

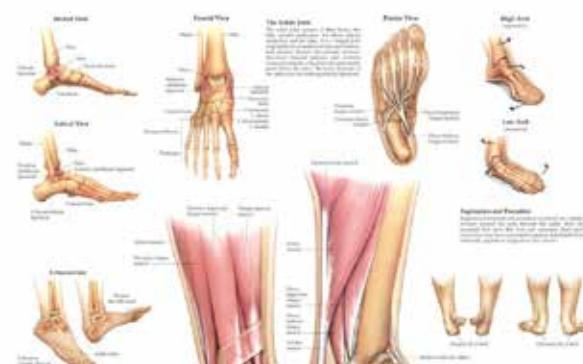
Clinical Anatomy of the Foot

Prof. Dr. Beat Riederer, UNIL
Hannes Bangerter, UNIBE

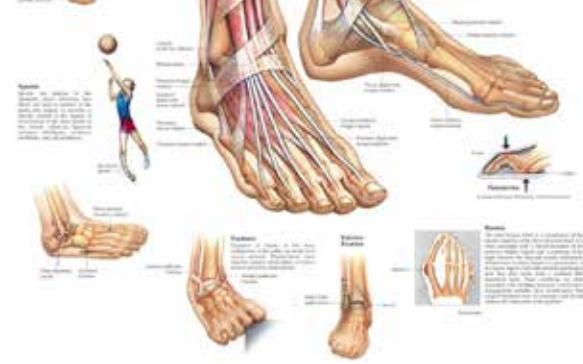
----- Introduction

Foot Facts

26 bones



33 Joints



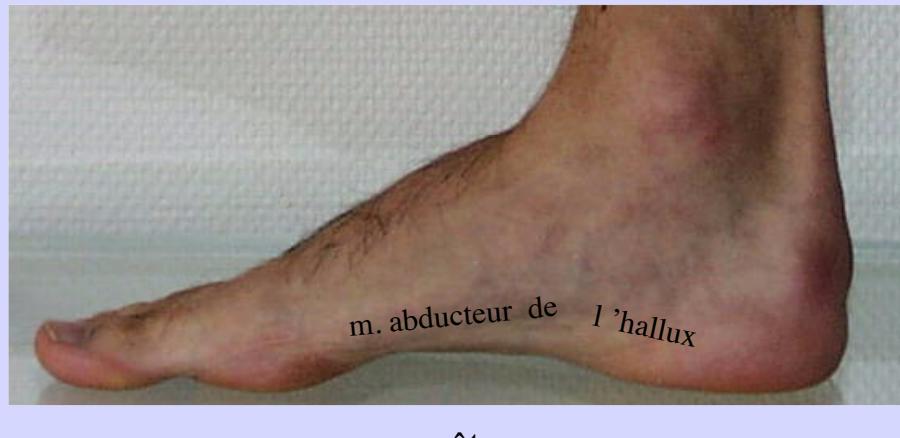
107 Ligaments

19 Muscles

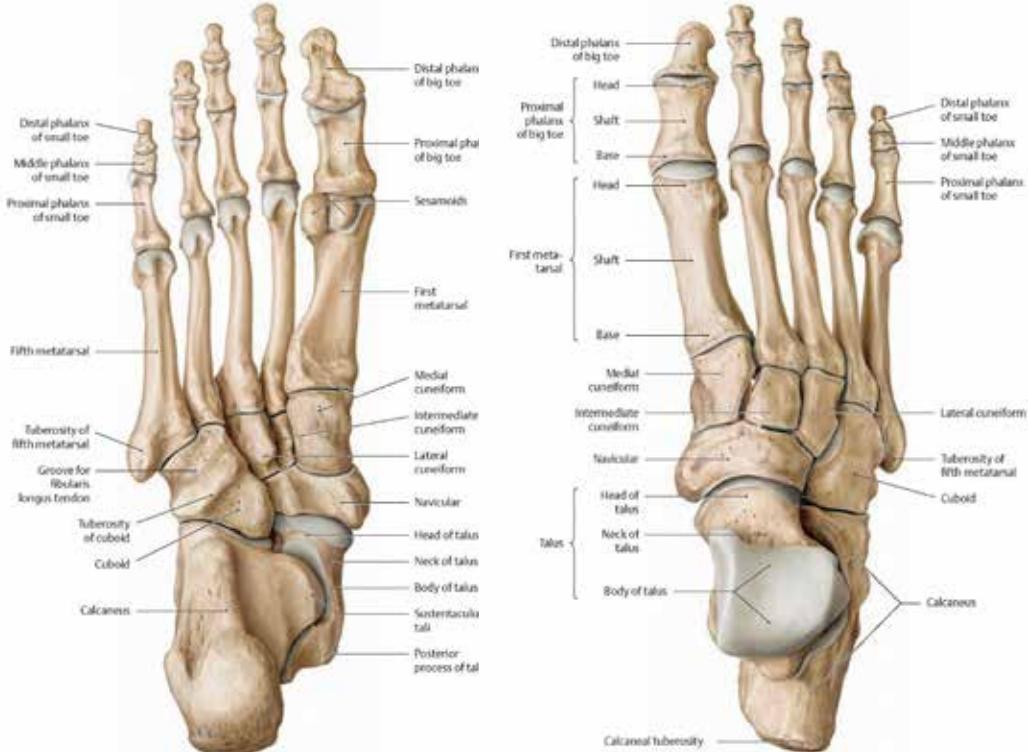
Ankle and foot



tendon d'Achille



voûte



E The bones of the right foot
Plantar view.

Illustrator: Karl Wesker

pp. 374-375

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A The bones of the right foot
Dorsal view.

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Ligne de Lisfranc

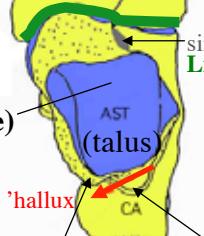
(naviculaire)

Ligne de Chopart

poulie (trochlée)

fléch. de l 'hallux

Tubercles médial et latéral



Phalanges

Métatarsiens

Tubérosité

Tarse

sinus du tarse

lg. fibulaire.
Lig. talo-calcanéen inteross.

AST (talus)

CA

Os sésamoïdes latéral & médial

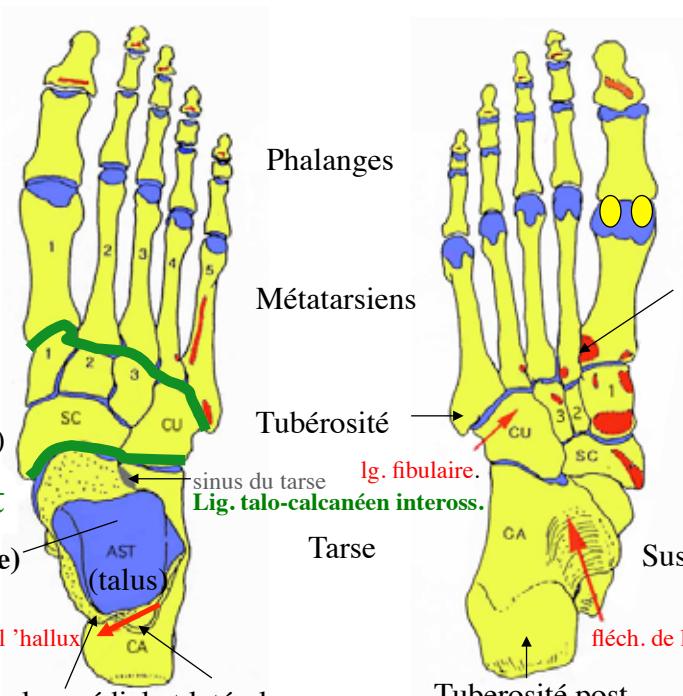
Tubérosité

Sustentaculum tali

fléch. de l 'hallux

Tubérosité post.

Amputation lines





C Transfer of compressive stresses in the weight-bearing foot

Schematic sagittal section at the level of the first ray, medial view.

- b Pattern of the cancellous (spongy) bony trabeculae resulting from compressive stress.

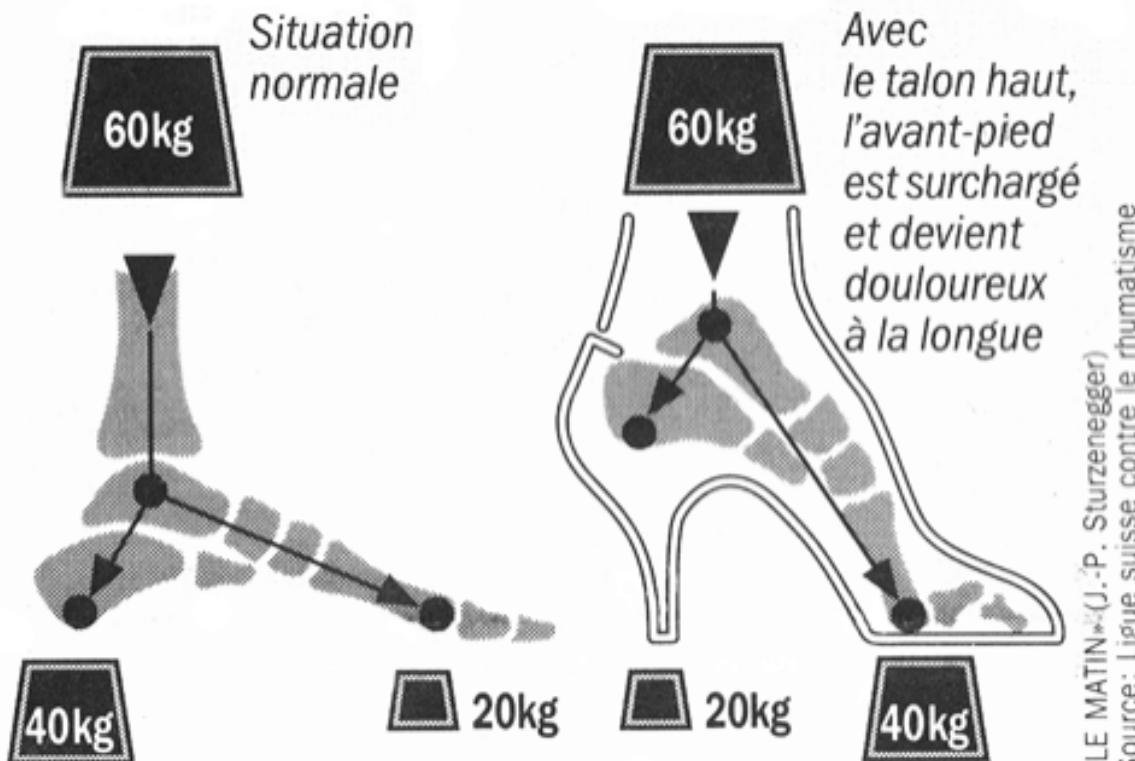
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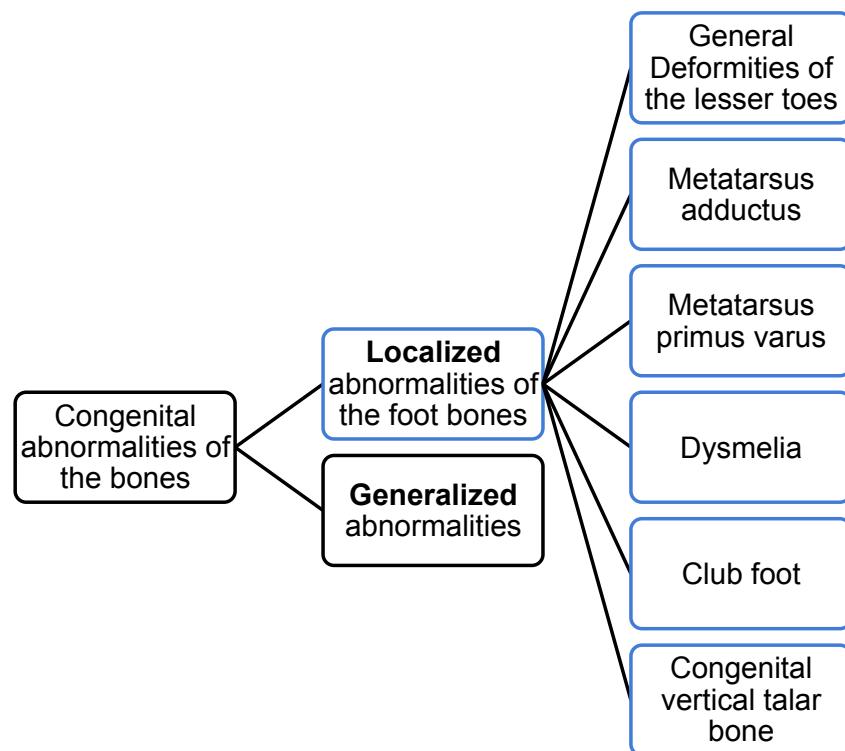
Repartition of body weight





Lets bet on the wellbeing or these feet

Congenital Deformities of the foot bones



Localized congenital Deformities of the foot bones

General deformities of the lesser toes:

Cross-over deformity

- Dorsal subluxation of the metatarsophalangeal articulation
- Overlapping and underlapping toes
- Most often affects the little toe



Varus deformity of the lesser toes

- Inherited inward angulation of distal bone segment or joint
- Very common
- Not clinically relevant
- Most often the 3rd toe



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Localized congenital Deformities of the foot bones

Dysmelia

- Birth defect of the limbs
- 1:1000



Types of dysmelia:

- | | |
|-----------------|-------------------|
| ■ Amelia | = missing limbs |
| ■ Oligodactyly | = too few limbs |
| ■ Brachydactyly | = too short limbs |
| ■ Syndactyly | = fused limbs |
| ■ Polydactyly | = too many limbs |

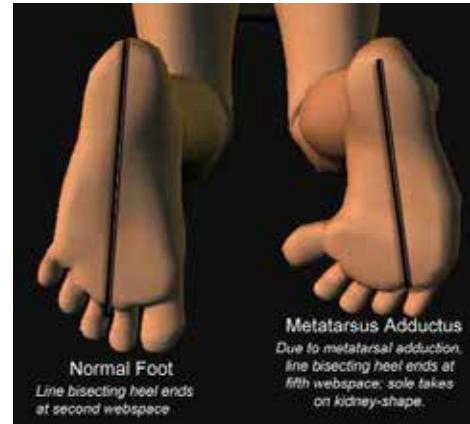


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Localized congenital Deformities of the foot bones

Metatarsus adductus / varus:

- Metatarsal bones pointing inward (**adduction of Lisfranc joint**) while positions of middle and forefoot are normal (in contrast to the clubfoot)
 - **Varus** = fixed deformity (medial subluxation of tarsometatarsal joints)
 - **Adductus** = flexible deformity (rotation into neutral position possible)
- Caused by **in utero confinement** of the fetus (fixed foot position)
- Pathophysiology:
 - **In-toeing**
 - Foot inversion (line bisecting heel)
 - Kidney or C shaped sole
 - Splaying of first web space
 - Prominent tuberosity of 5th metatarsal bone



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Localized congenital Deformities of the foot bones

Metatarsus adductus / varus:

- Epidemiology:
 - Most common congenital foot deformity
 - Incidence 1 – 2 per 1000 births
 - Female > male
- In-toeing caused by:
 - **Medial femoral torsion** (hip)
 - Medial tibial torsion (leg)
 - Metatarsus adductus
- Prognosis
 - 85 – 90% spontaneous resolution by year 1
 - Severe and rigid deformities are very rare



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Localized congenital Deformities of the foot bones

Metatarsus primus varus

- Syn.: Splay foot (german Spreizfuss)
- Varus deformity of the first ray, where the first metatarsal bone is rotated and angled away from the second metatarsal bone (increase in first intermetatarsal angle)
- Several causative factors are considered in pathogenesis :
 - Hereditary factors (family history)
 - Instability of first tarsometatarsal joint

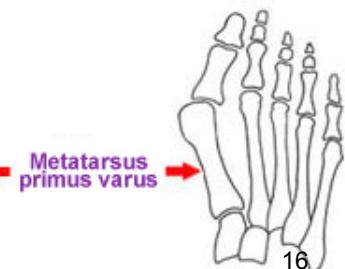
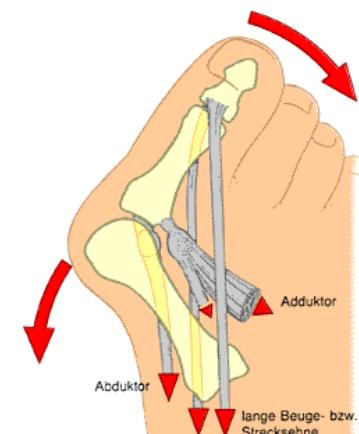


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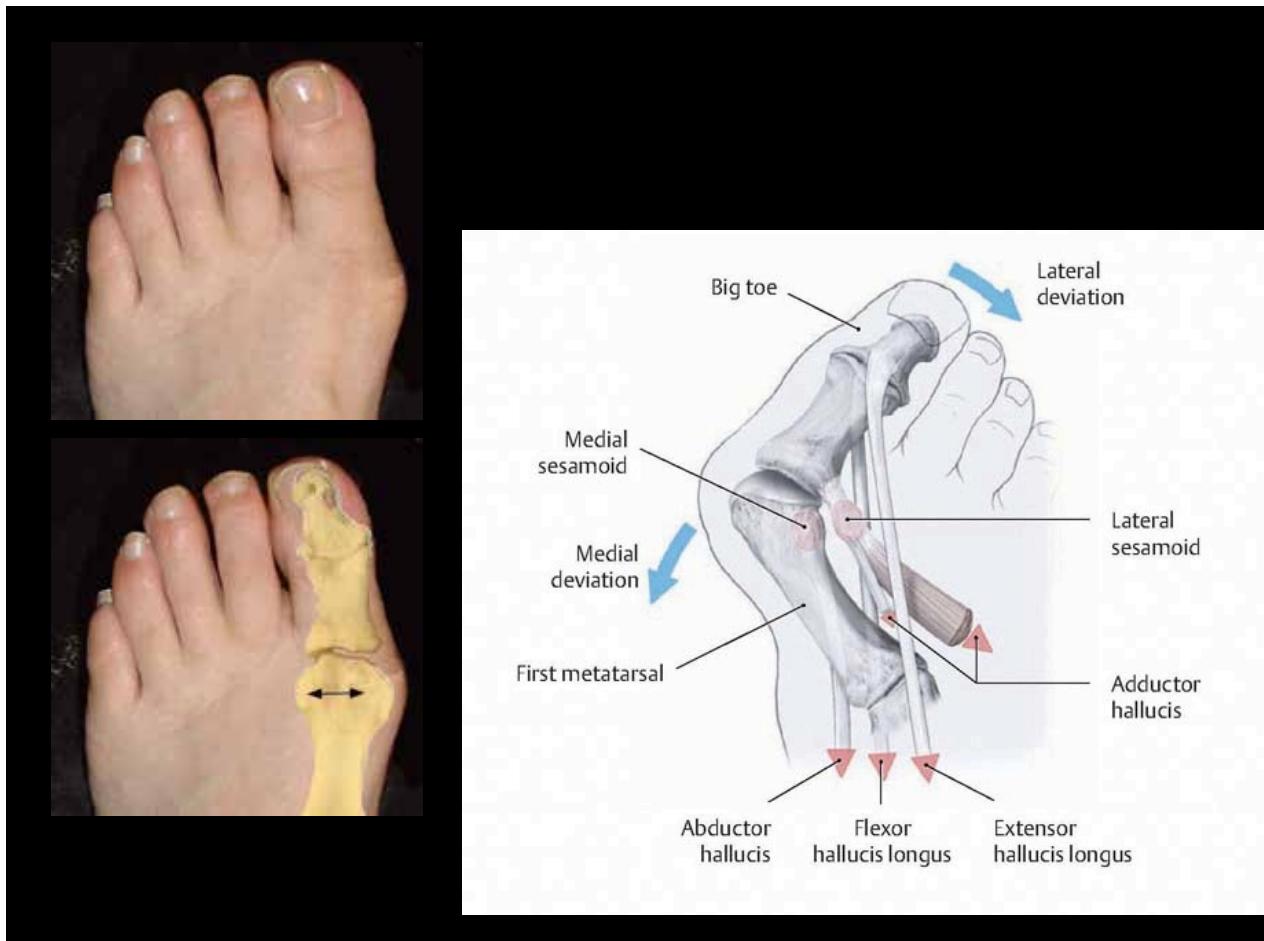
Localized congenital Deformities of the foot bones

Metatarsus primus varus

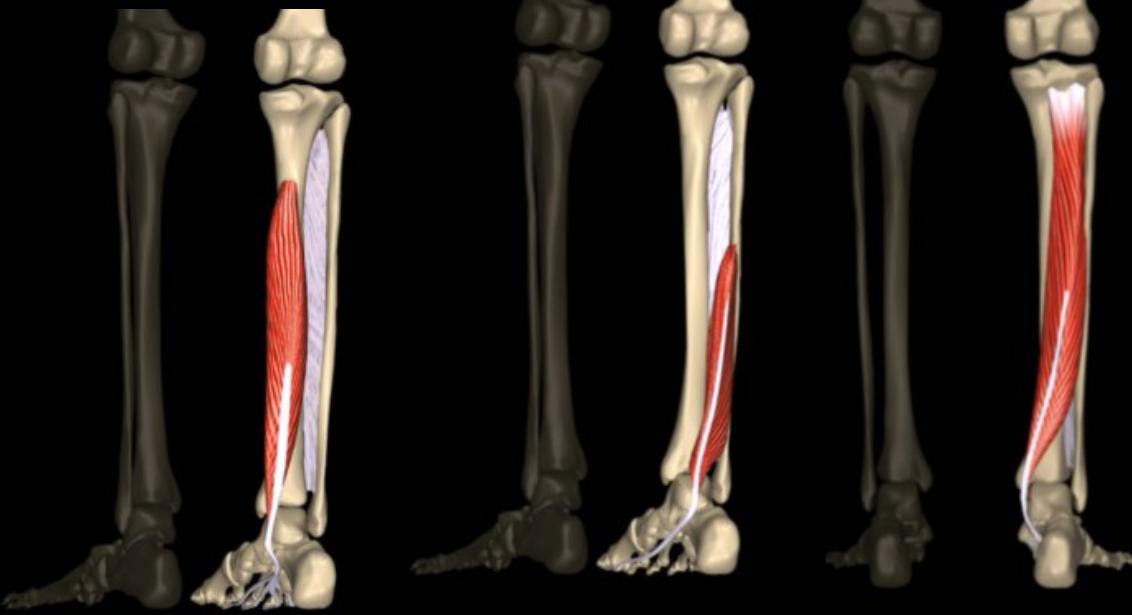
- Pathophysiology:
 - Association with **hallux valgus** (lateral deviation of the hallux in the metatarsophalangeal joint)
 - Medial deviation of metatarsal bone shifts M. abductor hallucis from medial to plantar position, leads to predominance of M. adductor hallucis
- Symptoms primarily because of the hallux valgus:
 - Pain
 - Footware problems
- Hallux valgus is very common pathology (25 – 30%) and has also secondary (acquired) etiologies!
 - Wrong Footware



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Loges postérieures



m. fléchisseur des orteils

m. fléchisseur de
l 'hallux

m. tibial postérieur

AOUT/SEPTEMBRE 2012 - Mensuel
Commission paritaire 1213 T 86410
ISSN : 1148 2362

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RENCONTRE



Jacques Vallotton

Jacques Vallotton exerce à Lausanne à la clinique Bois Cerf.
Il s'intéresse particulièrement au genou des sportifs. Ses études sur la cinématique de la marche
l'ont conduit à découvrir l'importance de la pathologie du long fléchisseur du gros orteil.
Il nous expose avec clarté et conviction toutes les implications fonctionnelles et
thérapeutiques de cette pathologie.



b

E Location of pain associated with splayfoot and flat foot (after Loeweneck)

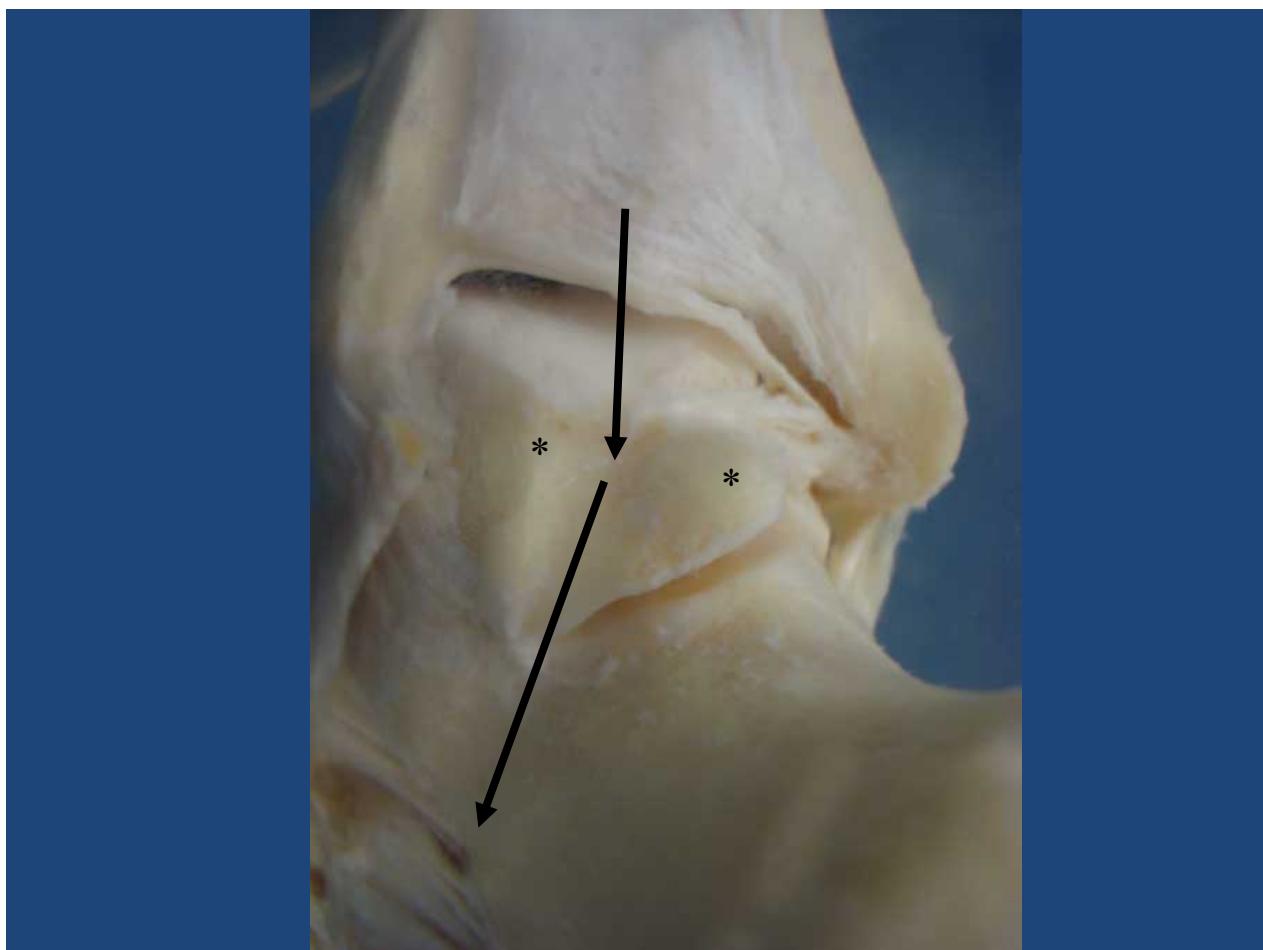
- b Right flat foot viewed from the medial aspect.

