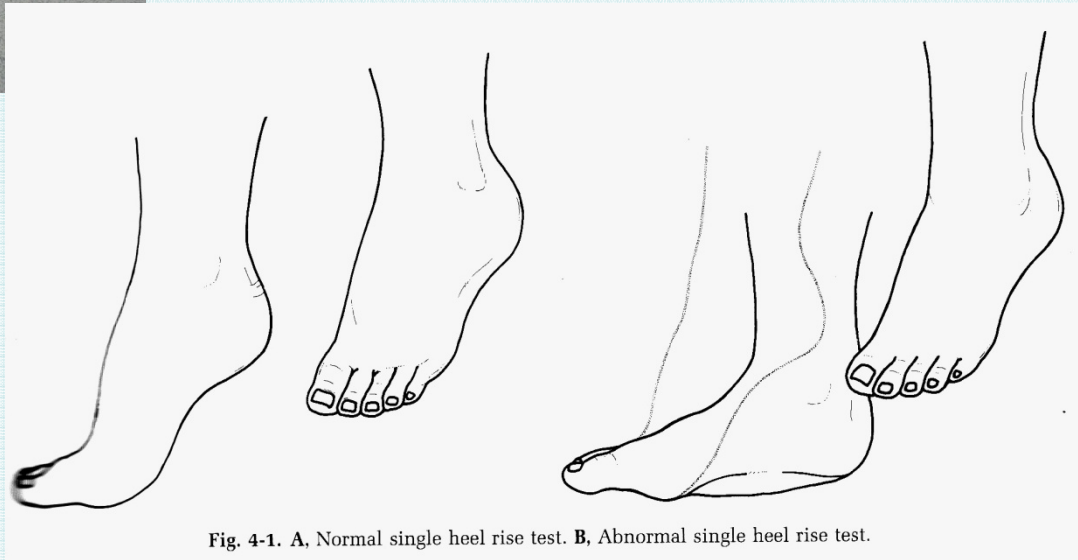

Fig. 4-1. A, Normal single heel rise test. B, Abnormal single heel rise test.

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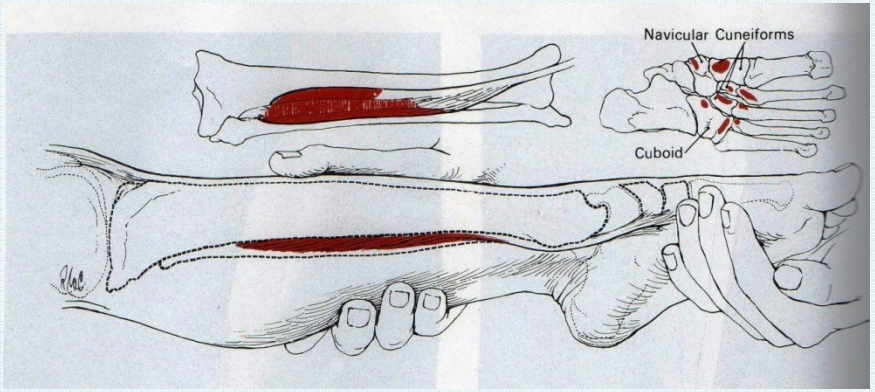


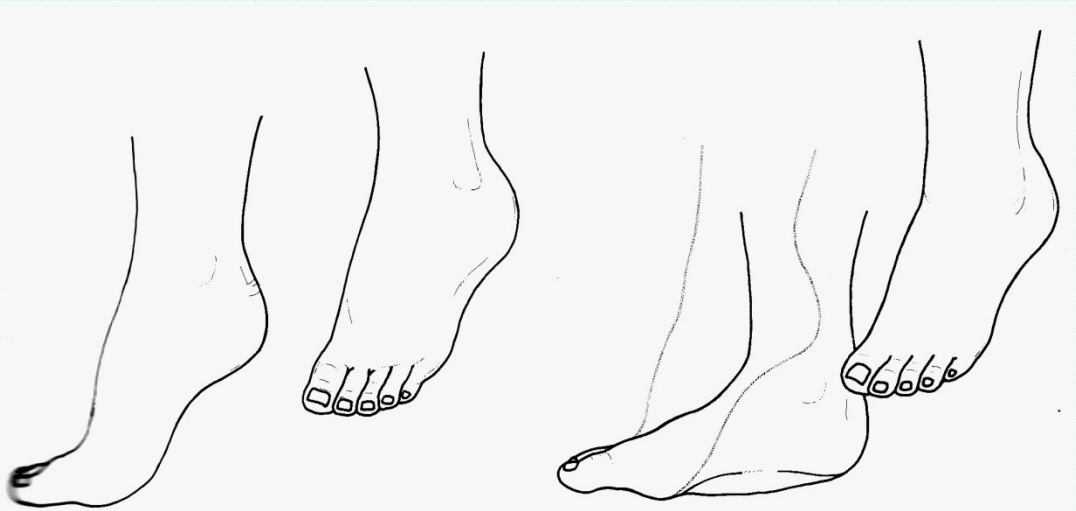

**Fig. 4-1. A,** Normal single heel rise test. **B,** Abnormal single heel rise test.

# Compartment Syndrome

- Increased interstitial pressure within muscle compartment interferes with circulation and function
- Vascular and neural effects within the muscle compartment - ischaemia
- Chronic, exertional or acute
- Relationship + mass by +volume +pressure
- Aetiology – obstruction crush burns exercise drug overdose
- Increase in thickness and stiffness fascia
- Venous collapse – decreased tissue perfusion
- FASCIOTOMY



(Garrett 1995, p.48)

# Medial tibial stress syndrome

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- Multi-factorial  overuse
- Exercise induced in runners
- 35% incidence in 124 naval recruits 10 week training programme (Yates and White 2004)
- Diagnosis? Problematic
- Stress reaction/ stress fracture/ tendinopathy musculotendinous strain and compartment syndrome
- Anatomy, training, strength , footwear, mechanics
- Excessive tensile forces to fascia by eccentric soleus and flex longus
- Tib post?
- Fasciitis/ periostitis changes in bone mineral density (Magnusson et al 2001)

# Tibial Stress Reaction and Stress Fracture (Shin splints )

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- Repetitive loading of bone
- Magnitude and fequency exceed ability for bone to remodel
- Stress fracture due to chronic loading
- Sudden increase in actvity

# Late stage prevention

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- complex problems = bony impingement, sinus tarsi inflammation, peroneal tendinopathy equinus contracture, arthrosis

- "can be effectively treated with aggressive conservative management using molded ankle foot orthoses and UCB inserts.“
- “67% of the subjects had results that were considered good to excellent based on pain, function, use of an assistive device, distance of ambulation and patient satisfaction.” (Chao et al. 1994)
- 87% (Nielson et al 2011)

# Conclusions

- Complex Aetiology, presentation
- Recognising stage 1 and stage 2A and B
- Treat acute symptoms

- Effective staged education
- Absence of pain not necessarily absence of pathology
- Orthotic - restore arch and architecture

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