Illustrator: Karl Wesker

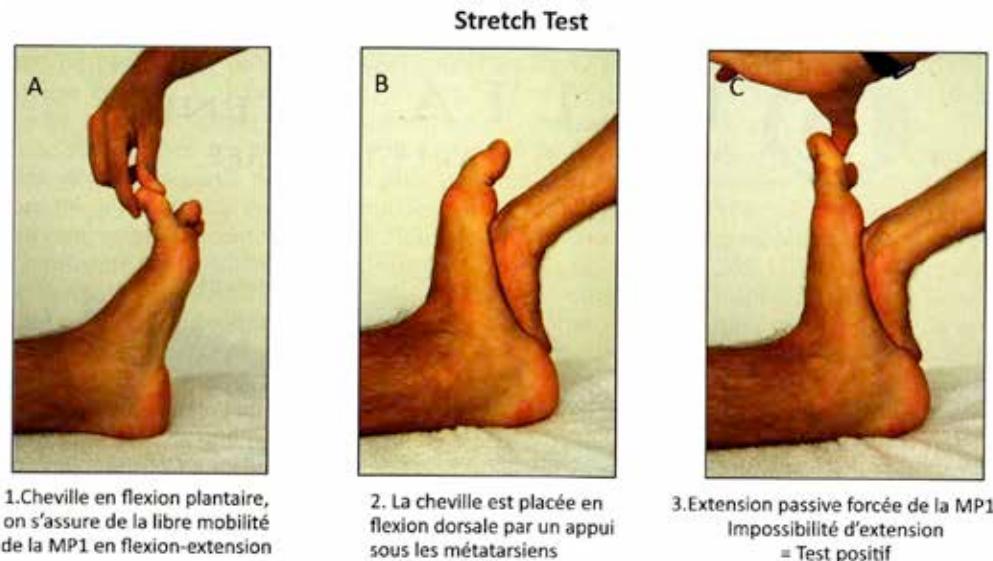
pp. 414-415

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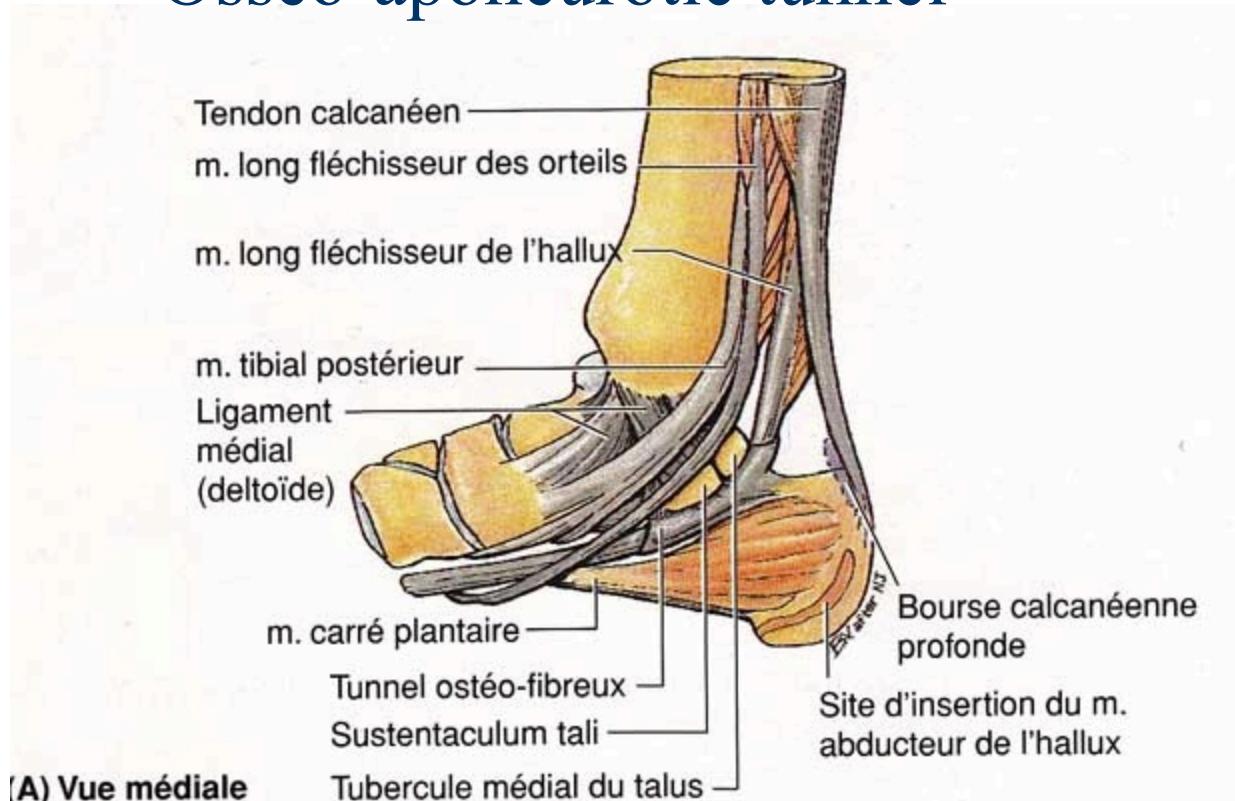
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Stretch test of hallux

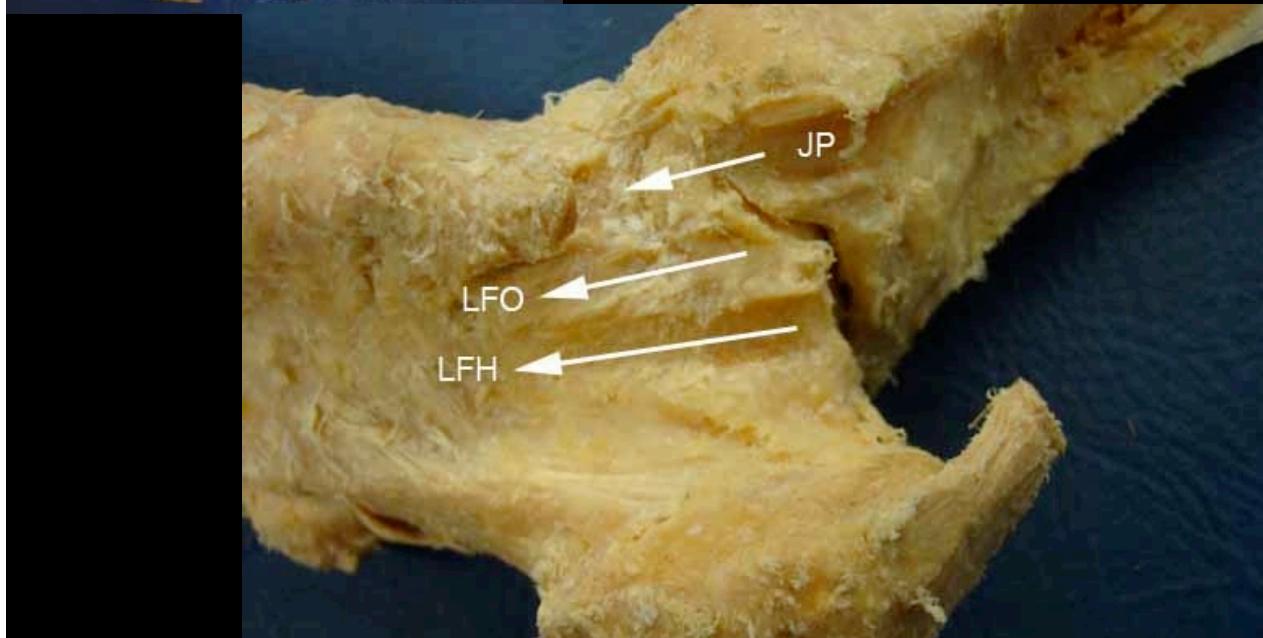


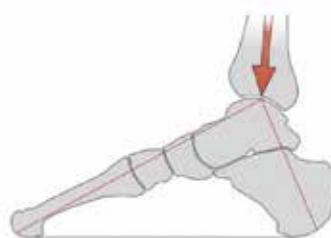
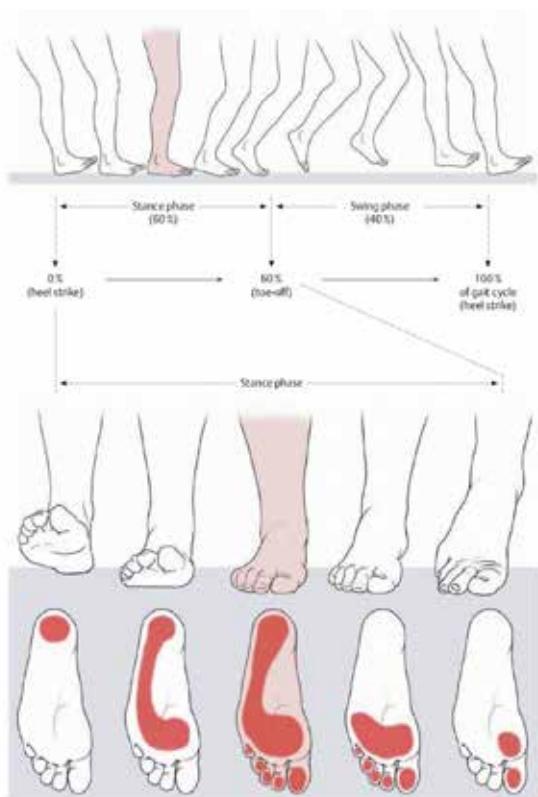
Osseo-aponeurotic tunnel





Trajectories of flexors





Illustrator: Karl Wesker

pp. 412-413

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D Movements of the leg during one gait cycle

Illustrator: Karl Wesker

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The art of podogrammes

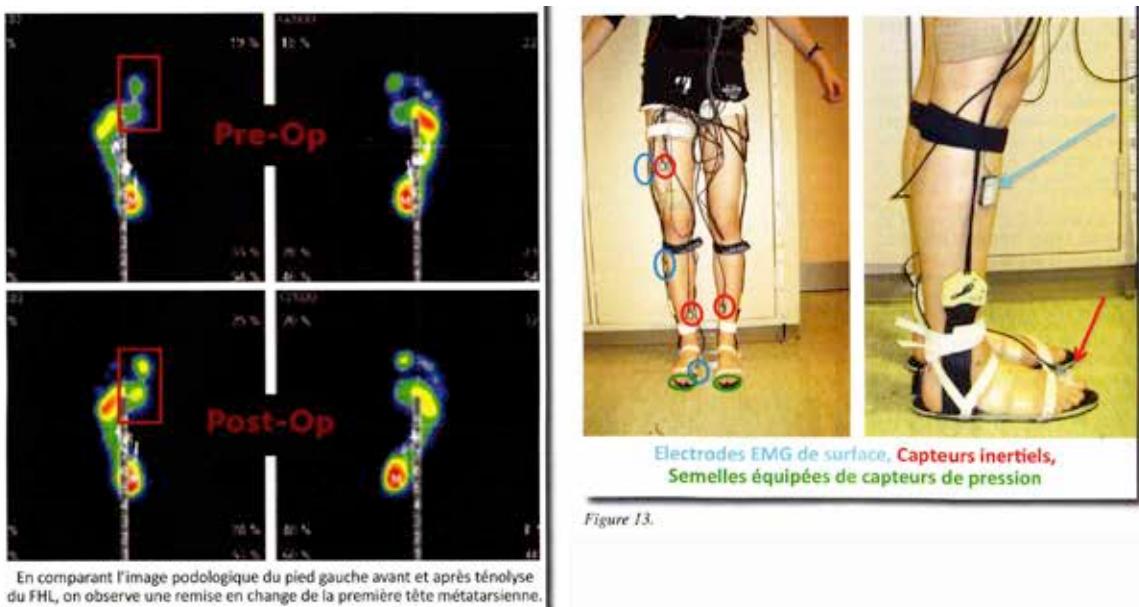


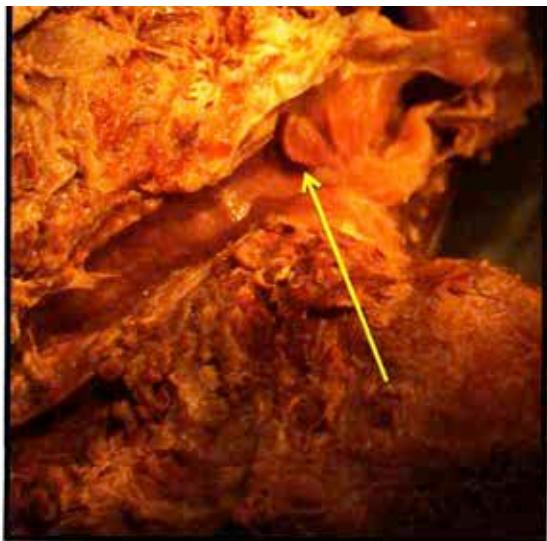
Figure 13.

Image podologique dynamique



Le déroulement du pas est schématisé sur la courbe rouge.
On observe un manque de stabilité à l'attaque du talon et,
en fin de phase d'appui, un rapide passage en pronation
caractérisé par une brusque inflexion de la courbe.

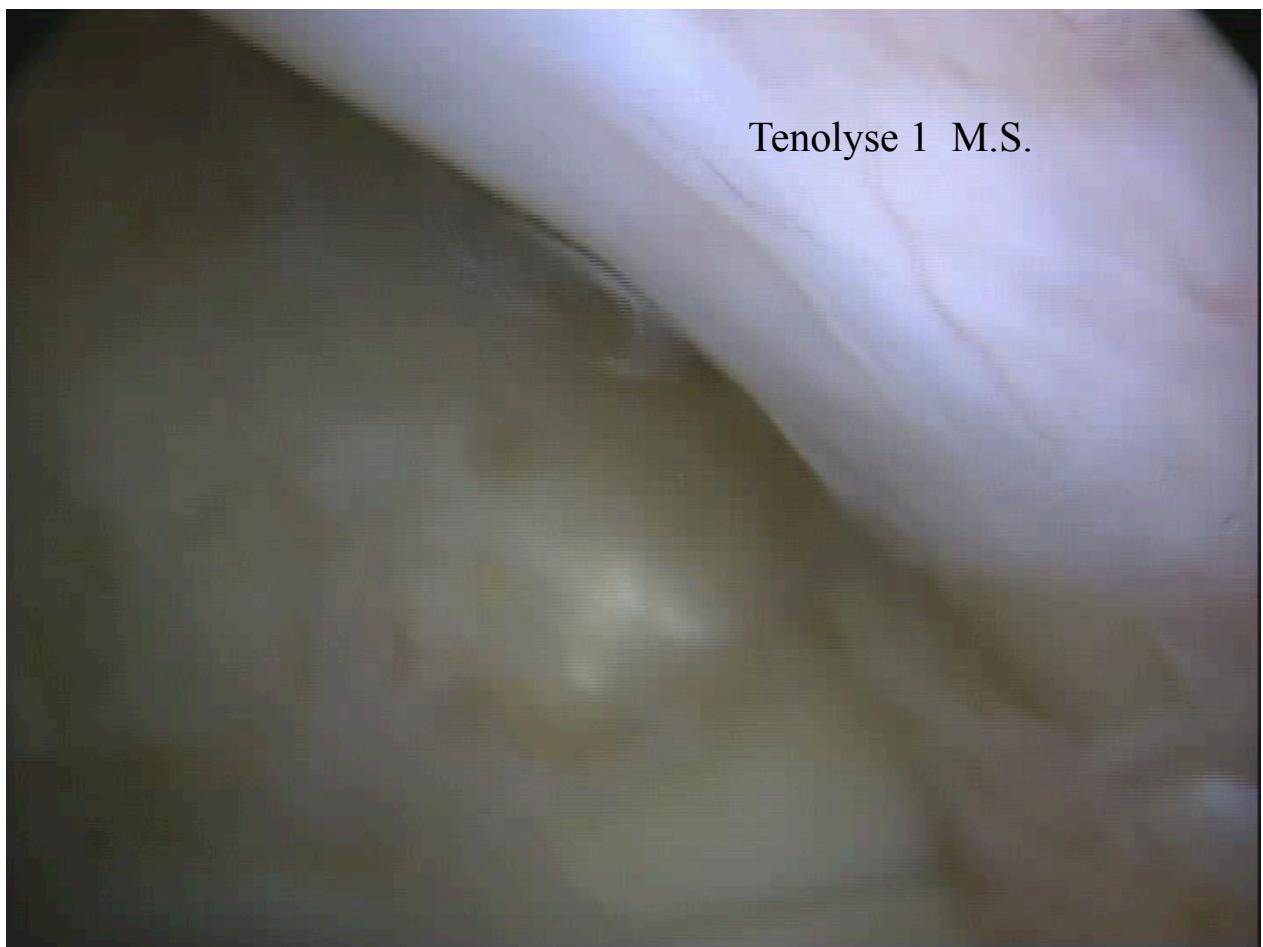
Tenolysis of the FHL canal



En regard de l'interligne talo-calcanéen,
on observe une structure synoviale
« méniscoïde » qui fait saillie à l'extérieur



Le scope est introduit parallèlement au
grand axe du pied jusqu'au contact de l'os.



Tenolyse 1 M.S.



Localized congenital Deformities of the foot bones

Club foot

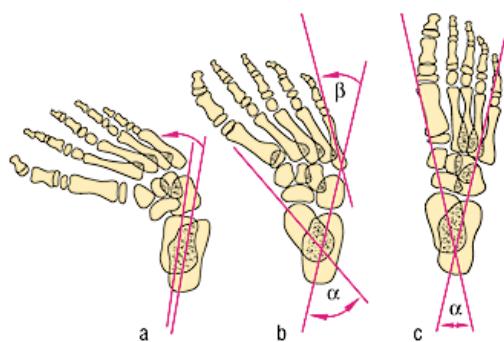
- Syn.: Congenital talipes equinovarus CTEV
- Epidemiology:
 - Incidence: 1-2 per 1000 live births
 - Often bilateral (30 - 50%)
 - Ratio male to female = 2:1
 - Higher familial incidence
 - Most common non-life threatening major birth defect



Localized congenital Deformities of the foot bones

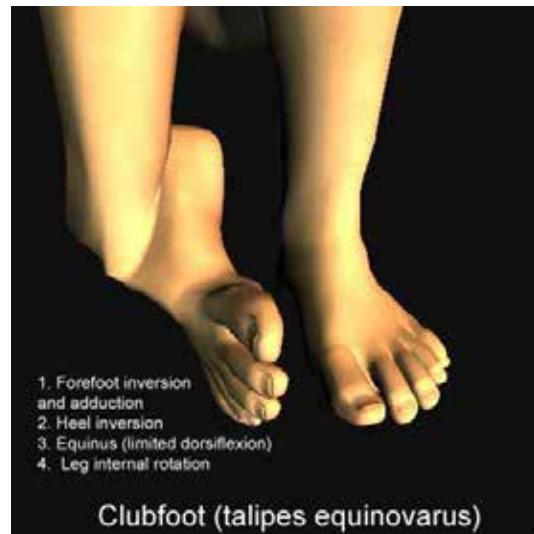
Club foot

- 4 Components: InAdEqate
 - Inversion at ankle and subtalar joint with internal rotation
 - Adduction at talonavicular joint
 - Equinus (plantar flexion) at ankle
 - Leg internal rotation



- Differential diagnosis:

- Metatarsus adductus (no equinus!)

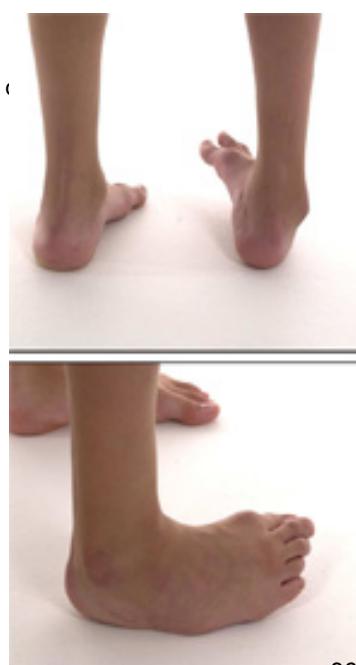


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Localized congenital Deformities of the foot bones

Club foot

- The exact etiology is unknown:
 - Inherited
 - Result of compression during development (abnormal position of embryo in utero, Amniotic band syndrome, Oligohydramnios, Compression)
 - By-product of various genetic diseases (Neural tube defects, NTDs, connective tissue diseases)
 - Effects of Medication during pregnancy (folic acid antagonists)
 - Acquired
 - Muscle weakness (M. peroneus longus et brevis)
 - Neurologic disorders
- Neuromuscular pathogenesis is implied:
 - Shortened tendons and muscles
 - Thickening of the joint capsules
- Club foot Types:
 - Extrinsic club foot (mild, supple)
 - Intrinsic clubfoot (severe, rigid)

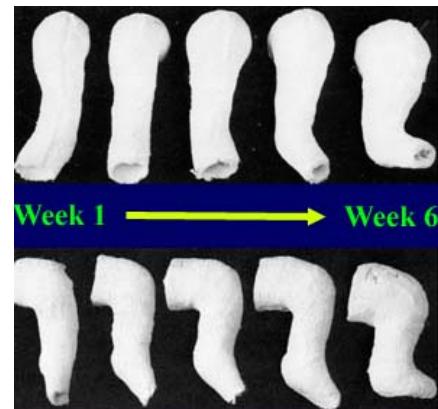


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Localized congenital Deformities of the foot bones

Club foot

- Associated diseases:
 - Congenital dislocation of hip
 - Spina bifida
 - Myotonic dystrophy
 - Arthrogryposis
- Therapy: Make the foot functional, painless and stable
 - **Serial Casting** (mechanical correction of the foot position during first 6 – 12 weeks of life)
 - **Surgery** (necessary in up to 50% of cases)



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Localized congenital Deformities of the foot bones

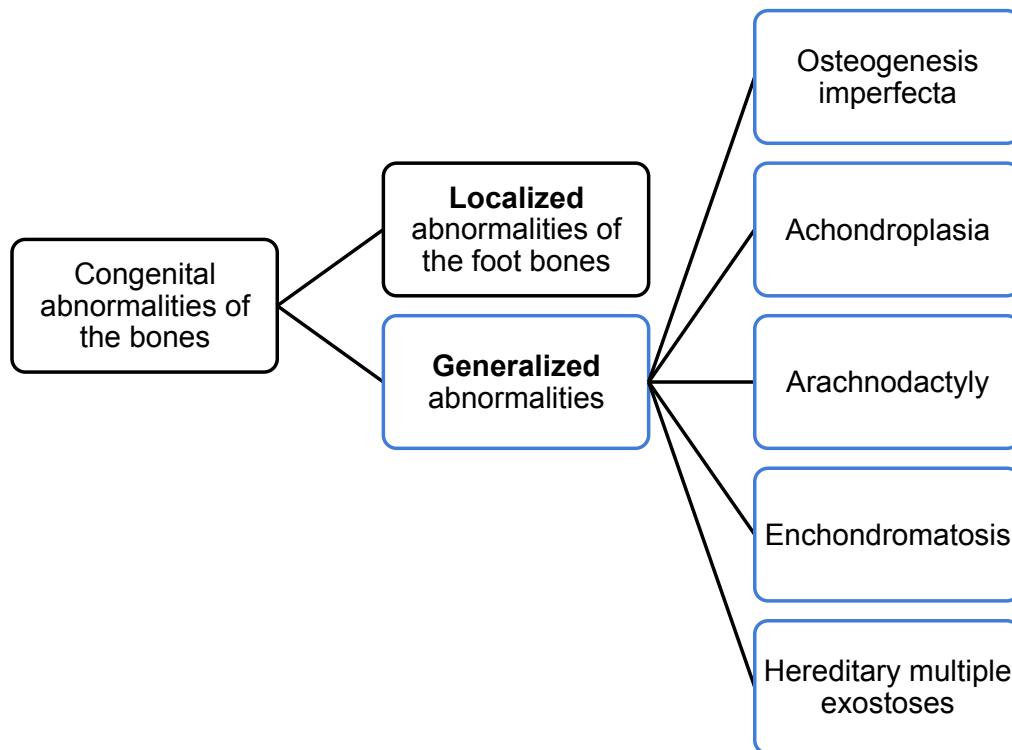
Congenital vertical talar bone

- Syn.: Pes planovalgus congenitus, congenital flatfoot, congenital rocker-bottom flatfoot
- Talar bone in a vertical position that results in a rigid dorsal and lateral luxation of the talocalcaneonavicular joint
- Caused by wrong bone formation
- Pathophysiology:
 - Rocker-bottom appearance (reversed longitudinal arch of the foot = **convex plantar surface**)
 - Plantar flexion of ankle joint
 - Midfoot and hindfoot dorsiflexed
- In 60% of cases associated with severe **neurological disorders**



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Congenital Deformities of the foot bones



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Generalized congenital Deformities of the bones

Osteogenesis imperfecta:

- Congenital dysfunction of collagen synthesis (type 1), leading to connective tissue disorders (bones, teeth, ligaments etc.)
- Increased fragility of bones (fractures) and lax ligaments
- Incidence: 1 in 20'000 live births



Enchondromatosis (Ollier's Dyschondroplasia):

- Rare, nonhereditary sporadic disease that is characterized by dysfunctional longitudinal bone growth
- Due to enchondromas (benign cartilaginous tumors derived from the epiphyseal plate) there is an inadequate growth and irregular calcification that can lead to shortening and bowing.
- Prevalence: 1 in 100'000 people



Hereditary multiple exostosis HME (Multiple osteochondromatosis):

- Rare autosomal dominant disease that is characterized by the growth of cartilage-capped benign bone tumours (particularly around metaphysis of long bones)
- Depending on the location, the exostosis can cause shortening and bowing of bones, compression of nerves (numbness, pain), vascular compromise and irritation of tendons, muscles and joints
- Prevalence: 1 in 50'000 people, mostly children and young adults



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Generalized congenital Deformities of the bones

Achondroplasia

- Congenital dysfunction of fibroblast-growth-factor-receptor 3 FGFR3, leading to disorder of enchondral ossification (growth of long and facial bones)
- Common cause of dwarfism (short extremities)
- Incidence: 1 in 40'000 live births



Hyperchondroplasia (Marfan Syndrome, Arachnodactyly)

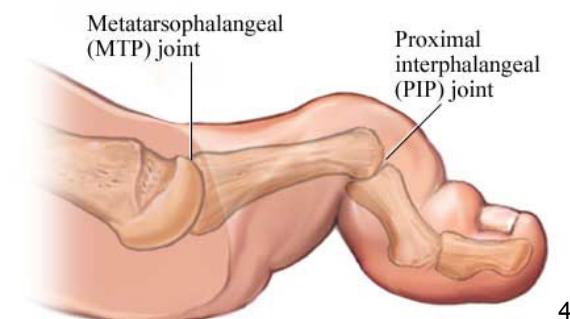
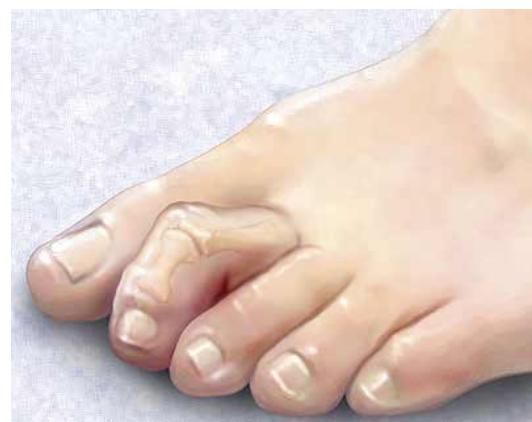
- Autosomal dominant inherited dysfunction the gene FBN1 that encodes for the connective protein fibrillin-1, leading to various disorders of connective tissue
- Most prominent symptoms affect the skeletal system (disproportionately long and slender limbs, abnormal joint flexibility and instability)
- Incidence: 1 in 3000 – 5000 live births



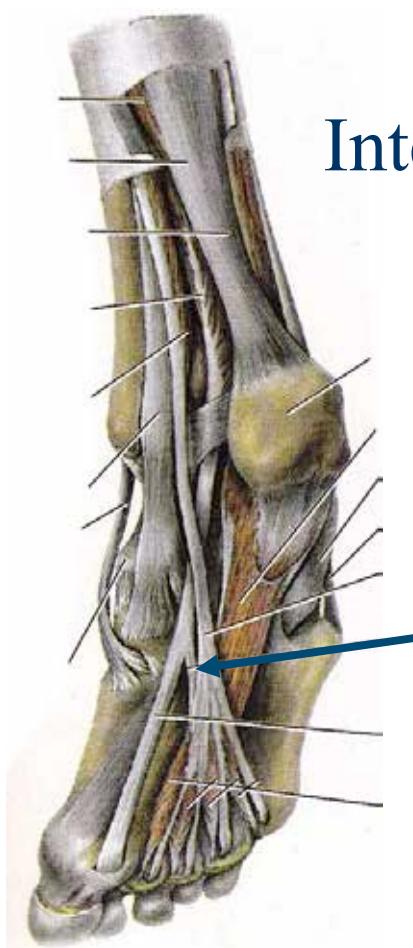
Localized acquired Deformities of the foot bones

Hammer Toe:

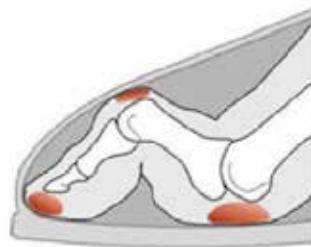
- Syn.: Digitus malleus, contracted toe
german Hammerzehe
- Fixed flexion (contracture) of the proximal interphalangeal joint
- Typically 2nd, 3rd or 4th toe



Intertendineous connections



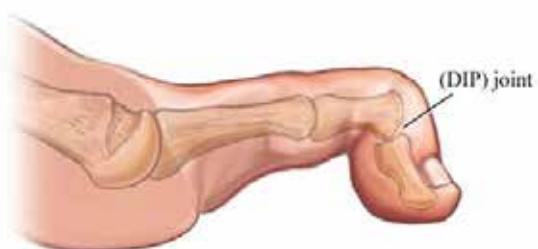
Observez la connexions entre le muscle long fléchisseur de l'hallux et des orteils.
Raccourcissement du LFH amène à la formation d'orteils comme des griffes.



Localized acquired Deformities of the foot bones

Mallet Toe:

- Fixed flexion (contracture) of the distal interphalangeal joint
- Similar to hammer toe



Localized acquired Deformities of the foot bones

Hammer toe (PIP) and Mallet Toe (DIP):



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Localized acquired Deformities of the foot bones

Hallux valgus:

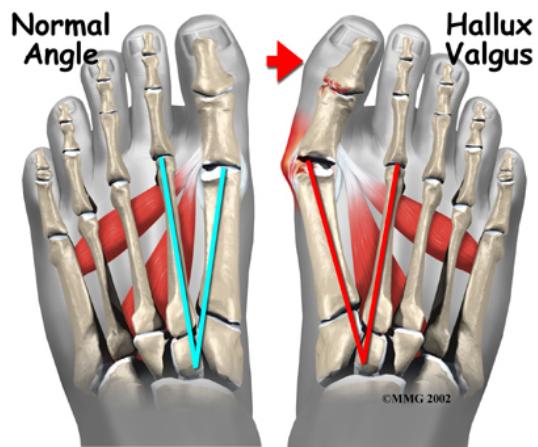
- Syn.: Bunion, hallux abducto-valgus
- Deformity of the big toe characterized by lateral deviation of the great toe at the first metatarsophalangeal joint

Pathogenesis:

- Bunions form due to pressure on the side of the big toe
- Footwear plays an important role

2 concepts for etiology:

- Long-term use of wrong footwear (Indian studies)
- Genetic predisposition (familial predisposition) exacerbated by use of wrong footwear
 - Rheumatic disorders
 - Hypermobility of joints and ligaments
 - Flat feet



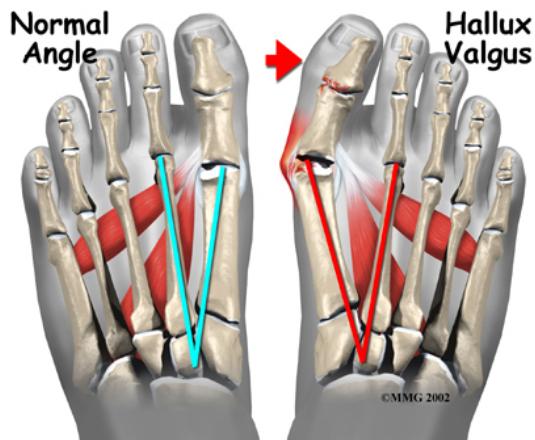
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Localized acquired Deformities of the foot bones

Hallux valgus:

Symptoms:

- Increased valgus angle ($> 15^\circ$) at first MTP joint
- Inflammation of soft tissue (bursitis)
- Painful callus on 2nd toe (forced hyperextension due to deviation)



Bunion associated with:

- Hammer toe of 2nd toe
- Osteoarthritis of great toe at MTP joint



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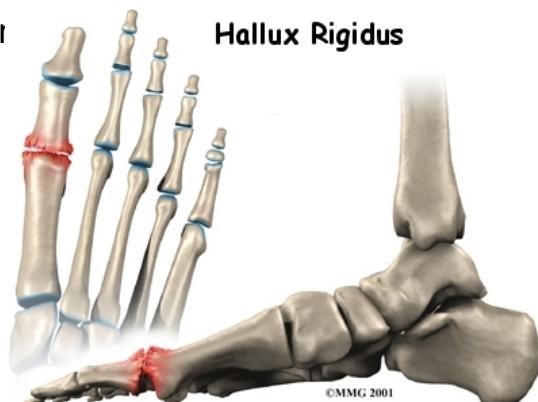
Localized acquired Deformities of the foot bones

Hallux rigidus

- Syn.: Stiff big toe
- Painful stiffening of MTP joint due to degenerative arthritis

Symptoms:

- Pain
- Stiffness (limitation for movement)
- Gait abnormality
- Swelling
- Inflammation

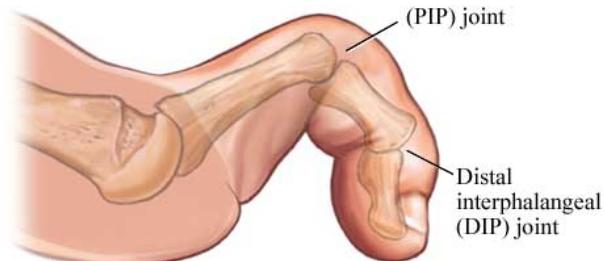


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Localized acquired Deformities of the foot bones

Claw Toe:

- Syn.: Digitus flexus, german Krallenzehe
- Fixed flexion (contraction) of proximal and distal interphalangeal joints (medial and distal phalanx) combined with dorsiflexion (hyperextension) of metatarsophalangeal joint (the proximal phalanx)
- Typically in 2nd, 3rd, 4th or 5th toe
- Luxation or subluxation of MIP



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Localized acquired Deformities of the foot bones

Cause and Effect:

Etiology:

- Congenital (rare)
- Acquired (often)
 - Neuromuscular diseases
 - Foot deformity (Contracted foot, splay foot)
 - Rheumatologic conditions
 - **Wrong footwear** (high heels)

Pathomechanism:

- Nerve damage (diabetes, alcoholism) → Weak muscles
- Deformity or wrong footwear → Forcing into positions

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Localized acquired Deformities of the foot bones

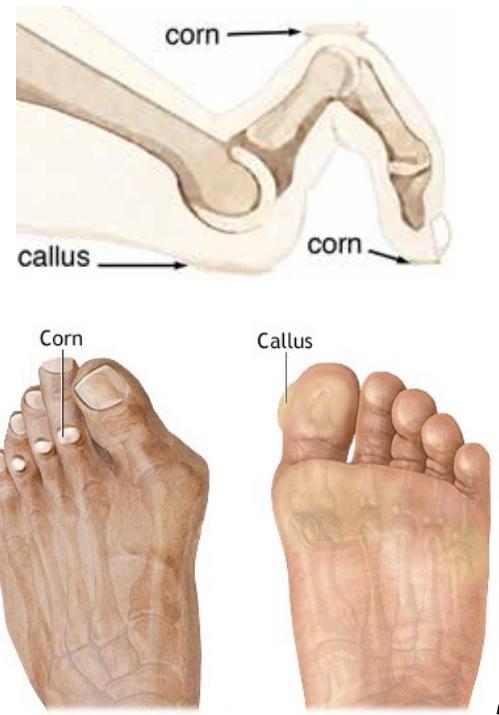
Cause and Effect:

Pathophysiology:

- Formation of pressure points
 - Distal Phalanx
 - Under MTP joint
 - Over PIP joint
- Callus = Thickening of skin at bottom
- Clavus (corn) = Thickening of skin on top

Signs and Symptoms:

- Pain
- Fixed deformity (over time)



51 ADAM.

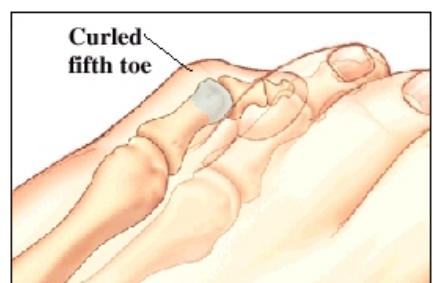
Localized acquired Deformities of the foot bones

Curly toe

- Deformity of toe characterized by fixed flexion (contracture) of the distal phalanx and medial or lateral deviation of the toe
- Mostly lateral toes

Cause:

- Congenital tightness of flexor tendons
- Present at birth



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Localized acquired Deformities of the foot bones

Flatfoot (pronation):

- Syn.: Pes planus, fallen arches, german Plattfuss
- Condition in which the arch of the foot collapses and the sole of the foot comes into partial or complete contact with the ground
- Unilateral or bilateral



Epidemiology:

- 20 – 30% of general population
- Transient in infants and toddlers (state of development)

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Localized acquired Deformities of the foot bones

Flatfoot:

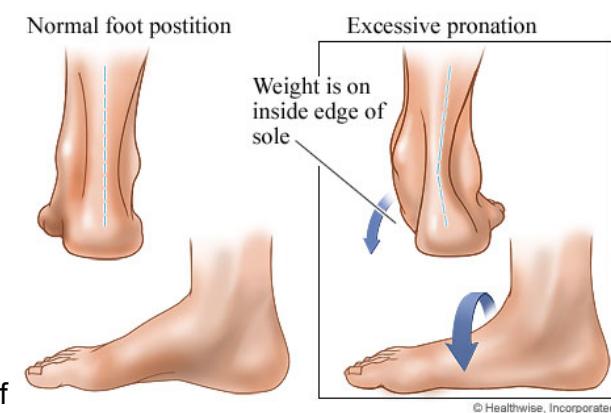
Etiology:

- Congenital form (rare)
 - Talus verticalis
 - Tarsal coalition
- Acquired form (weakness ligaments and muscles)
 - Overstressing
 - Immobilization
 - Rickets
 - Neurologic diseases
 - Rheumatic diseases



Pathophysiology:

- Excess subtalar pronation (hindfoot)
 - Tightening of Achilles tendon
 - Weight shift to the inside
- Excess midtarsal abduction and supination (forefoot)
- Complete or near-complete contact of the sole with the ground



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Localized acquired Deformities of the foot bones

Flatfoot:

Symptoms:

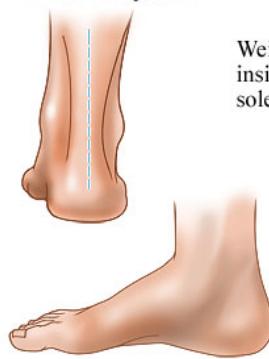
- Often no symptoms
- Foot pain
- Ankle pain
- Lower leg pain

Therapy:

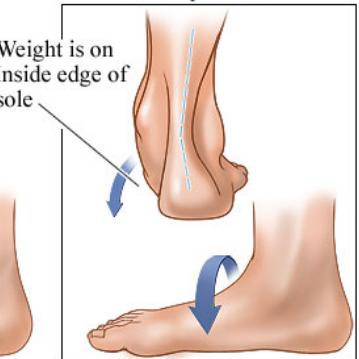
- NSAID
- Physical therapy
- Taping, bracing
- Orthotic device
- Surgery



Normal foot position



Excessive pronation



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Localized acquired Deformities of the foot bones

Contracted foot (supination):

- Syn.: Pes excavatus, pes cavus, high instep, high arch, talipes cavus, german Hohlfuss
- Functional deformation characterized by a fixed plantar flexion and adduction of forefoot, supination of hindfoot and high arch
- 10 – 20% of adult population affected
- Opposite condition to flatfeet



Etiology:

- Inherited (hereditary diseases)
- Acquired (caused by muscular imbalance)
 - Neuromuscular diseases
 - Orthopedic diseases
 - Neurological diseases



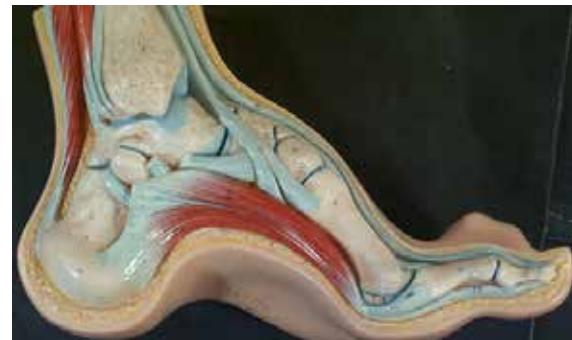
56

Localized acquired Deformities of the foot bones

Contracted foot (supination):

Pathophysiology:

- Pressure points (arch, sole, toes)
- Compression of metatarsal (stress fractures)
- Instability in gait (risk for sprain)

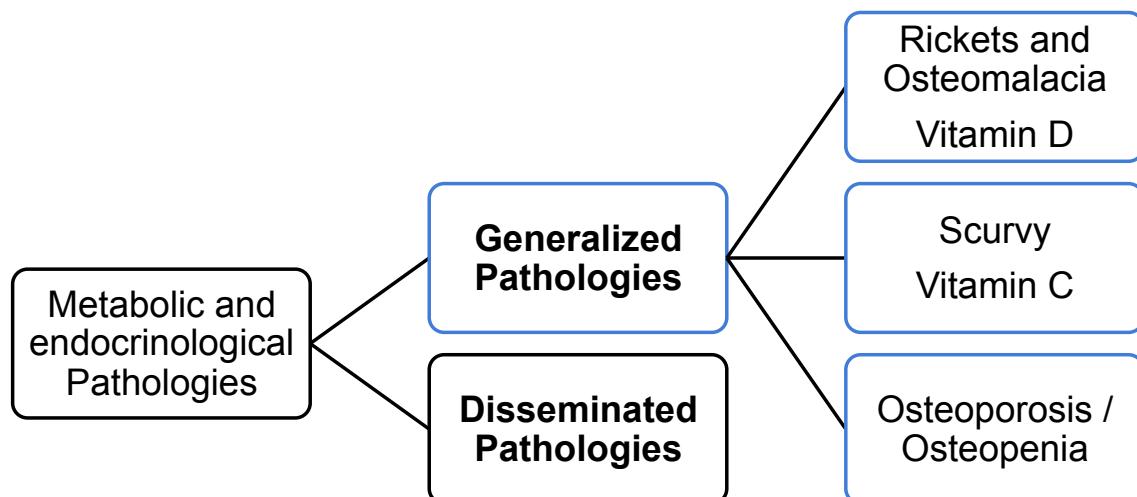


Symptoms:

- Often asymptomatic
- Pain!

57

Metabolic and endocrine pathologies of the bones



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Metabolic and endocrine pathologies of the bones

Rickets and Osteomalacia

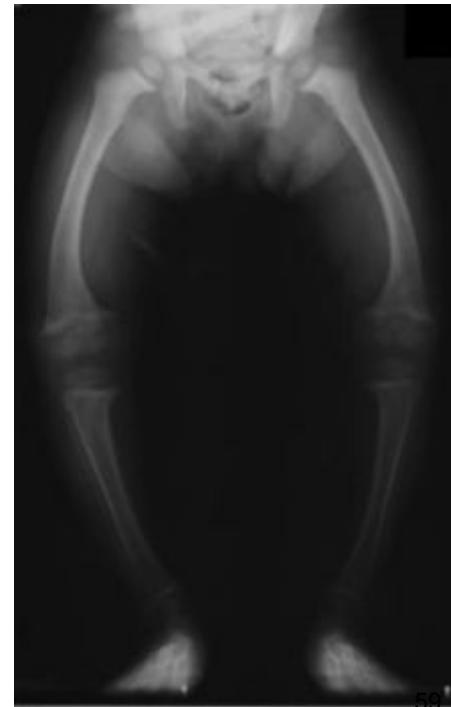
- Syn.: German Rachitis
- Metabolic disease due to defective or impaired metabolism of Vitamin D, Phosphorus or Calcium
 - Rickets = children
 - Osteomalacia = adults
- Amongst most frequent childhood diseases (developing countries)

Etiology:

- Vitamin D deficiency (GI Tract, Diet)
- Vitamin D resistance (Kidney)
- Disturbed Vitamin D metabolism (Liver)
- Phosphate or Calcium deficiency

Pathophysiology:

- Defective mineralisation of the bone
- Skeletal deformity
 - Genu varum
 - Genu valgum



50

Metabolic and endocrine pathologies of the bones

Scurvy:

- Syn.: German Skorbut, Vitamin C Hypovitaminosis
- Disease due to Vitamin C deficiency that is characterized by defective collagen metabolism
- Vitamin C deficiency caused by malnutrition

Pathophysiology:

- Intracellular deficiency of collagen causes change in various tissues:
 - Gingiva
 - Periosteum
 - Joints
 - Skin (bleeding, edema)
 - Pericardium
 - Pleura
 - (...)



60

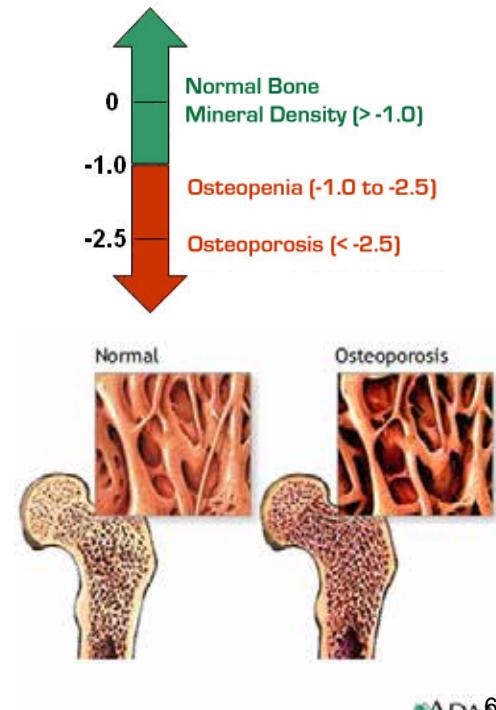
Metabolic and endocrine pathologies of the bones

Osteopenia and Osteoporosis:

- Terms:
 - Osteoporosis = porous bones
 - Osteopenia = precursor to osteoporosis
- Systemic disease of the skeleton characterized by decreased bone mass, changes of bone microarchitecture and the resulting pathophysiologic consequences

Epidemiology:

- 1 in 3 women and 1 in 12 men worldwide affected
- Most common disease of the bone in elderly people
- High costs!

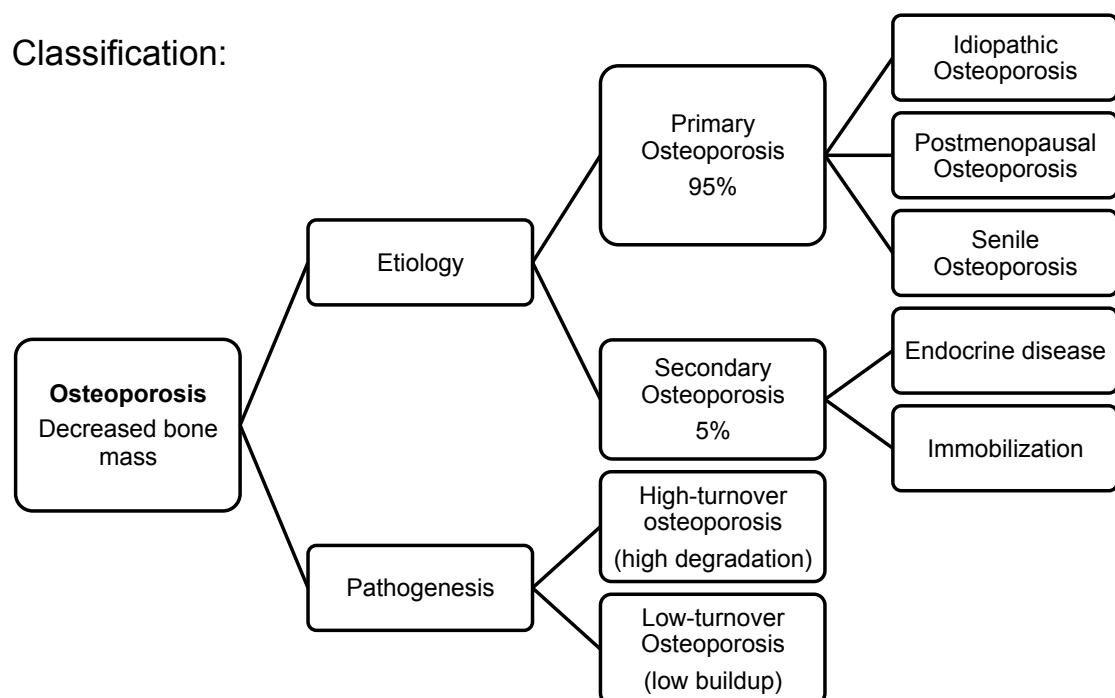


ADA 61

Metabolic and endocrine pathologies of the bones

Osteopenia and Osteoporosis:

Classification:



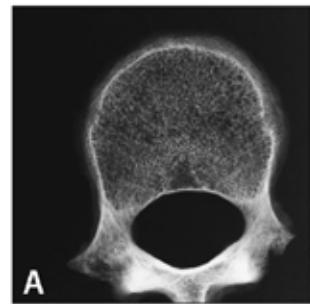
62

Metabolic and endocrine pathologies of the bones

Osteopenia and Osteoporosis:

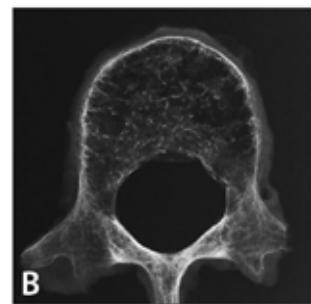
Endocrine Osteoporosis

- Hyperparathyreoidism
 - Hypophosphatämie
- Pituitary adenoma
 - Growth hormone → Acromegaly
 - Bone weakness
- Hyperthyroidism
 - Cretinism
 - Defective bone maturation and ossification
- **Hypercortisolism (M. Cushing)**
 - Primary (pituitary Adenoma)
 - Medication (secondary)



Behaviour linked Osteoporosis:

- Diet (low Calcium, coffee, alcohol)
- **Immobilisation**



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Metabolic and endocrine pathologies of the bones

Osteopenia and Osteoporosis:

Postmenopausal Osteoporosis (Type 1)

- Most common form
- Estrogen deficiency (menopause) associated with rapid reduction in bone mineral density

Senile Osteoporosis (Type 2):

- In men
- Geriatric syndrome (zinc deficiency, low calcium intake, decreased Vitamin D absorption)
- Decrease in testosterone associated with reduction in bone mineral density

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Metabolic and endocrine pathologies of the bones

Osteopenia and Osteoporosis:

Pathogenesis:

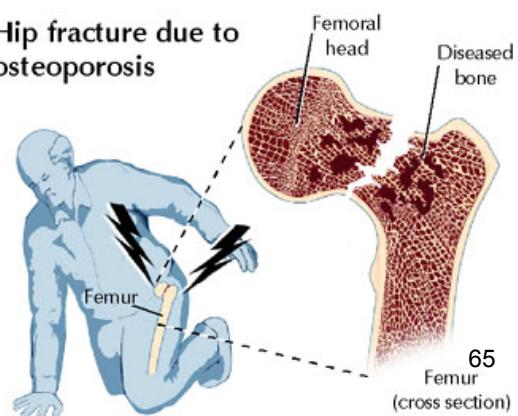
- Imbalance between bone build-up and degradation
 - Inadequate peak bone mass
 - Excessive bone resorption
 - Inadequate formation of new bone during remodelling
- Development of fragile bone tissue

Pathophysiology:

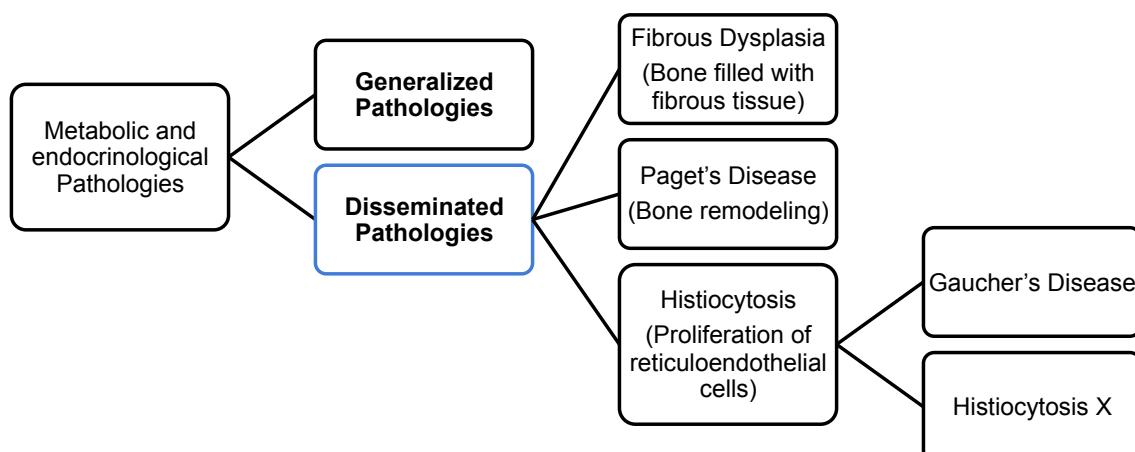
- Osteoporotic fractures
 - Vertebral column (vertebral collapse)
 - Rib
 - Hip (fracture of femoral neck)
 - Wrist
- Falls risk (associated with aging)



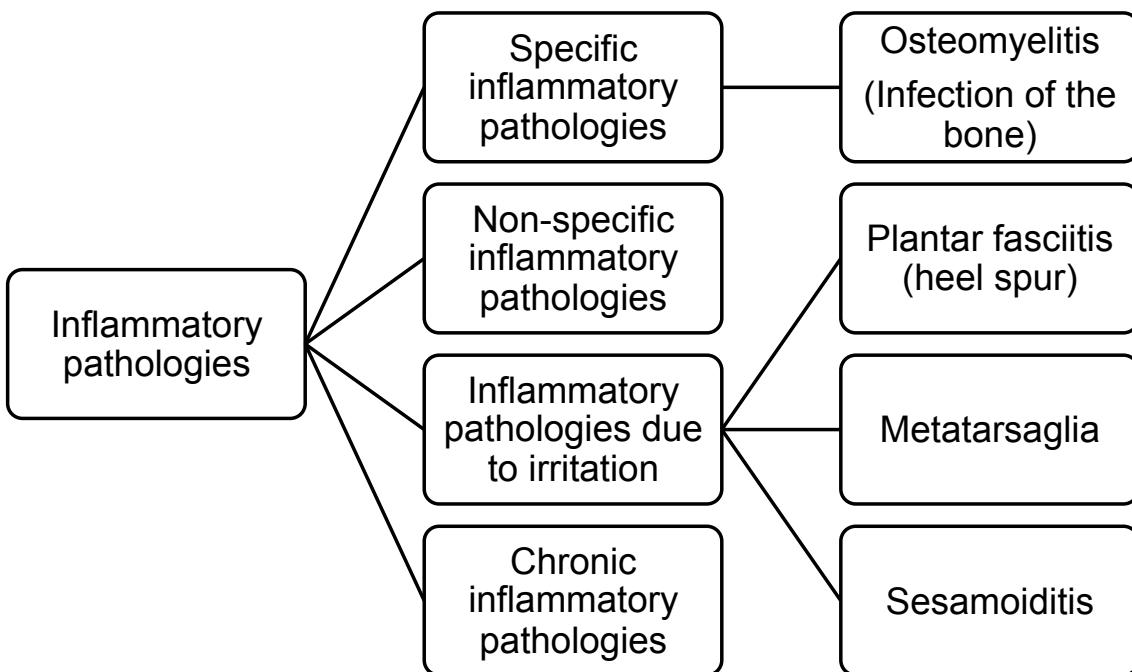
Hip fracture due to osteoporosis



Metabolic and endocrine pathologies of the bones



Inflammatory Pathologies of the bones



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Inflammatory Pathologies of the bones

Plantar fasciitis PF

- Syn.: Heel pain, Policeman's heel, Fasciitis plantaris, heel spur syndrome
- Painful inflammatory process of the plantar fascia, the connective tissue and the sole of the foot
- Often associated with heel spurs
 - Inferior spur = aponeurosis plantaris
 - Posterior spur = Achilles tendon (rare)



Etiology and Pathogenesis:

- Overstressing of connective tissue
- Accumulation of micro tears
- Inflammation (acute)
- Degeneration (chronic)



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Inflammatory Pathologies of the bones

Metatarsalgia

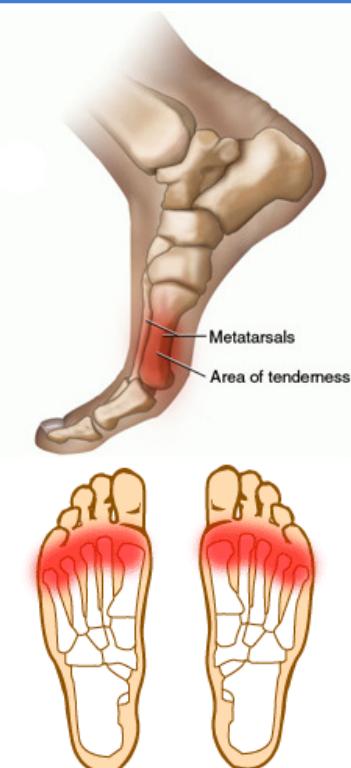
- Syn.: Metatarsal pain, stone bruise, dropped metatarsal heads
- Painful inflammation of the metatarsals (joints and bones)
- Often 1st or 2nd metatarsal

Etiology and Pathogenesis

- Short or hypermobile first ray results in excess pressure on the 2ndmetatarsal
- Foot injury (sport)
- Arthritis
- Overstressing (wrong footwear)

Pathophysiology:

- Forefoot pain due to inflammation
- Abnormal weight distribution due to overpronation



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Inflammatory Pathologies of the bones

Sesamoiditis

- Painful Inflammation of the sesamoid bones under the 1st metatarsal head of the big toe
- Sesamoids transmit muscle force, assist with weight-bearing and elevate the metatarsal of the hallux
- The bones are connected to tendons or embedded in muscles that can be inflamed due to irritation, trauma etc.

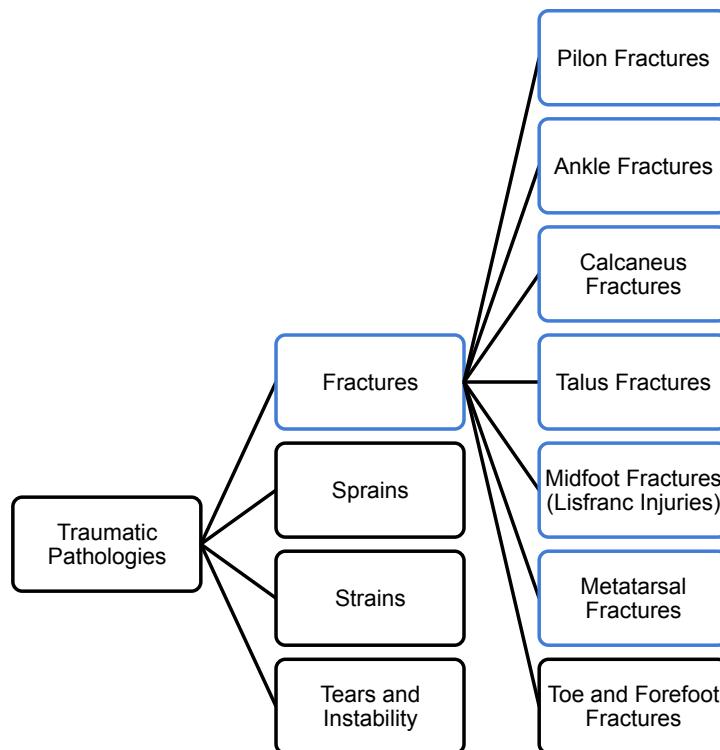


Symptom:

- Similar to metarsalgia
- Painful movement of big toe

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Traumatic pathologies of the foot bones



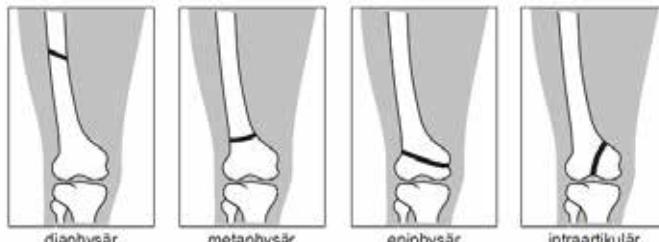
71

Traumatic pathologies of the foot bones

Fractures:

Position:

- Diaphyseal
- Metaphyseal
- Epiphyseal
- Intra-articular



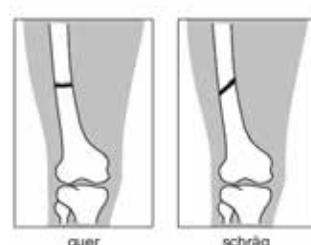
Fragmentation:

- Incomplete = bone fragments still partially joined
- Complete = bone fragments completely separated



Implication of skin:

- Open (compound) fracture = skin lesion due to bone or trauma (wound = risk of infection)
- Closed (simple) fracture = skin intact



Orientation of fracture in the bone:

- Linear = parallel to long axis
- Transverse = 90° angle to long axis
- Oblique = diagonal to long axis
- Spiral / torsion fracture = when torque is applied along the axis

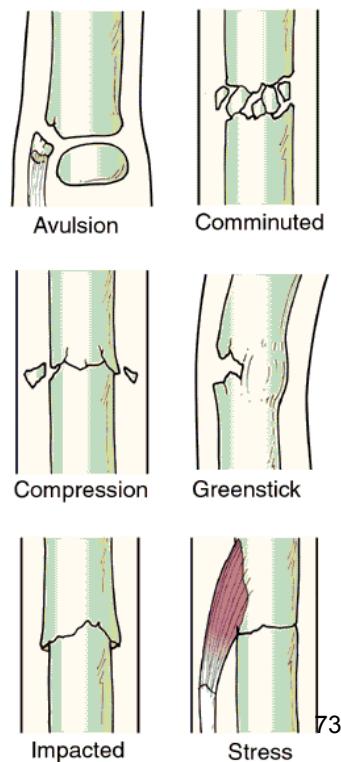
72

Traumatic pathologies of the foot bones

Fractures:

Types:

- Comminuted fractures = bone broken into number of pieces
- Impacted fracture = bones driven into each other
- Avulsion fracture = bones fragments separated from main mass
- Compression fracture = collapse of a vertebra
- Stress / fatigue fracture = incomplete fracture caused by unusual or repeated stress
- Green Stick fracture = incomplete fracture in a young and soft bone as it bends



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Traumatic pathologies of the foot bones

Fractures:

Causes:

- Traumatic fracture
 - Trauma inflicted on bone
 - Overuse (chronic mechanical stress)
- Pathologic fracture
 - Osteoporosis

General symptoms:

- Pain and Tenderness
- Swelling
- Bruising
- Deformity



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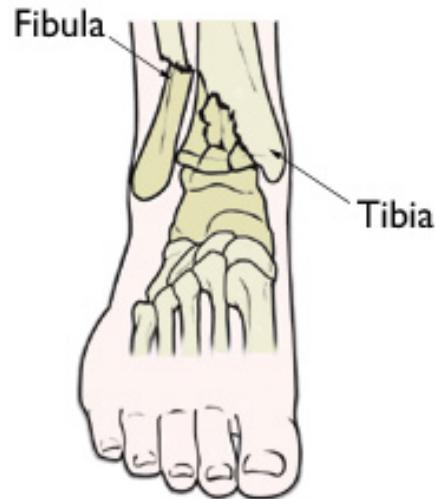
Traumatic pathologies of the foot bones

Pilon Fracture:

- Syn.: Cooper fracture
- Fractures of distal tibia involving the central bottom of the tibia at the ankle joints
- Overlap with malleolar fractures

Epidemiology:

- 5% of all tibial fractures
- Most often caused by high-energy impacts
- In 25 – 50% additional injuries
- In most cases fracture of both tibia and fibula
- More often in males

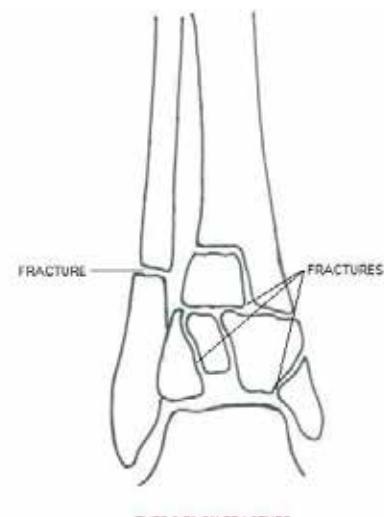
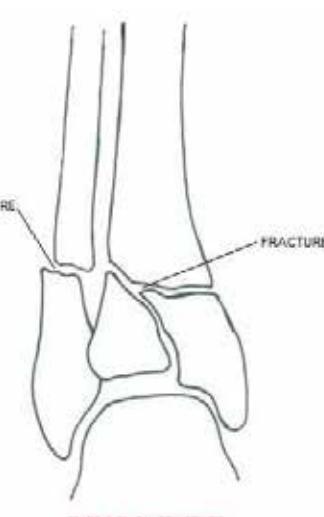
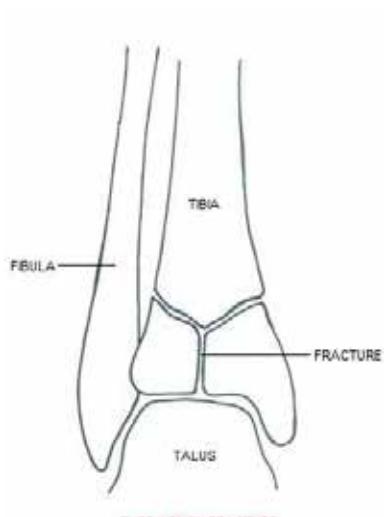


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Traumatic pathologies of the foot bones

Pilon Fracture:

3 Types of Pilon fractures according to Ruedi/Allgower classification:



TYPE 1 PILON FRACTURE

TYPE 2 PILON FRACTURE

TYPE 3 PILON FRACTURE

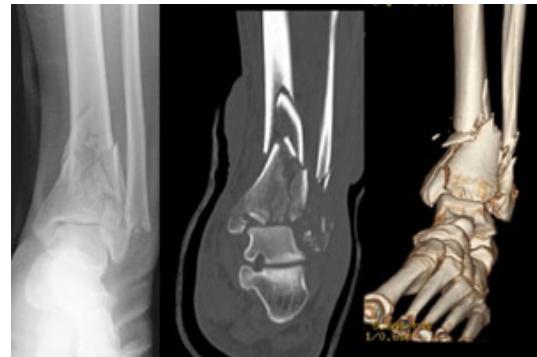
76

Traumatic pathologies of the foot bones

Pilon Fracture:

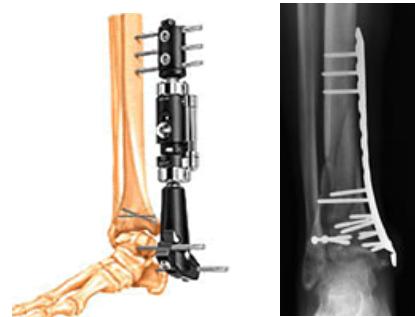
Symptoms:

- Pain, Tenderness
- Swelling, Bruising
- Cannot put any weight on injured foot
- Deformity



Therapy:

- Non-surgical treatment (Splints, casts)
- Surgical treatment
 - Open reduction and internal fixation
 - External fixation



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Traumatic pathologies of the foot bones

Ankle Fractures:

- German: Malleolarfraktur, Fraktur des oberen Sprunggelenks OSG
- Fraction of one or several components of the subtalar joint (articulatio talocruralis), which consists of tibia, fibula and talus



Epidemiology:

- Most common fracture of lower extremities
- Mostly low-energy twisting injuries (falls)
- Incidence: 100 – 200 per 100'000 persons per year

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Traumatic pathologies of the foot bones

Ankle Fractures:

Symptoms:

- Immediate, severe pain
- Swelling
- Bruising
- Tenderness
- Inability to put weight on injured foot
- Deformity



Risk factors:

- Contact, jumping, twisting sports
- Increase in body mass
- Higher age

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Traumatic pathologies of the foot bones

Ankle Fractures:

Types of ankle fractures:

Malleolar
fracture

Bimalleolar
fracture

Trimalleolar
fracture

Lateral

Medial

Posterior

80

Traumatic pathologies of the foot bones

Ankle Fractures:

Lateral malleolar fracture (Danis-Weber Classification):

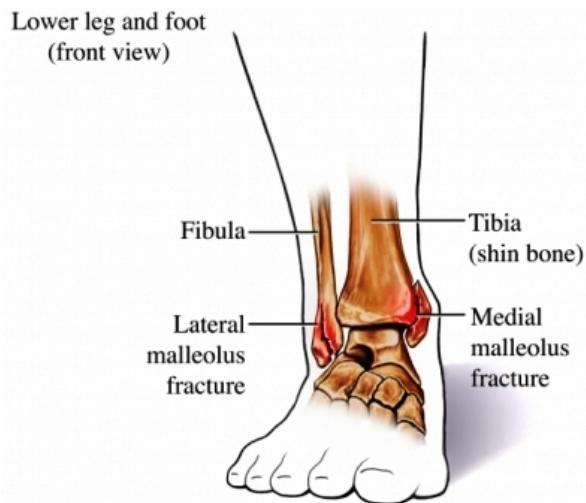


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Traumatic pathologies of the foot bones

Ankle Fractures:

Medial malleolar fracture:



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Traumatic pathologies of the foot bones

Ankle Fractures:

Posterior malleolar fracture:

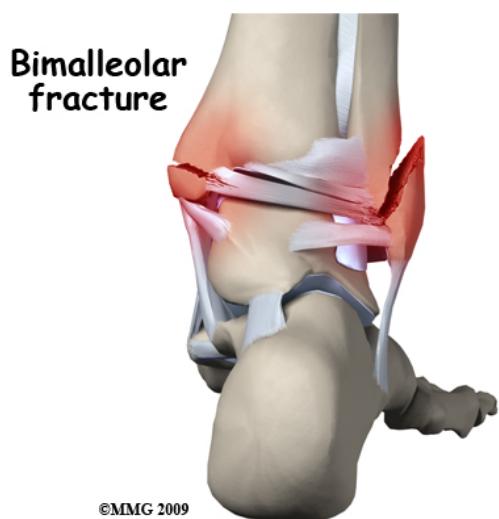


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Traumatic pathologies of the foot bones

Ankle Fractures:

Bimalleolar fracture:



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Traumatic pathologies of the foot bones

Ankle Fractures:

Trimalleolar fracture:



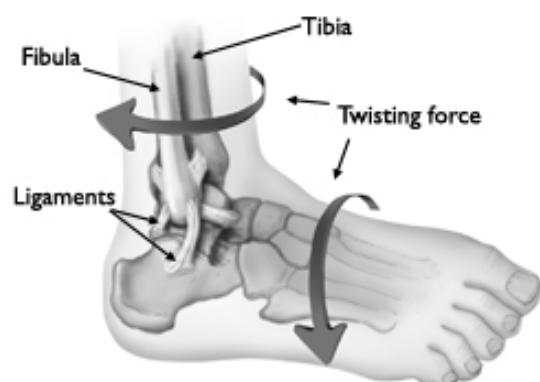
85

Traumatic pathologies of the foot bones

Ankle Fractures:

Pathogenesis:

- Indirect ankle fractures are always caused by luxation of the ankle joint to some degree (caused by pronation or supination)
- Luxation is combined with a rotational element (eversion, adduction)



Pathophysiology:

- Loss of range of motion (gait problems)
- Alteration in contact area (post-traumatic arthritis)
- Alterations in inferior tibiofibular movement
- Deformity

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Traumatic pathologies of the foot bones

Calcaneus (heel bone) Fractures:

Epidemiology:

- Most frequently fractured tarsal bone
- 60% of tarsal bone fractures
- In 10% additional fracture of spine or hip

Cause and Pathogenesis:

- High-energy collisions (fall, crash)
- Impact proportional to damage
- Different fracture pattern
 - Stable
 - Displaced
 - Comminuted
 - Open
- Often severe fractures with long-term problems

Pathophysiology (longterm):

- Pain (especially when walking)
- Damage of subtalar joint and postaccidental arthritis and/or arthrosis (stiffness)
- Gait problems (uneven ground)
- Skin irritation



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Traumatic pathologies of the foot bones

Talus Fractures:

Cause and Pathogenesis:

- Often caused by high-energy trauma (especially motor vehicle accidents and snowboarding)
- Forced dorsiflexion (against anterior lip of tibial plafond) and vertical shear (against tibial plafond)



Classification:

- Posterior or lateral process (25 – 35%)
- Neck (30 – 50%)
- Body (15 – 25%)



Pathophysiology (longterm)

- Osteoarthritis of ankle and subtalar joints
- Avascular Osteonecrosis (in 50% collapse)
- Pain
- Gait problems



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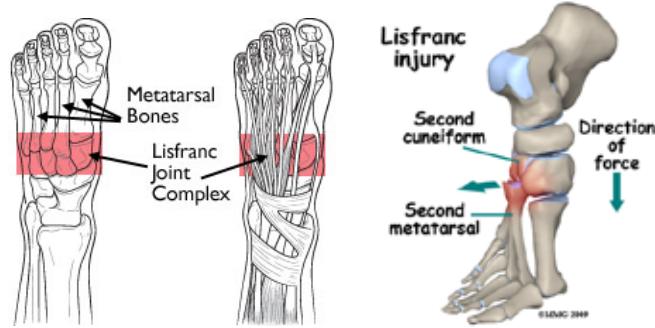
Traumatic pathologies of the foot bones

Midfoot (Lisfranc) Injuries:

- Often mistaken as simple sprain!

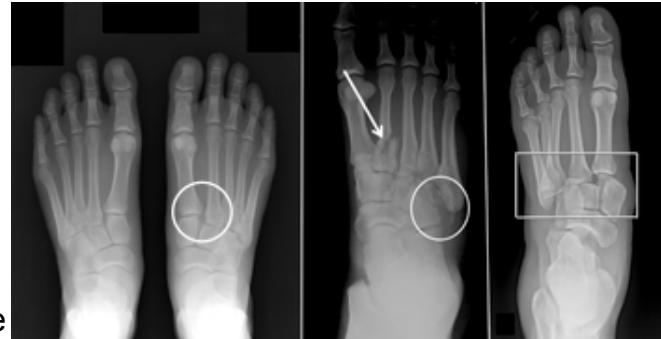
Cause and pathophysiology:

- Caused by low-energy injuries (Simple twists and falls as in soccer) or high-energy injuries (high falls)
- Bone fractures or ligament tears that support the midfoot
- Single joint or multiple joints



Signs and symptoms:

- Pain (worse when standing or walking)
- Swelling
- Bruising!!!
- Standard treatment for sprain (rest, ice) does not give relieve from symptoms!



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Traumatic pathologies of the foot bones

Metatarsal Fractures:

- Very common traumatic foot injury (sport)
- 2nd, 4th and 5th metatarsal most commonly affected

Etiology:

- Acute fractures:
 - Direct trauma (football)
 - Excessive rotational force (ballet dancers)
- Stress fractures
 - Overstressing (army recruits, runners)



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Traumatic pathologies of the foot bones

Metatarsal Fractures:

Acute metatarsal fractures

- Mostly 5th metatarsal bone
- Acute symptoms



Stress fractures of the metatarsals

- Incomplete fractures from overuse
- Repeated irritation and micro tears of the bone (no complete healing)
- Cracks in the bone surface
- Gradual increasing Pain
- Rarely disabling

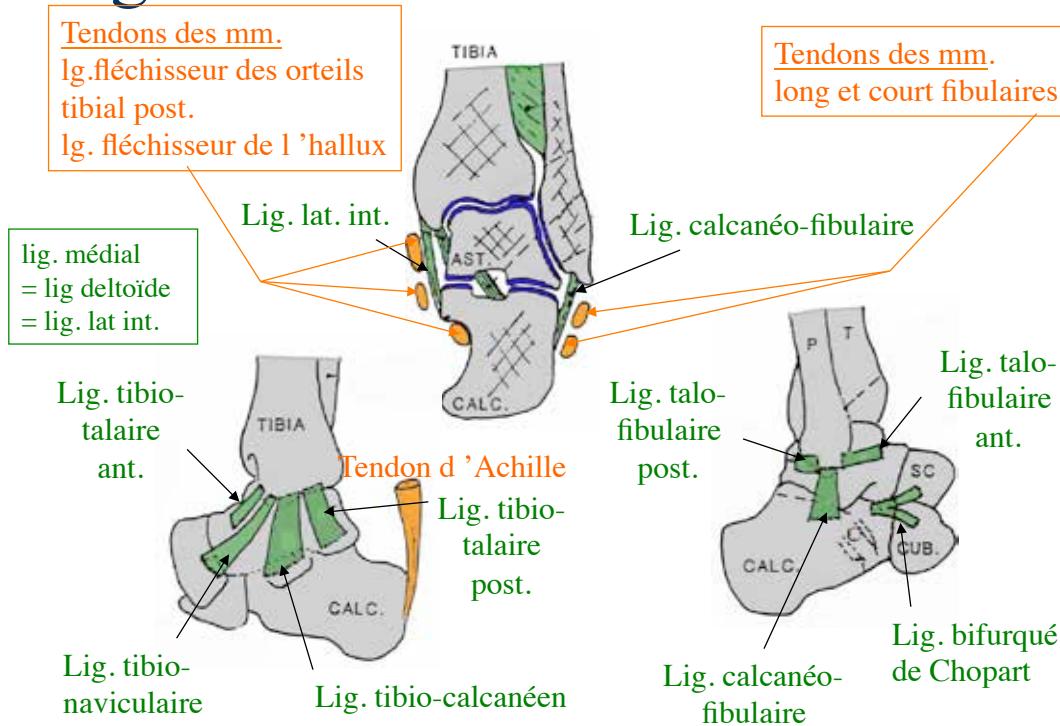


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Ligaments and joints



Ligaments of the ankle



2/2

Ankle (art. talo-crurale)

Lig.talo-fibulaire post.
(péronéo-astragalien)

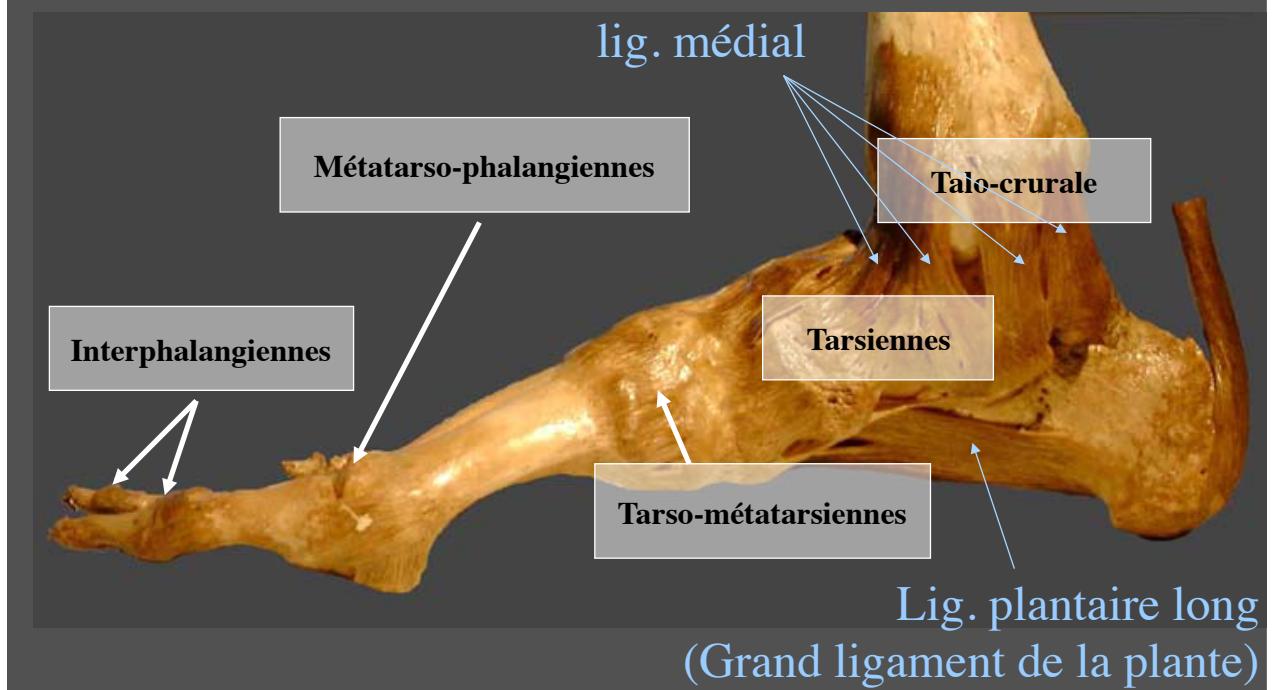


Lig. bifurqué
de Chopart

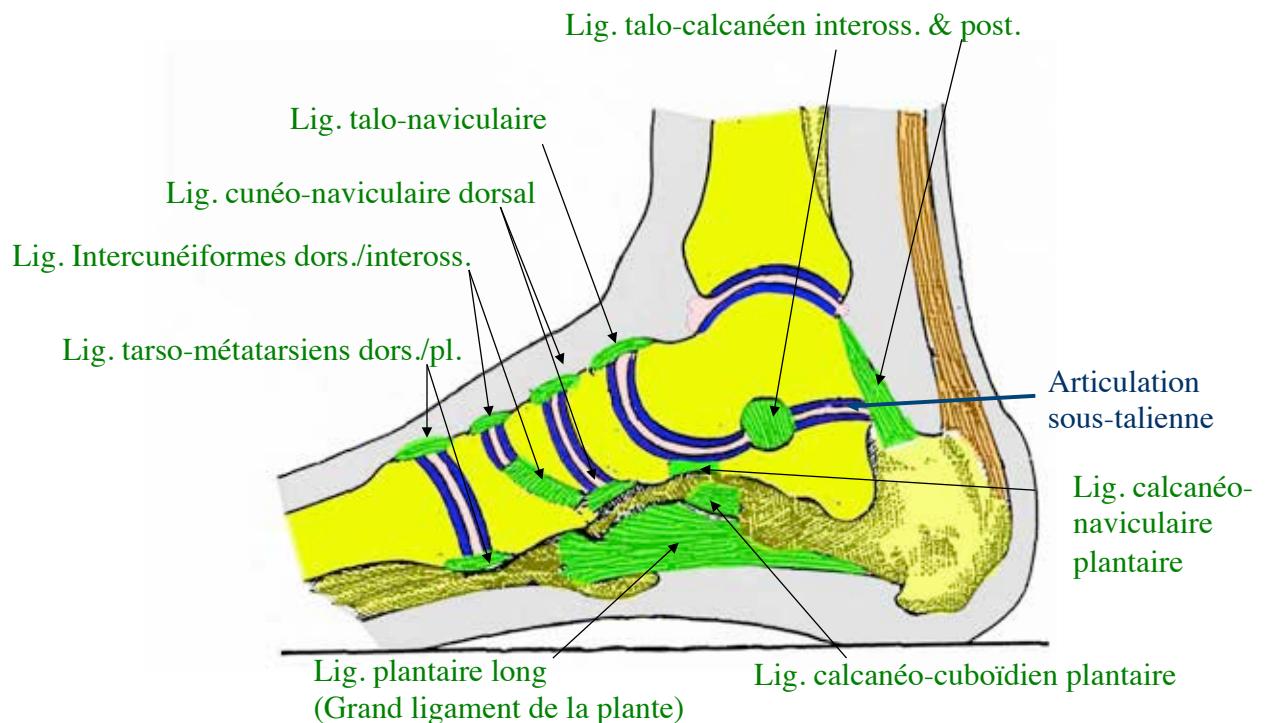
Lig.calcanéo-fibulaire
(péronéo-calcanéen)



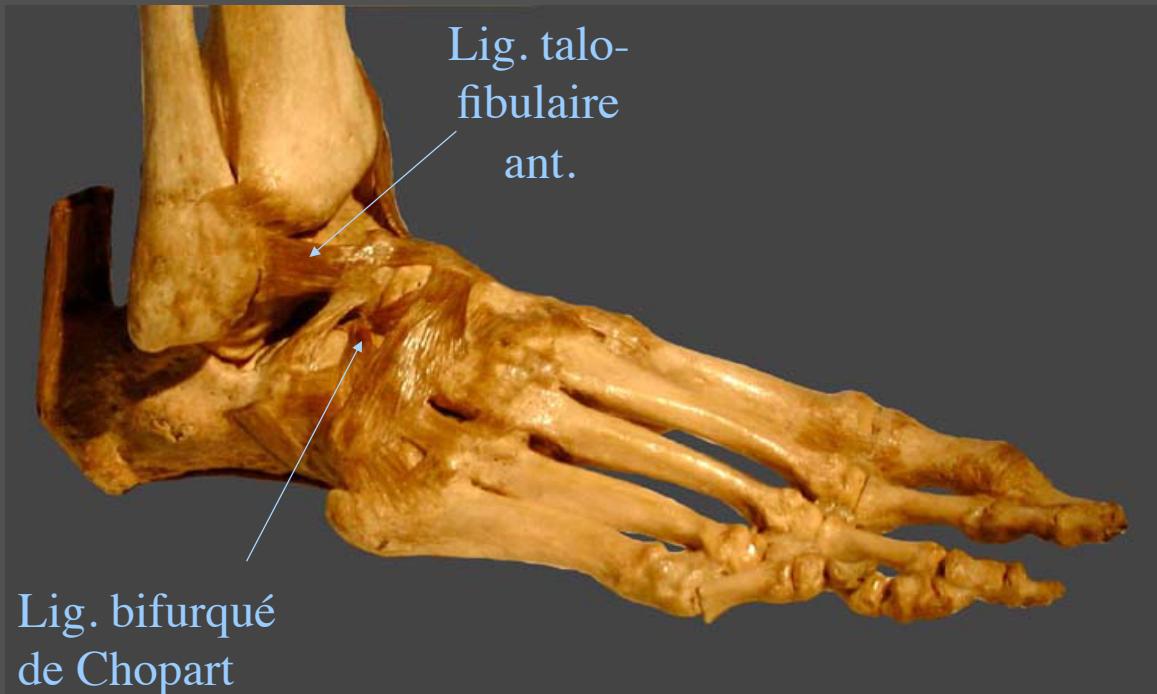
Ligaments et articulations



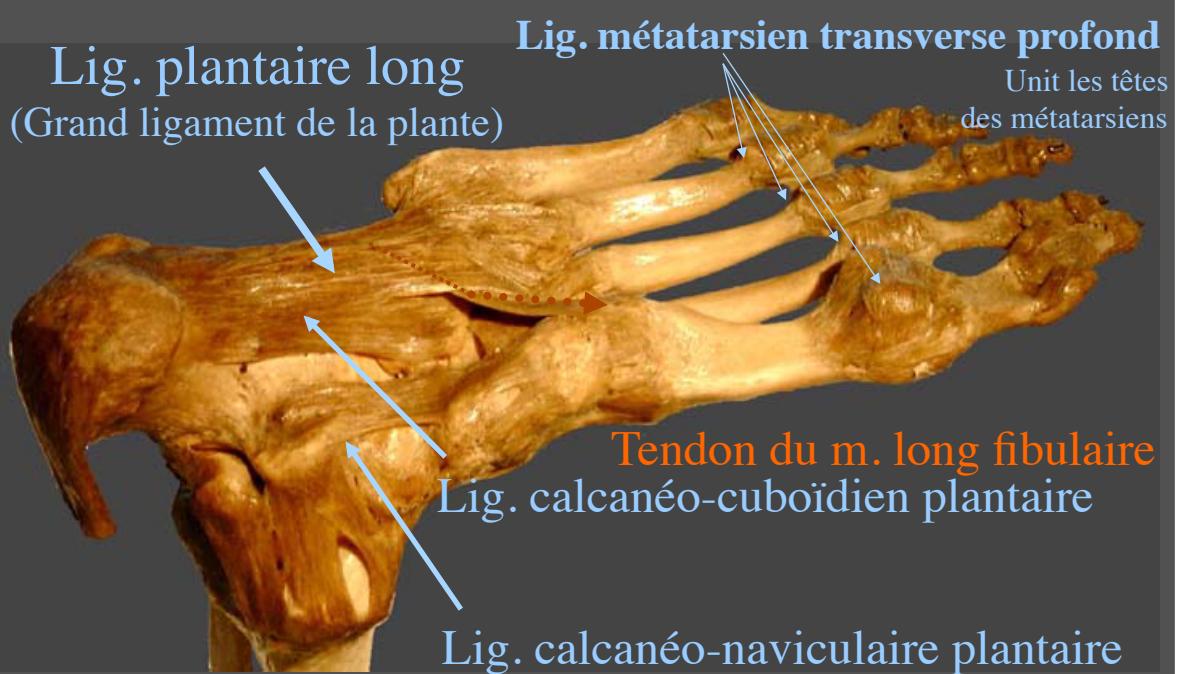
Les ligaments du tarse



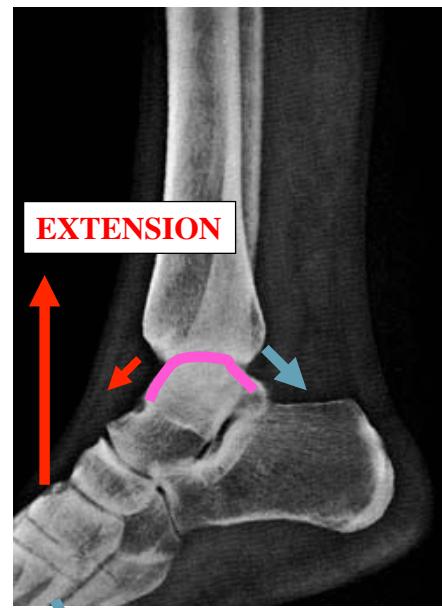
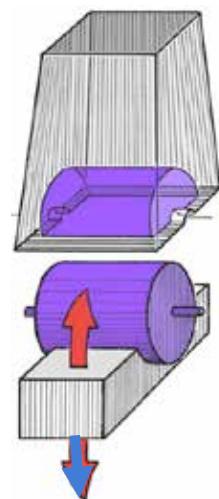
tarsal ligaments



plantar ligaments



Ankle joint



Ankle joint:
Flexion/Extension



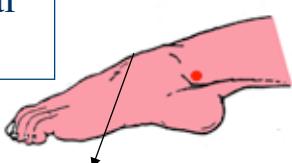
Tarsal joints: **Eversion/ Inversion**



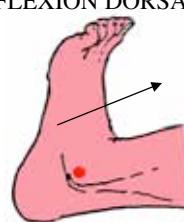
Mouvements: ankle and foot

m.tibial post.
mm.fléchisseurs
m.triceps sural
m/lg.fibulaire

FLEXION

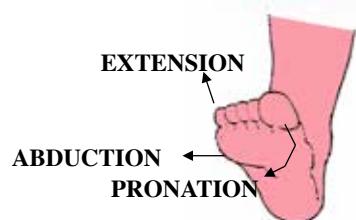


EXTENSION
(FLEXION DORSALE)



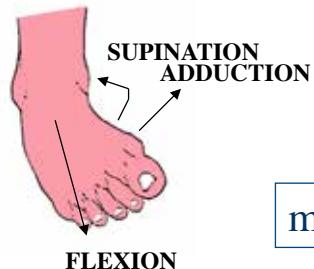
m.tibial ant.
mm.extenseurs.

EVERSION

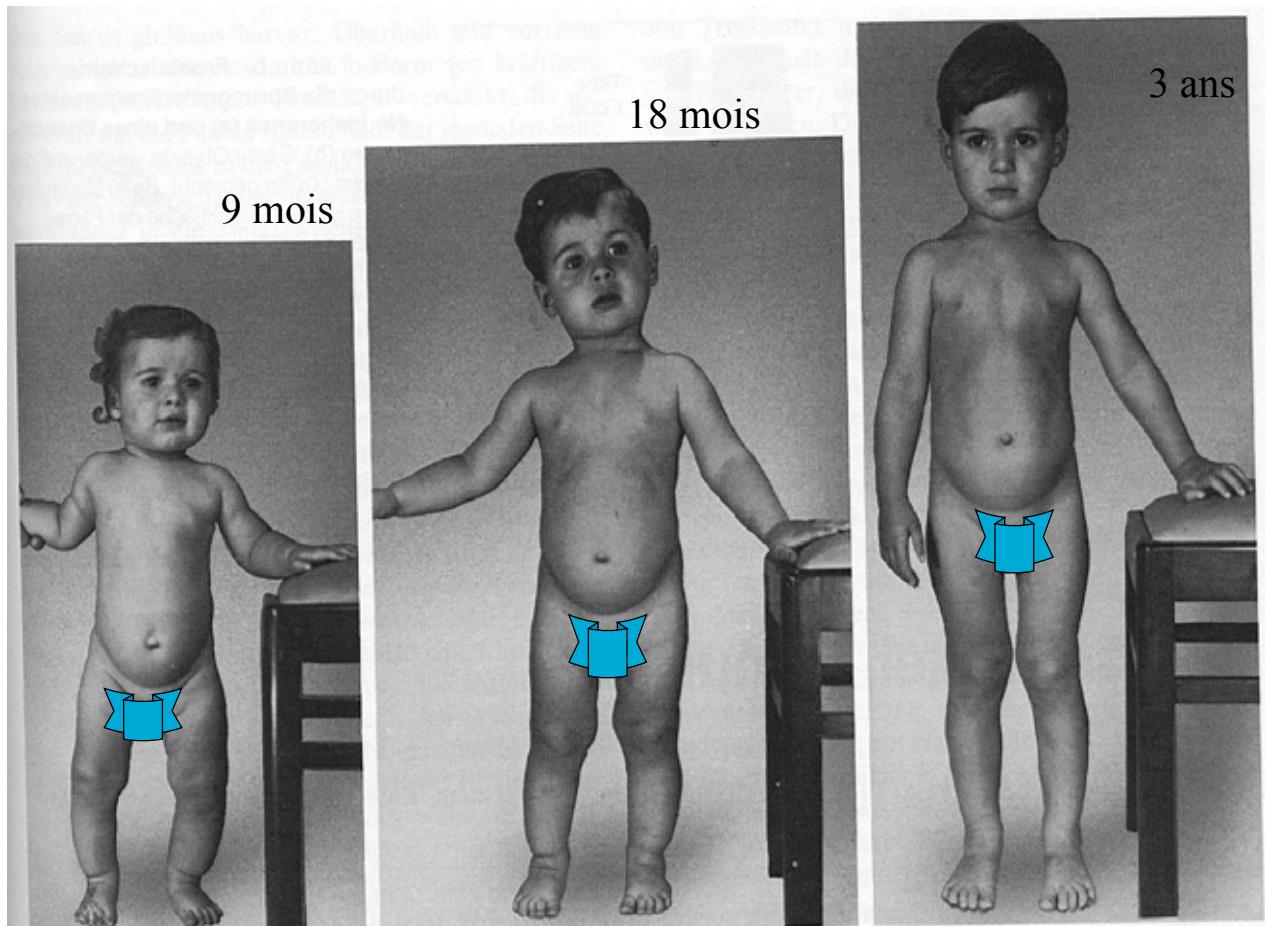


mm.fibulaires.

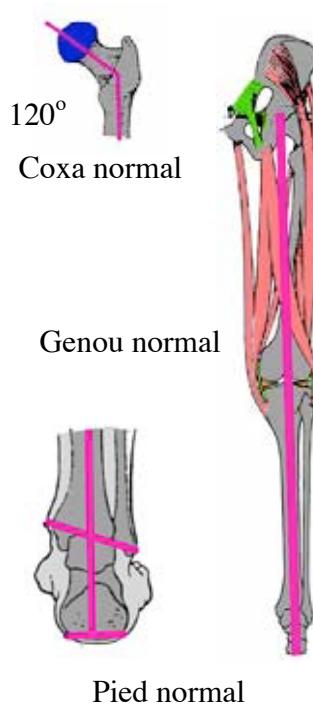
INVERSION



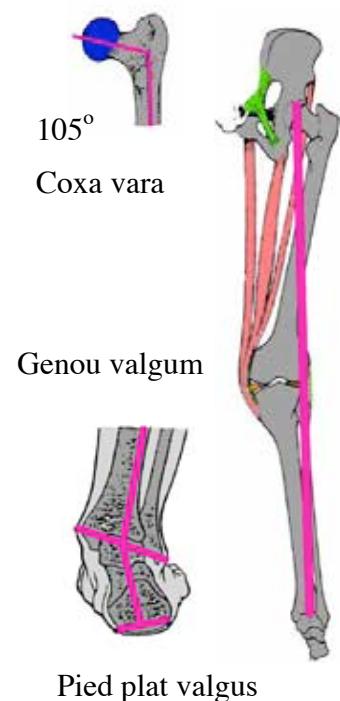
mm.tibiaux



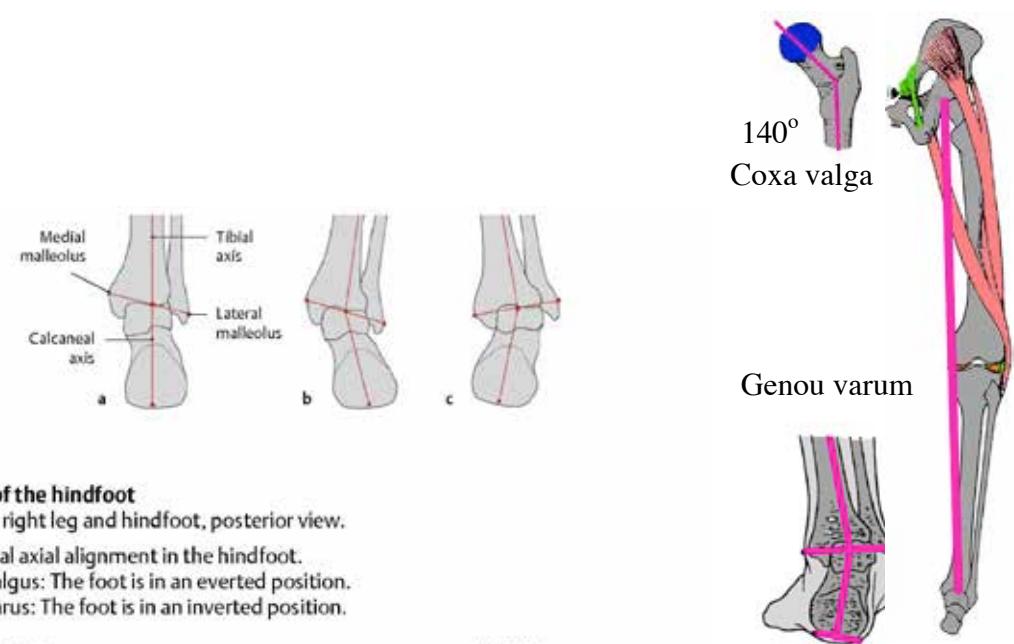
Mechanical and anatomical axis



Mechanical and anatomical axis



Mechanical and anatomical axis



C Axis of the hindfoot

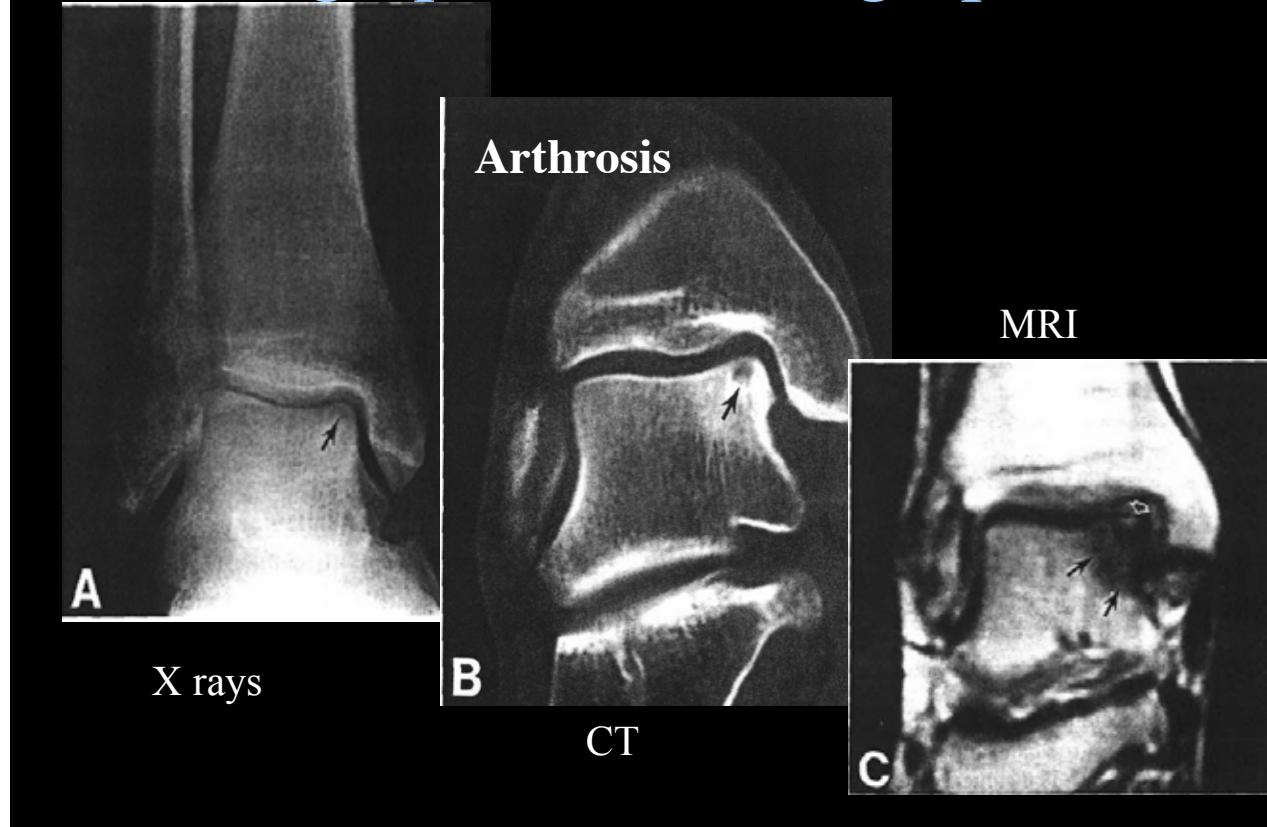
Distal right leg and hindfoot, posterior view.

- a Normal axial alignment in the hindfoot.
- b Pes valgus: The foot is in an everted position.
- c Pes varus: The foot is in an inverted position.

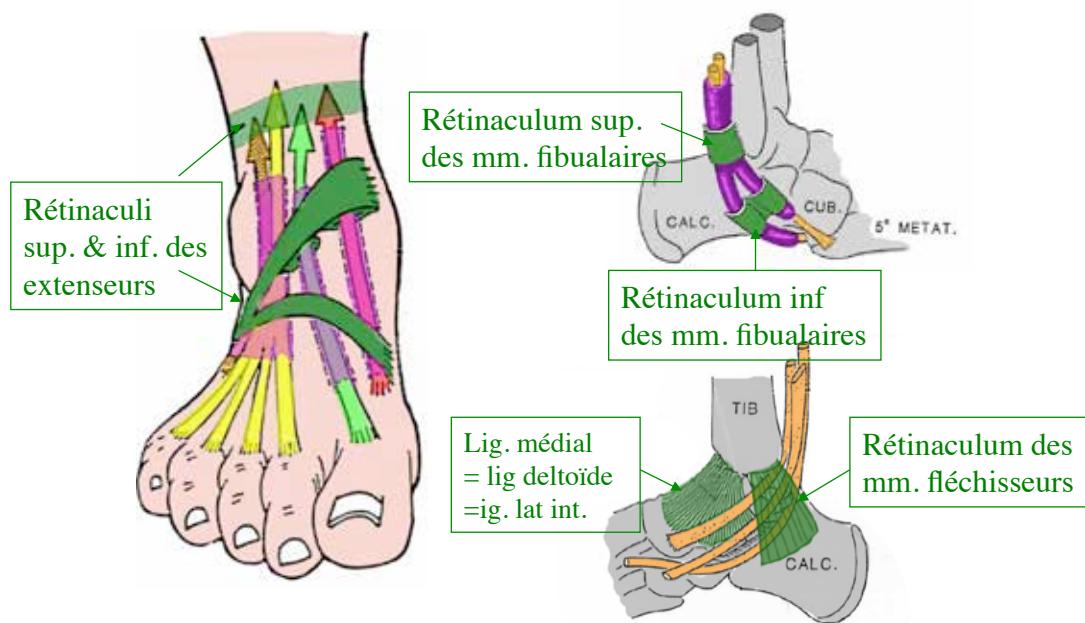
Illustrator: Karl Wesker

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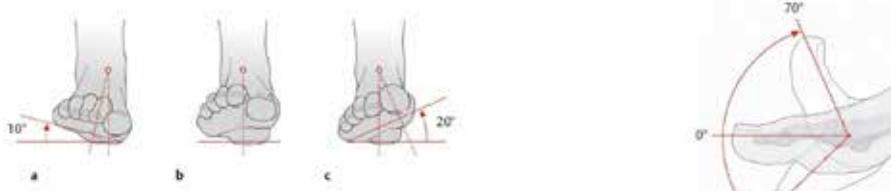
Radiographie et Tomographie



Retinaculi



Ligament - Rétinaculum - Fixation



E Range of motion of the subtalar joint
Right foot, anterior view.

- a Everted by 10 degree.
- b Neutral (zero-degree) position.

F Range of motion of the joints of the big toe

Lateral view.
1/extension of the first metatarsophalangeal joint.

I Wesker
pp. 410-411
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D Normal range of motion of the talocrural joint
Lateral view.

- b Right foot off the ground (swing leg).

Illustrator: Karl Wesker

pp. 410-411

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D Footprints (podograms) of right feet (after Rauber and Kopsch)

- a Normal plantar arches (pes rectus).
- b Increased height of the longitudinal arch (pes cavus).
- c Loss of the transverse arch (splayfoot = pes transversoplanus).
- d Loss of the longitudinal arch (flat foot = pes planus).

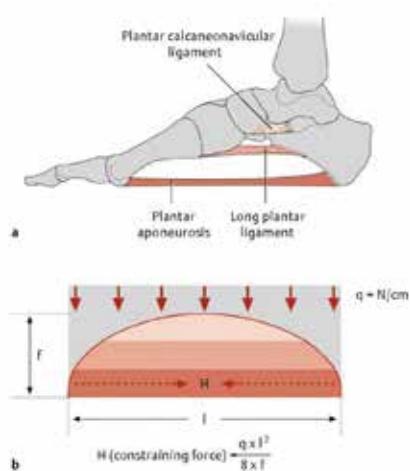
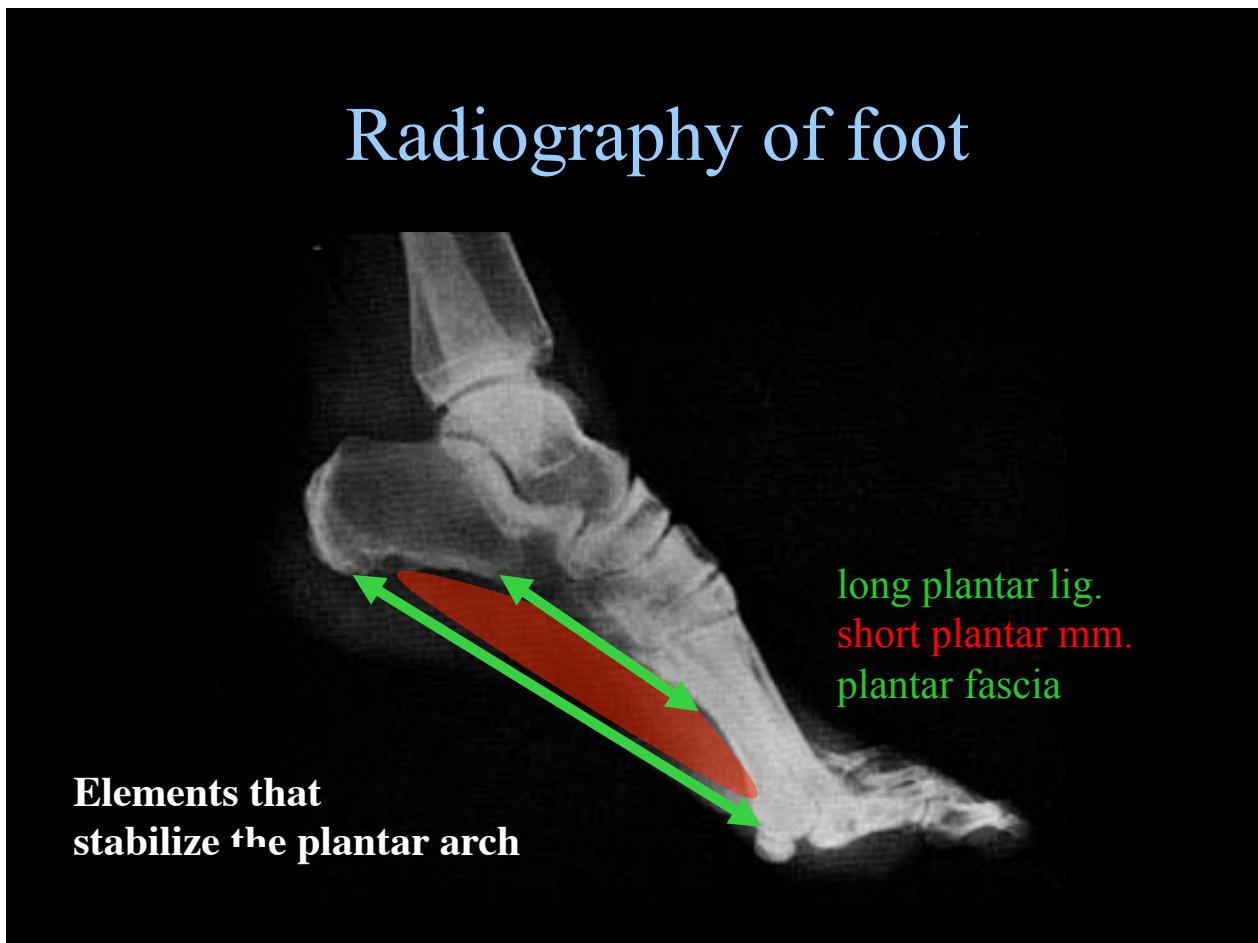
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pp. 414-415

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Thieme

Radiography of foot



C Support of the longitudinal arch

- Ligamentous support of the longitudinal arch (right foot, medial view).
- Calculating the constraining force (H) needed to maintain the arch (after Rauber and Kopsch).

Illustrator: Karl Wesker

pp. 414-415

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Thieme

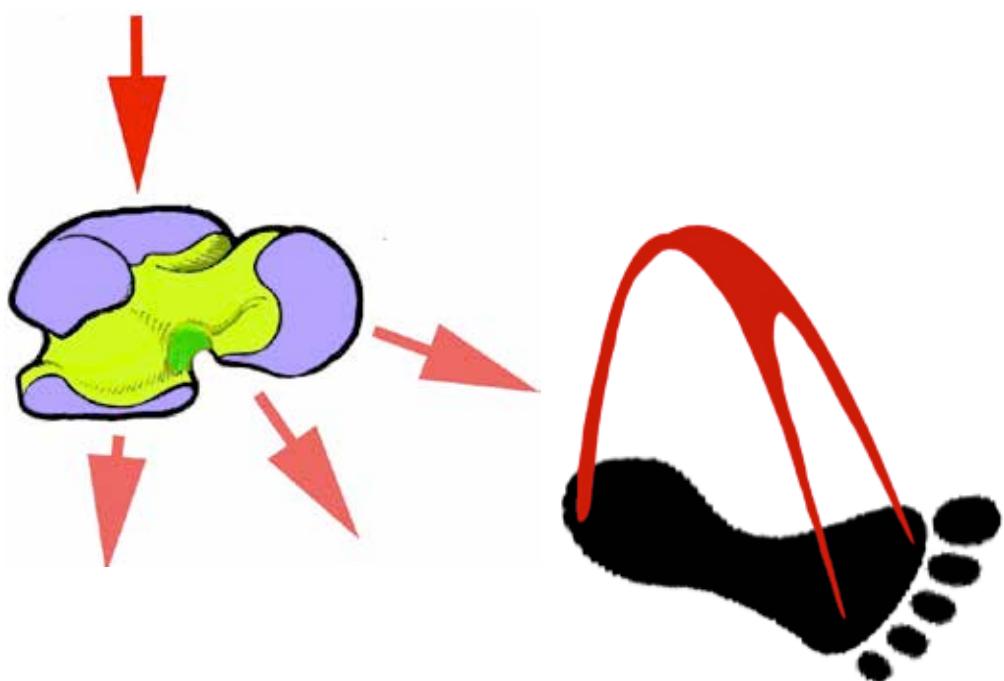
Plantar Arch



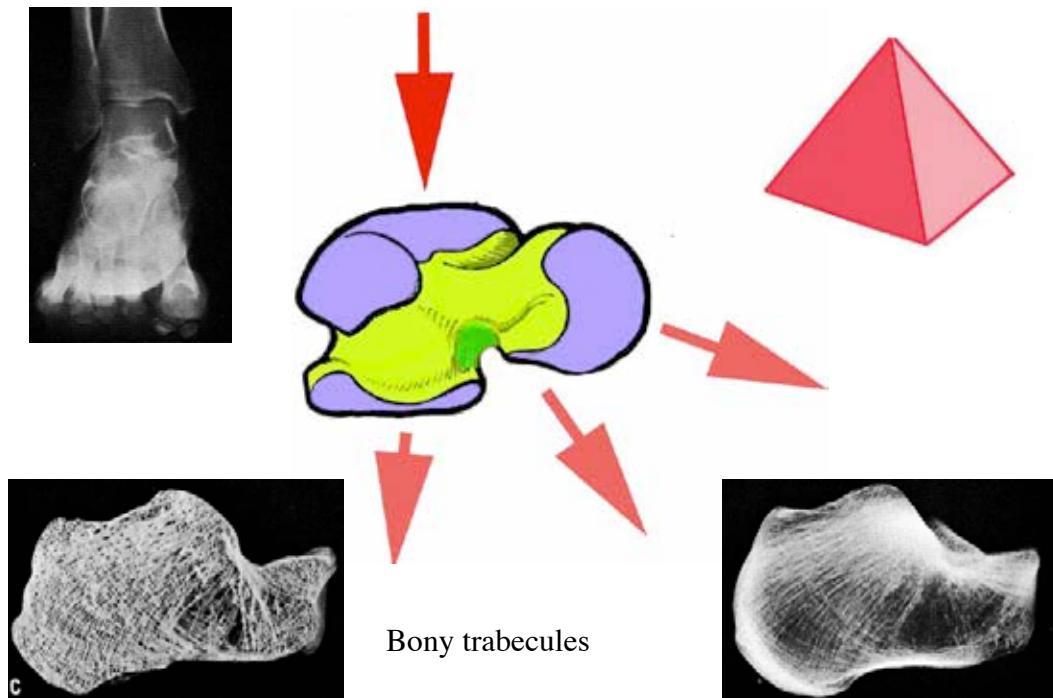
Podogrammes

- A normal
- B arch increased
- C arch decrease
- D foot valgus

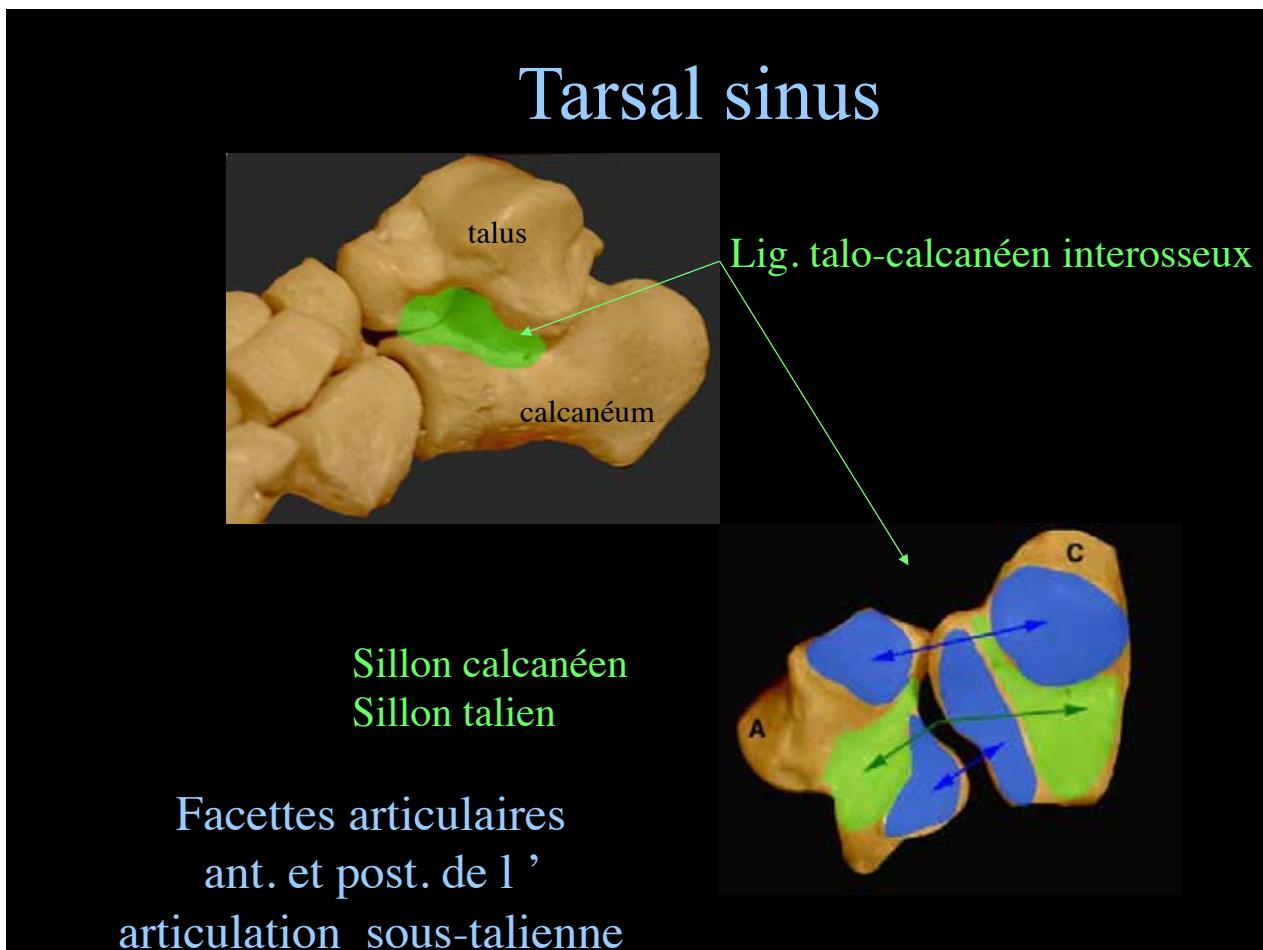
Plantar arch



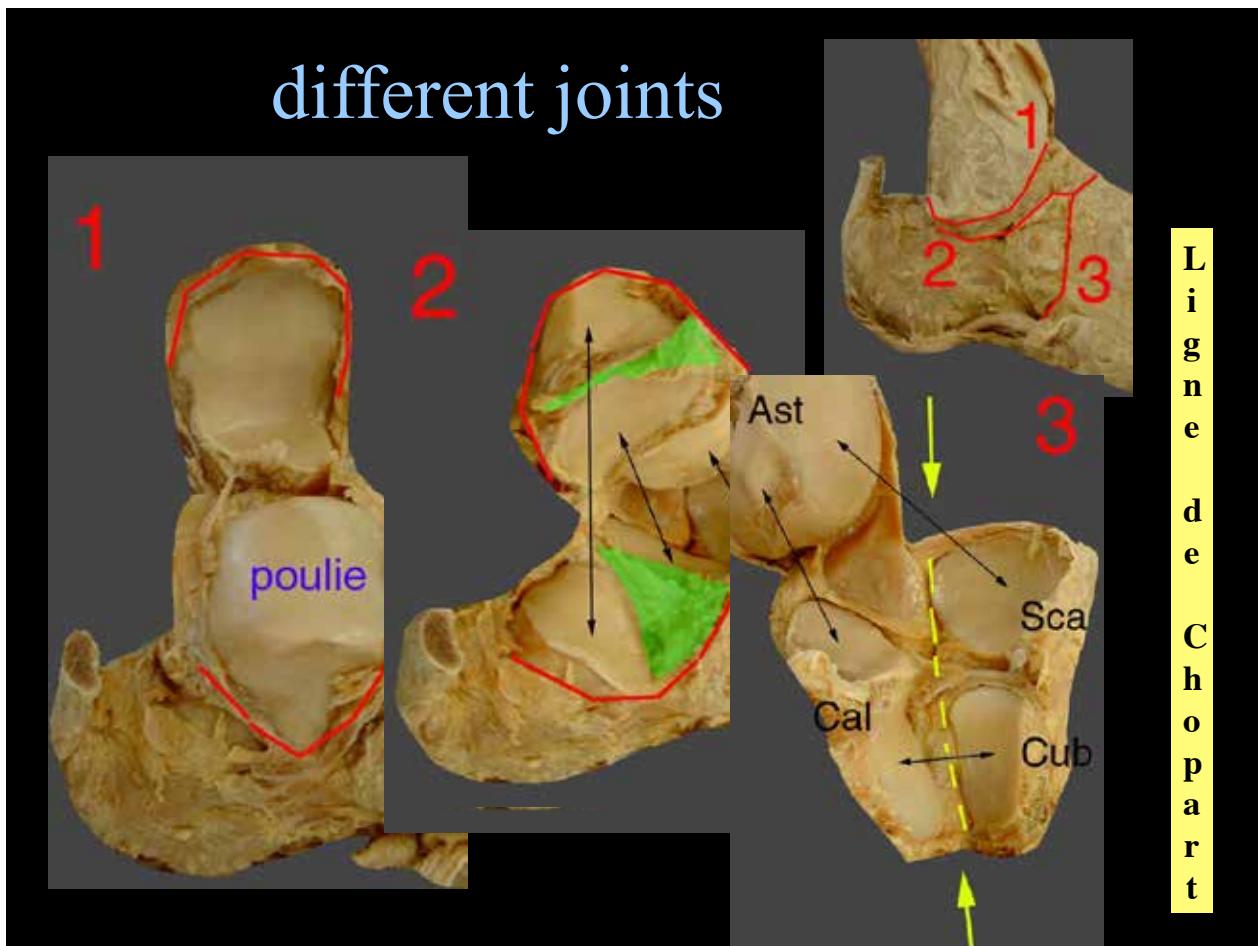
Talus bone is the head of the plantar arch, in form of a tripod



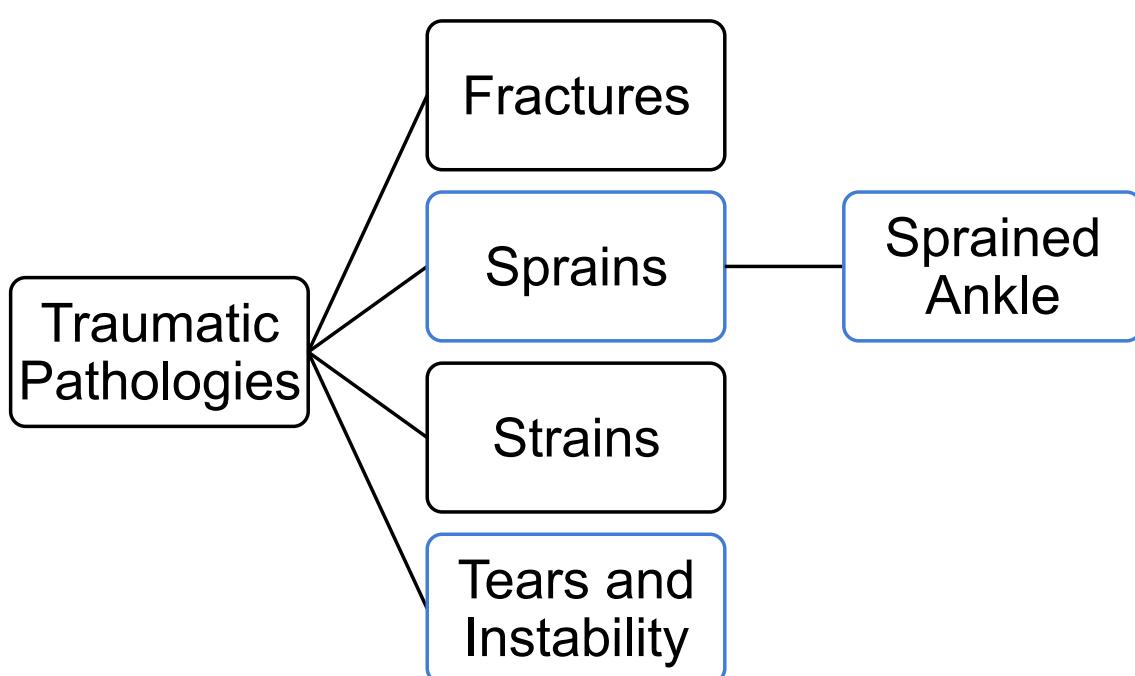
Bony trabecules



different joints



Traumatic pathologies of the Ligaments



Traumatic pathologies of the Ligaments

Sprained Ankle:

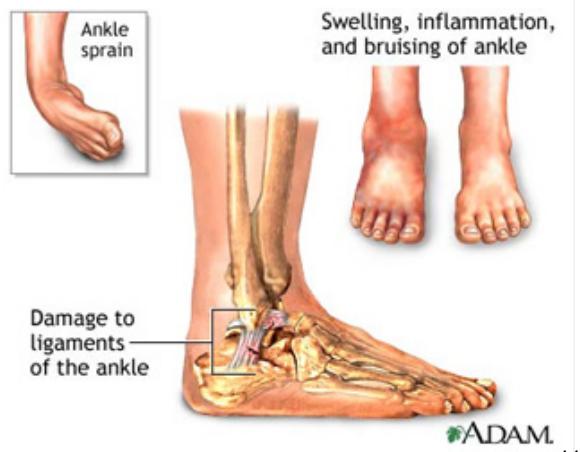
- Syn.: German Verstauchung
- Stretching of **ligaments** on the outside of the ankle due to unnatural twisting and/or force on ankle
- 25'000 people per day

Symptoms:

- Pain and tenderness
- Swelling, heat, redness

Associated conditions:

- Repeated sprains
- **Chronic lateral ankle pain**
- Tear of ligaments



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Traumatic pathologies of the Ligaments

Chronic lateral Ankle Pain:

- Recurring or chronic pain on the outside of the ankle
- Most often caused by ankle sprain

Signs and Symptoms:

- Instability (walking on uneven ground)
- Pain
- Repeated ankle sprains
- Stiffness
- Swelling
- Tenderness



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Traumatic pathologies of the Ligaments

Chronic lateral Ankle Pain:

Other causes for chronic lateral ankle pain:

- Fracture
- Arthritis
- Nerve damage
- Ankle sprain (scar tissue)
- Rupture of tendon
- Inflammation of tendon



Therapy:

- Anti-inflammatory drugs
- Physical therapy

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Inflammatory Pathologies of the foot joints

Arthritis:

- General term for an inflammation of one or several joints (mono-, oligo-, polyarthritis)
- Predominantly in elderly people

Description:

- Acute or chronic
- Localized or Systemic diseases

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Inflammatory Pathologies of the foot joints

Arthritis:

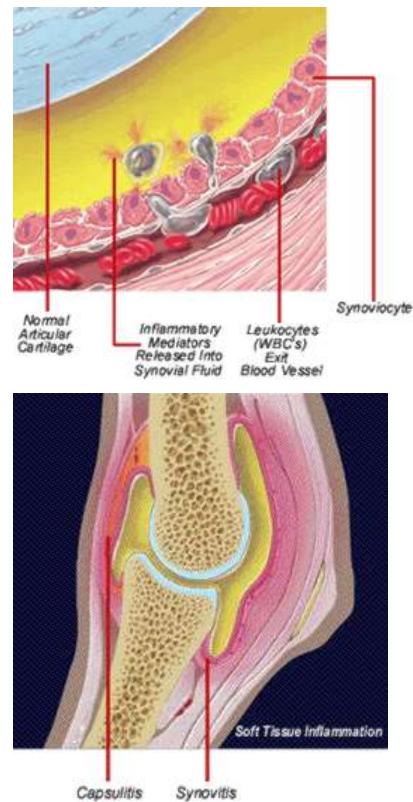
Signs and Symptoms:

■ Primary:

- Joint pain
- Swelling
- Heat
- Swelling
- Joint stiffness (loss of function)

■ Secondary:

- Muscle weakness
- Loss of flexibility
- Decreased aerobic fitness



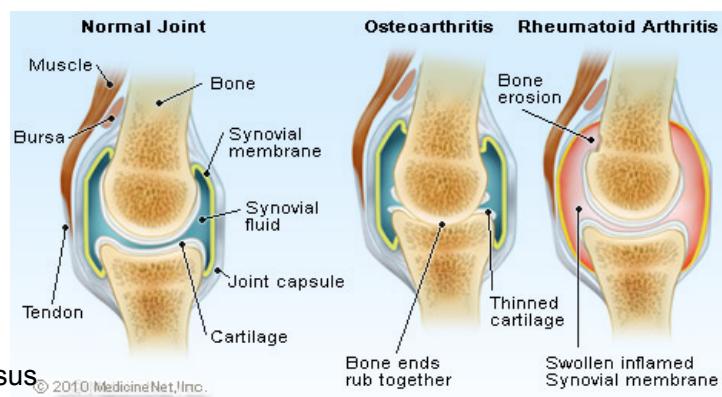
123

Inflammatory Pathologies of the foot joints

Arthritis:

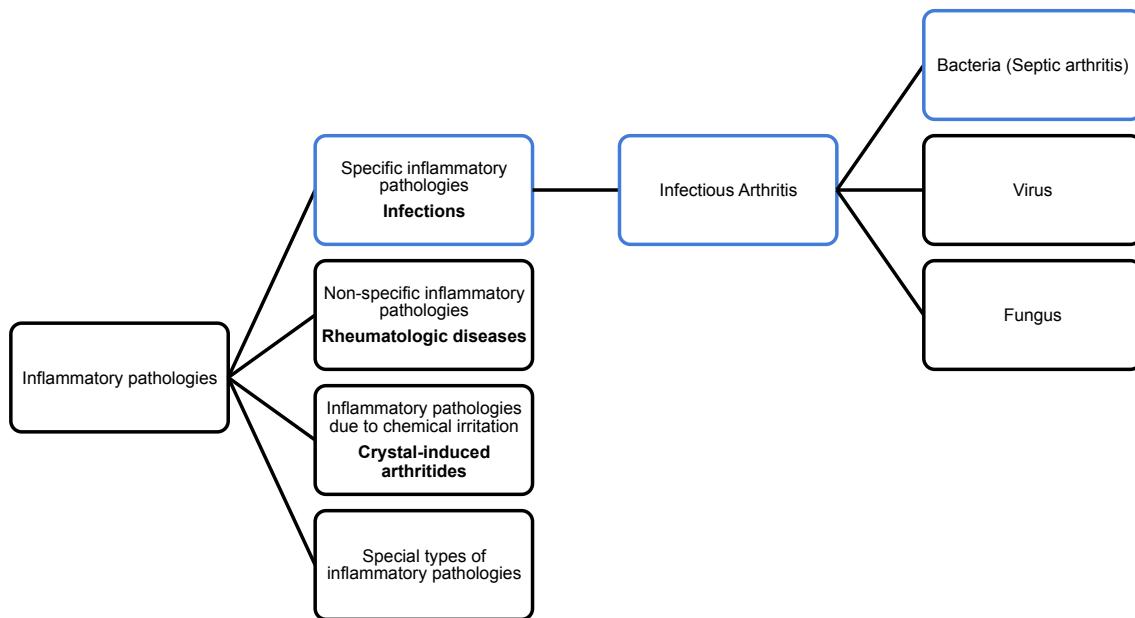
Classification:

- Primary arthritis
- Osteoarthritis
 - Rheumatoid arthritis
 - Gout and pseudo-gout
 - Septic Arthritis
- Secondary arthritis
- Psoriatic Arthritis
 - Reactive Arthritis
 - Systemic lupus erythematosus
 - Vasculitides
 - (...)



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Inflammatory Pathologies of the foot joints



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Inflammatory Pathologies of the foot joints

Septic Arthritis:

- Inflammation of a joint due to invasion of an infectious agent
- Acute and life-threatening pathology

Etiology:

- *Staphylococcus aureus* (90%)
- Streptococci
- *Mycobacteria tuberculosis*

Bacteria reach the synovial membrane of the joint by:

- Systemic dissemination via blood
- Local dissemination from infectious focus
- Entry via penetrating trauma (skin lesion)



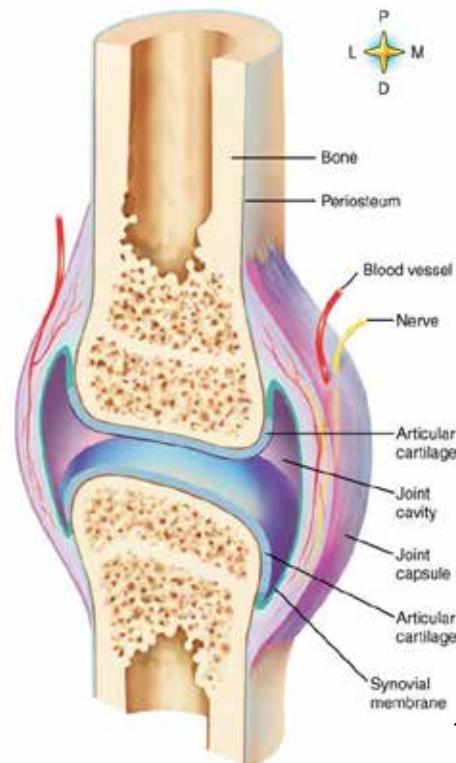
126

Inflammatory Pathologies of the foot joints

Septic Arthritis:

Pathophysiology:

- Pyogenic exudate (bacteria and macrophages) destroys cartilage (exposure of bone) and connective tissue (collagen) of joint (instability)
- Granulation inhibits joint function (subluxation)
- Granulation may inhibit nutrition of cartilage through synovial membrane (erosion)
- High pressure of joint makes it impossible for antibiotics to take effect



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Inflammatory Pathologies of the foot joints

Septic Arthritis:

Important Symptom: Fever!

Risk for septic arthritis:

- Artificial joint implants
- Bacterial infection
- Chronic diseases
- Joint injury or surgery



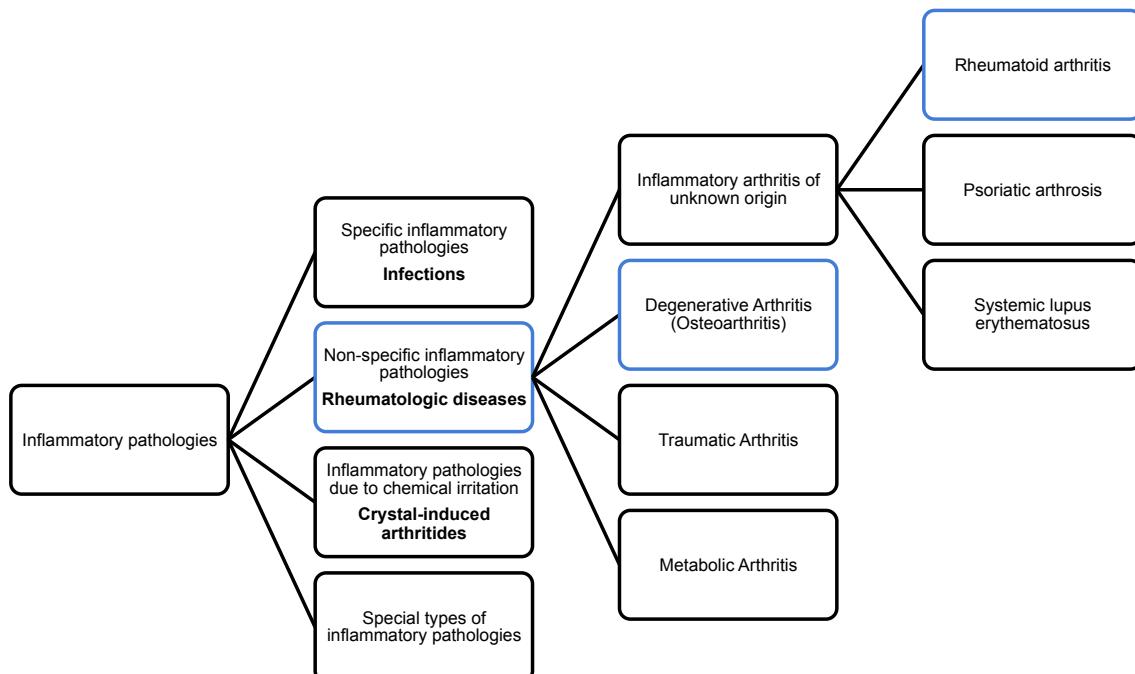
Epidemiology:

- Most often in children < 3 years of age and elderly people
- Can affect all ages
- In children hip is often site of infection



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Inflammatory Pathologies of the foot joints



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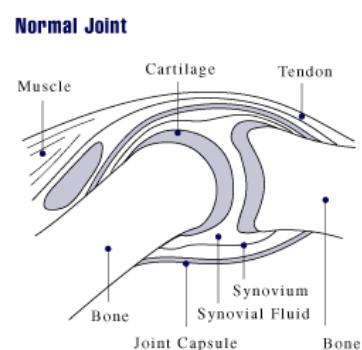
Inflammatory Pathologies of the foot joints

Rheumatoide Arthritis

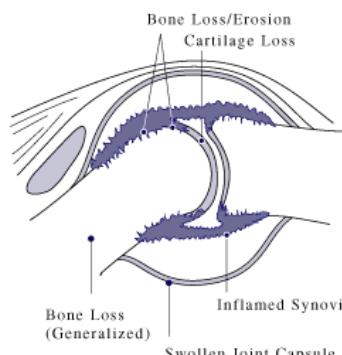
- Chronic, systemic, inflammatory disease of the connective tissue (predominantly the synovial joints and surrounding tissue)
- Autoimmune disease (unclear)

Epidemiology:

- One of the most common inflammatory disease of the joints
- Incidence: 3 per 10'000 people per year
- Incidence increases with age (peak 35 – 45 years)
- Women:Men = 3-5:1



Joint Affected by Rheumatoid Arthritis



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Inflammatory Pathologies of the foot joints

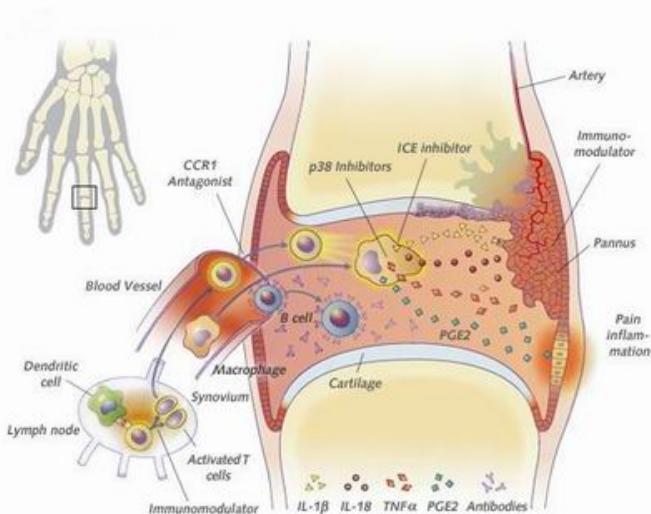
Rheumatoide Arthritis

Unknown etiology:

- Genetic factors (HLH-Types)
- Environmental factors (HPV6, EBV, Vitamin D)

Pathogenesis in joints:

- Defective immune cells migrate to joint and produce inflammation (Cytokines) with inflammatory response of synovia (**synovitis**)
- Synovia shows a **tumor-like-proliferation** and hyperplasia with formation of pannus (connective tissue with vessels) and migration of aggressive cells that degrade cartilage and bone (with photolytic enzymes)
- Activation of Osteoclasts leads to destruction of bone and cartilage



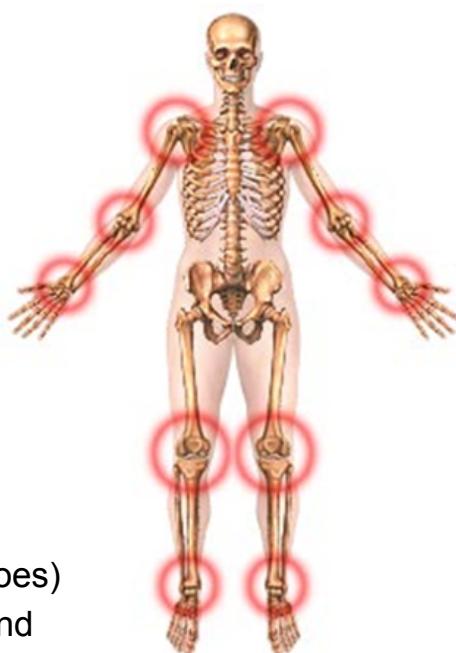
131

Inflammatory Pathologies of the foot joints

Rheumatoide Arthritis

Pathophysiology in joints:

- Destruction of joint
- Ankylosis (fusion of joints)
- Muscular atrophy
- Tendosynovitis
- Tendinitis
- Bursitis
- Rheumatoid granulomas



Progress:

- RA start in small joints (fingers and toes)
- RA spreads to other (bigger) joints and extraarticular areas

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Inflammatory Pathologies of the foot joints

Rheumatoide Arthritis

Signs and Symptoms:

- Intraarticular
 - Swelling, pain, heat
 - Stiffness (especially in the morning)
 - Restriction of movement
- Extraarticular (due to vasculitis and lymphocytic infiltrate)
 - Necrotizing granulomas in the skin (rheumatoid nodules)
 - Episcleritis
 - Sicca symptoms
 - Compression syndromes (e.g. carpal tunnel syndrome)
 - Arteritis
 - Anemia
 - Peripheral neuropathy
 - Interstitial lung diseases



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Inflammatory Pathologies of the foot joints

Rheumatoide Arthritis

Effects of RA on foot and ankle:

- Rheumatoid nodules (pain)
- Dislocated and stiff joints
- Hammertoe
- Bunion
- Heel pain
- Achilles tendon pain
- Flatfoot
- Ankle pain



Figure 1

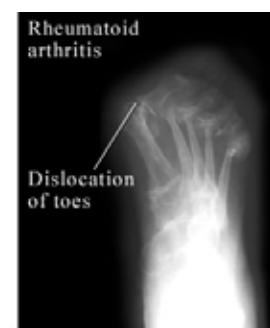
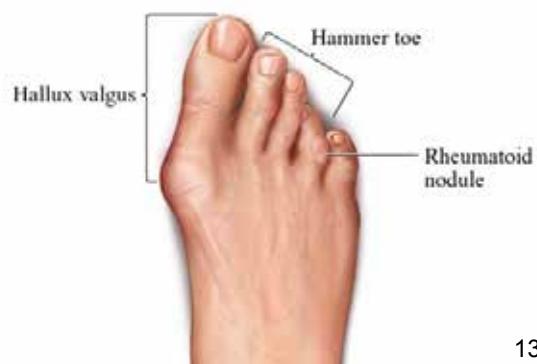


Figure 2



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Degenerative Pathologies of the foot joints

Osteoarthritis OA:

- Syn.: Degenerative arthritis, degenerative joint disease, Osteoarthritis, german Arthrose, Arthrosis deformans
- Mechanical abnormalities of joints (involving articular cartilage, subchondral bone) that are not age related
- Most important feature: premature degeneration and hypertrophy of cartilage
- „Wear-and-tear“ disease

Epidemiology:

- Elderly people affected (15% men and 25% women above 65 years of age)
- The most common form of Arthritis
- About 60% of people over 65 are affected (not always symptomatic)

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Degenerative Pathologies of the foot joints

Osteoarthritis OA:

Classification:

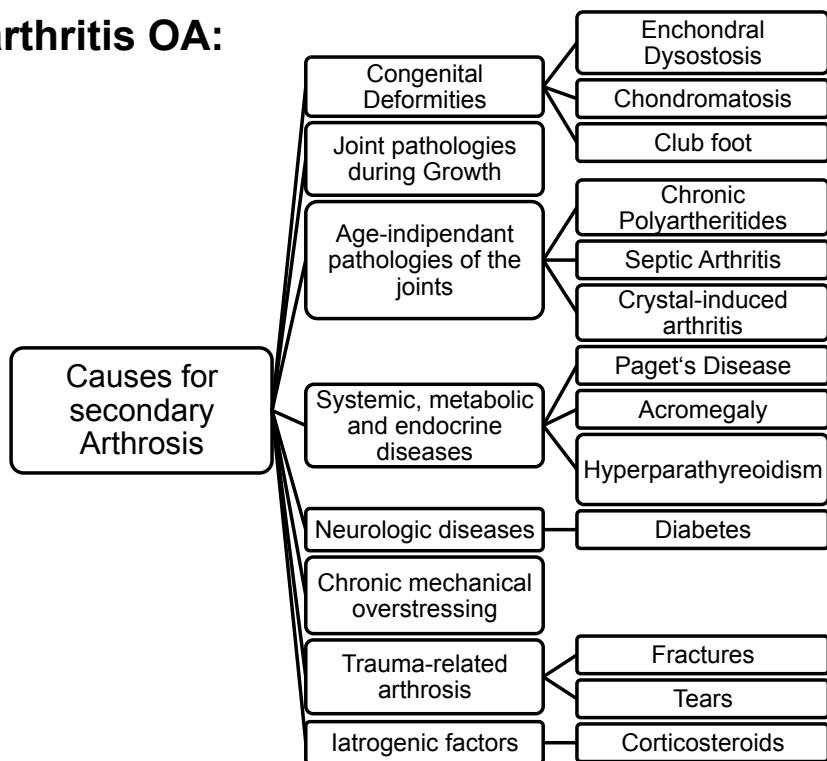
- Primary arthrosis = chronic degenerative disorder of unknown origin
 - Genetic factors
 - ???
- Secondary arthrosis = because of previous damage or disease (various etiologies)
 - Congenital Deformities of bones and joints
 - Joint pathologies during Growth
 - Age-independant pathologies of the joints
 - Systemic, metabolic and endocrine diseases
 - Neurologic diseases
 - Chronic mechanical overstressing
 - Trauma-related arthrosis
 - Iatrogenic factors



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Degenerative Pathologies of the foot joints

Osteoarthritis OA:



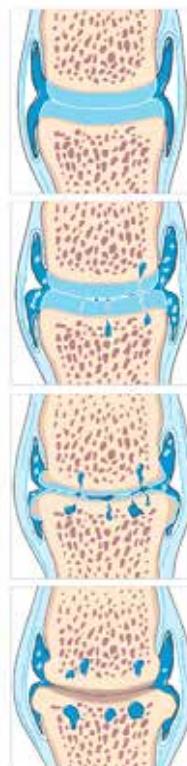
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Degenerative Pathologies of the foot joints

Osteoarthritis OA:

Cause Pathogenesis:

- OA develops because of a mismatch of joint stress capacity and the actual stress level inflicted on the joint
- OA develops in 4 stages:
 - Stage 1: Softening of the cartilage
 - Stage 2: Superficial damage of the cartilage
 - Stage 3: Profound damage of the cartilage
 - Stage 4: Loss of joint cartilage



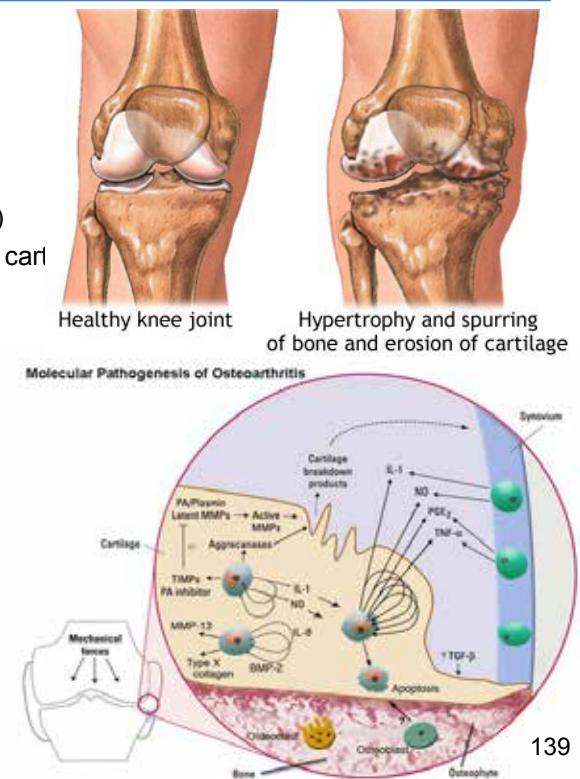
138

Degenerative Pathologies of the foot joints

Osteoarthritis OA:

Pathogenetic components:

- Joint cartilage
 - Loss of proteoglycans (Chondromalacia)
 - Uprooting of collagen → Destruction of cartilage
 - Proliferation of chondroblasts (healing)
 - Vascularisation → Inflammation
- Subchondral bone
 - Loss of joint cartilage = higher pressure)
 - Sclerosis
 - Atrophy
- Synovial membrane
 - Chronic inflammation
 - Capsula shrinkage (stiffness)
 - Pain
- Muscles
 - Spasm
 - Contracture

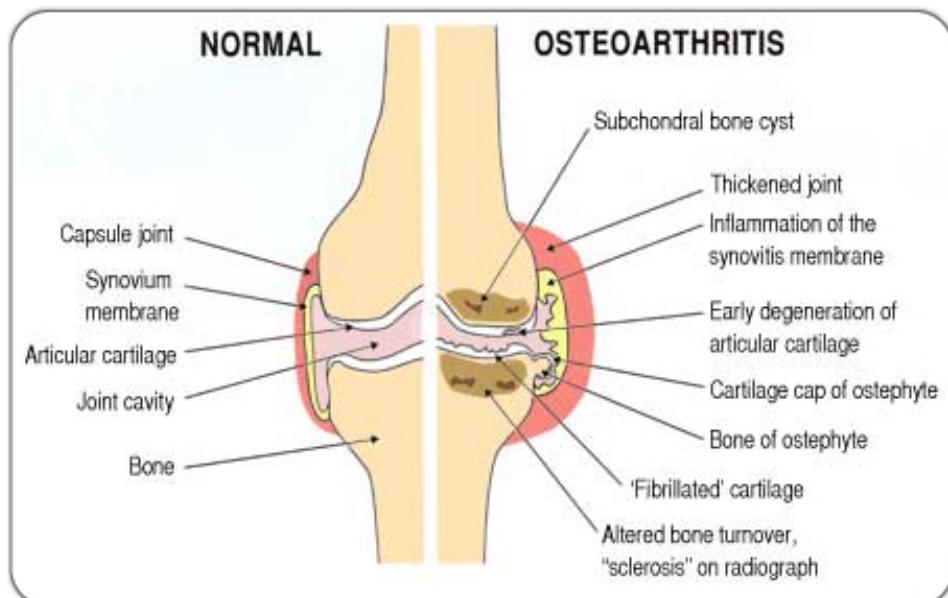


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Degenerative Pathologies of the foot joints

Osteoarthritis OA:

Pathogenesis:



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Degenerative Pathologies of the foot joints

Osteoarthritis OA:

Signs and symptoms:

- Sharp aching pain
- Loss of ability (restricted movement)
- Swelling
- Stiffness of joints
- Clicking noise (Crepitus)
- Effusion (joint filled with fluid)
- Enlargement and deformation of the joint

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Degenerative Pathologies of the foot joints

Osteoarthritis OA:

Common Locations:

- Hands
- Feet
- Spine
- Hips
- Knees



The weight bearing joints are most often affected!

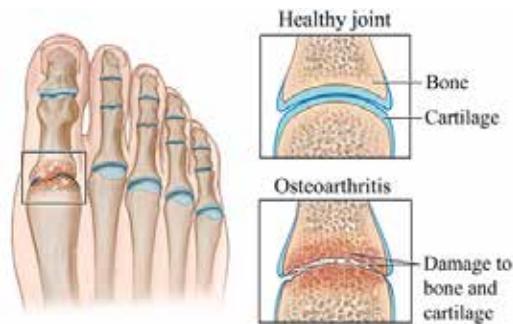
142

Degenerative Pathologies of the foot joints

Osteoarthritis OA:

OA of the big toe
(metatarsophalangeal joint):

- Jamming of the toe,
- Trauma
- Shoes



Deformities of big toe:

- Hallux valgus
- Hallux rigidus



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Degenerative Pathologies of the foot joints

Osteoarthritis OA:

OA of the **hindfoot**

- Subtalar joint
- Talonavicular joint
- Calcaneocuboid joint



OA of the **midfoot**

(Metatarsocuneiform joint)

- Trauma
- Strain
- Sprain



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Degenerative Pathologies of the foot joints

Osteoarthritis

OA:

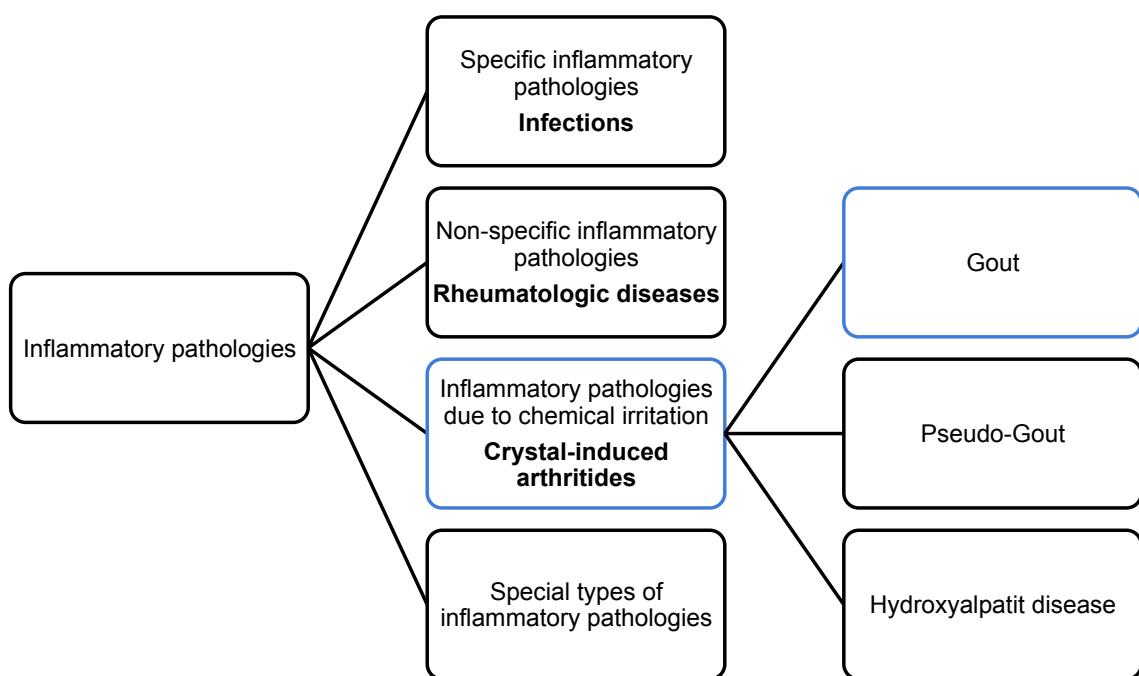
OA of the **ankle**
(tibiotalar joint)

- Fracture
- Sprain



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Inflammatory Pathologies of the foot joints

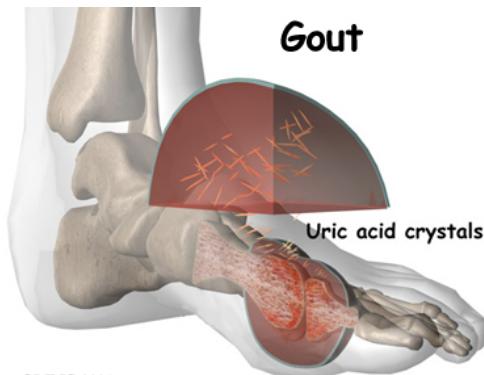


146

Inflammatory Pathologies of the foot joints

Gout

- Syn.: Podagra (big toe), gouty arthritis, German Gicht, Harnsäuregicht
- Deposition of uric acid crystals in joints and organs because of hyperuricemia due to defective purin metabolism



©MMG 2001

Epidemiology:

- 1 – 2 % of western population affected
- In over 90% primary Gout
- Men > Women

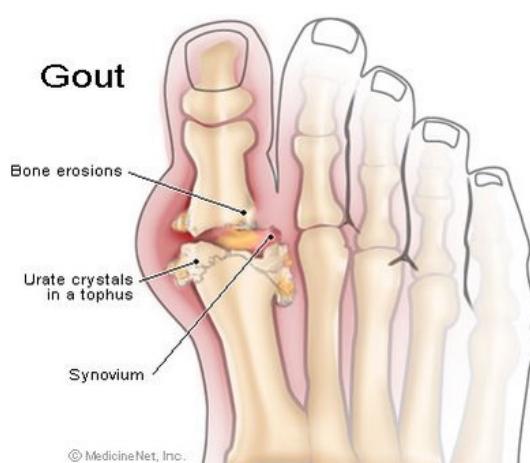
147

Inflammatory Pathologies of the foot joints

Gout

Etiology:

- Primary (inherited) Gout (common)
 - Renal under excretion of uric acid (>90%)
 - Overproduction of uric acid (<10%)
- Secondary (acquired) Gout (rare)
 - Diabetes mellitus
 - Alcoholism
 - (...)



Hyperuricemia

- Crystallization and deposition of uric acid in joints and organs
- Crystals irritate synovia, cartilage and bone and cause inflammation

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Inflammatory Pathologies of the foot joints

Gout

Signs and Symptoms:

- Acute symptoms
 - **Pain!!!** (often in the middle of the night)
 - Monoarticular (often first MTP joint)
 - Red, warm
 - Tenderness
 - Fever
- Chronic symptoms
 - Often less painful
 - **Deformity of joints**
 - Deposition in connective tissue (toes, finger, ear)
 - Destruction of inner organs (kidney)



Acute symptoms often due to exacerbation

- Diet (meat, alcohol)
- Exercise



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Inflammatory Pathologies of the foot joints

Pseudogout

- Syn.: Chondrocalcinosis, calcium pyrophosphate dehydrate disease CPPD
- Rare rheumatologic disorder characterized by pain due to accumulation of calcium pyrophosphate dehydrate in the connective tissue
- Genetic disease with unknown pathogenesis
- Symptoms similar to Gout (mono- or oligoarticular inflammation of joints)



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Degenerative pathologies of the foot joints

Osteochondrosis

- Syn.: Epiphysitis, Osteochondritis, Aseptic necrosis (...)
- Group of orthopaedic diseases that involve degenerative changes of bone and cartilage in joints and epiphysis
- Characteristic is the interruption of blood supply of the bone and epiphysis (followed by localized bony necrosis) and the self-limited nature of the pathology

Epidemiology:

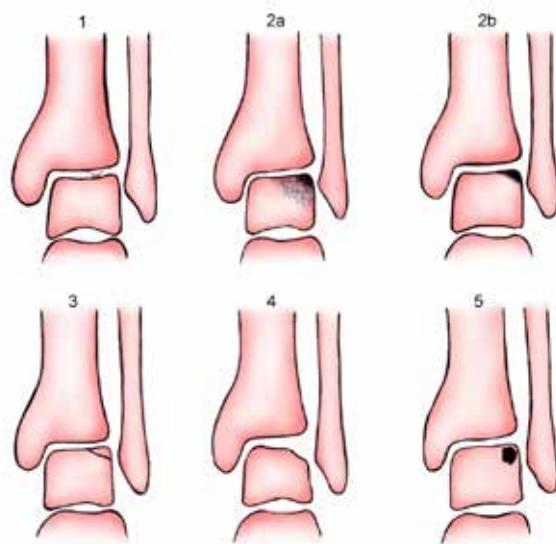
- - Most common between 3 and 10 years of age
- Boys > Girls
- Lower extremities > upper extremities
- In 15% bilateral

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Degenerative pathologies of the foot joints

Osteochondrosis

- Etiology (unclear):
 - Genetic factors (heredity)
 - Rapid growth
 - **Trauma**
 - Diet
 - Anatomy
- Pathogenesis (well-known):
 - Interruption of blood supply (unknown origin)
 - Necrosis of epiphysis
 - Revascularisation
 - Fractures of the (old) subchondral bone
 - Subluxation and deformation of joint
 - Healing of the bone
 - Endphase
 - Residual deformity
 - Progression to degenerative arthritis



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Degenerative pathologies of the foot joints

Osteochondrosis

Fractures are most important symptom:

- Pain, swelling, tenderness
- Atrophy and contraction of muscle

Therapy:

- Early recognition
- Avoid subchondral fractures and subluxation, in order to minimize deformity and sustain joint structure
- Anti-inflammatory drugs
- Casts
- Surgery



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Degenerative pathologies of the foot joints

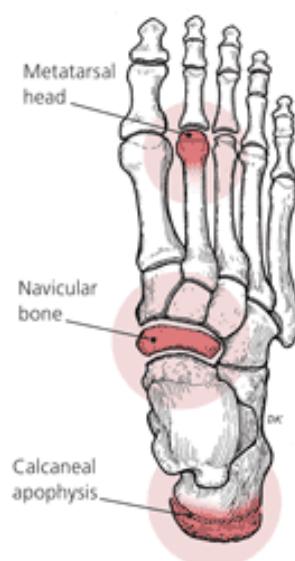
Osteochondrosis

Localized types of osteochondrosis:

- **M. Freiberg** = Osteochondrosis of Caput metatarsale
- **M. Kohler** = Osteochondrosis of Os naviculare
- **M. Sever** = Partial tear of calcaneal apophysis

Osteochondrosis at various locations:

- **Post-traumatic avascular necrosis** of subchondral bone
- Tangential avascular necrosis of talus (Osteochondritis dissecans)



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Degenerative pathologies of the foot joints

Freiberg's Disease:

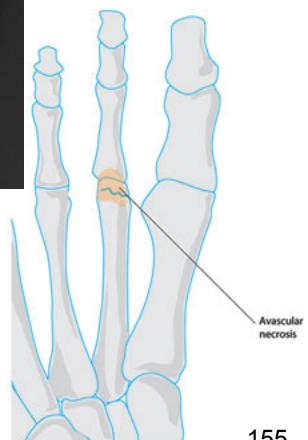
- Osteochondrosis of Caput metatarsale
- Most often in young girls
- Often associated with congenital long 2nd or short 1st metatarsal bone (pressure)

Etiology:

- Unclear
- Repetitive stress

Pathogenesis:

- Micro fractures near growth plate of metatarsal head cause inadequate circulation
- Necrosis of metatarsal head with risk of detachment
- Deformity with degenerative pathology of joint

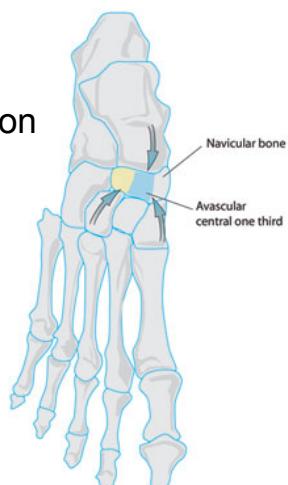


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Degenerative pathologies of the foot joints

Kohler's Disease

- Spontaneous loss of blood supply with consecutive necrosis of primary ossification centre of the os naviculare
- Rare Osteochondrosis
- Typically in boys age 4 to 8)
- Midfoot pain
- In most cases complete healing with low risk for deformities

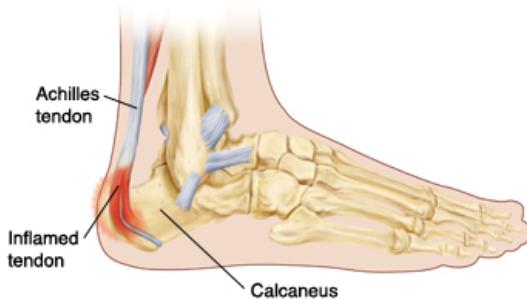


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Degenerative pathologies of the foot joints

M. Sever

- Partial tear of calcaneal apophysis causes inflammation of any growth centre of the calcaneal apophysis (Calcaneal apophysitis)
- Pain and tenderness
- Often in boys age 8 to 15
- Often complete healing

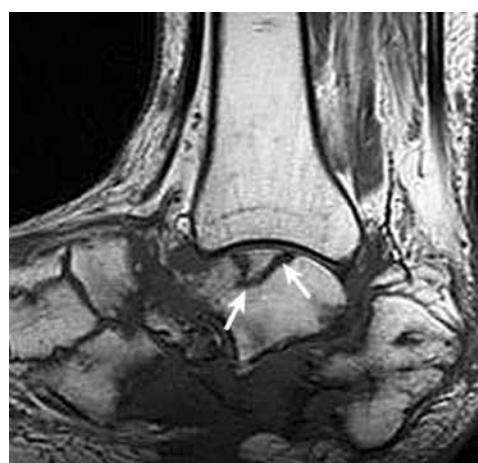


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Degenerative pathologies of the foot joints

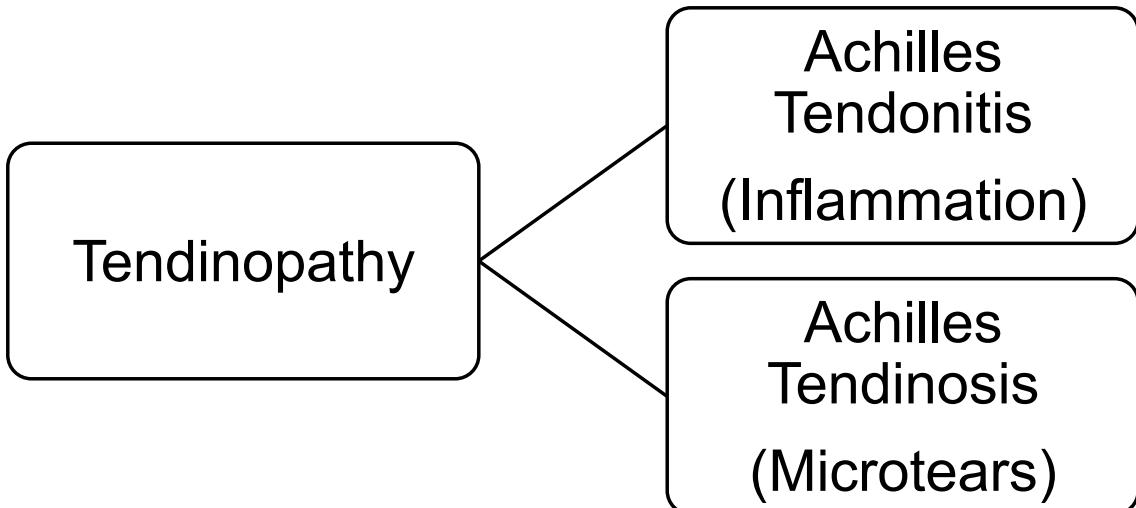
Posttraumatic avascular necrosis of subchondral bone

- Severe trauma can destroy blood supply of subchondral bone and cause avascular necrosis (ischemia)
- Typically for fractures of talus
- Often in children



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Inflammatory and Degenerative Pathologies of the Muscles and Tendons



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Inflammatory and Degenerative Pathologies of the Muscles and Tendons

Achilles Tendonitis:

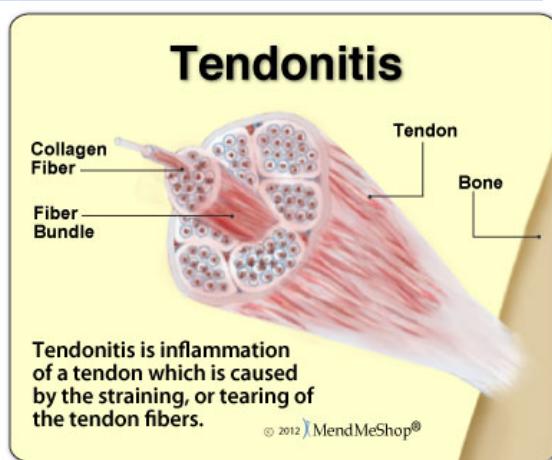
- Syn.: Achilles tendosynovitis
- Inflammation of the achilles tendon (and usually also the stealth)
- Rare occurrence!

Cause:

- Acute: Sudden contraction (running, climbing, sprint)
- Chronic: Repetitive use, Overload, lack of flexibility

Pathomechanism

- Excessive loading leads to irritation and micro-tearing of collagen fibres and causes inflammation
- Scar tissue develops (weakens collagen fibres and increases risk for further injury) and tendon may get thicker
- Poor blood supply of tendon



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Inflammatory and Degenerative Pathologies of the Muscles and Tendons

Achilles Tendinosis:

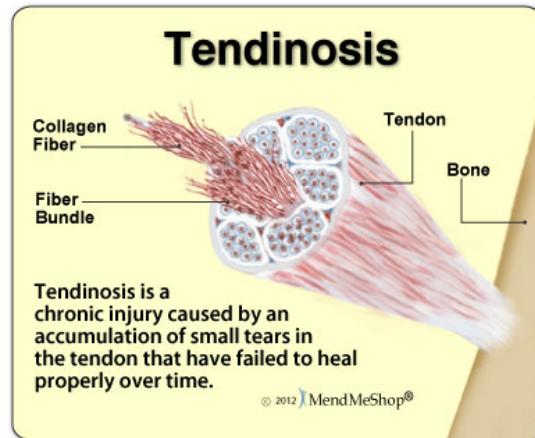
- Non-inflammatory degeneration of the collagen fibers in and around the tendon
- No inflammation
- Most common!

Caused by repetitive stress:

- Overuse
- Adipositas
- Footwear

Pathomechanism

- Excessive loading (wear and tear) leads to micro-tears of collagen fibres in tendon
- Tissue damage exceeds healing process (tendon doesn't heal properly)
- Collagen fibres deteriorate (weak)
- Poor blood supply of tendon



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Inflammatory and Degenerative Pathologies of the Muscles and Tendons

Achilles Tendonitis vs. Tendinosis:

Tendonitis	Tendinosis
Inflammation	Degeneration
Swelling, Red color, heat, Pain	Pain, Tenderness, stiffness

Therapy:

- Minimize scar tissue formation
- Maximize realignment of tendon fibres
- Rest
- Bandage
- Anti-inflammatory drugs (Inflammation)
- Surgery (in severe cases)

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Inflammatory pathologies of the Muscles and Tendons

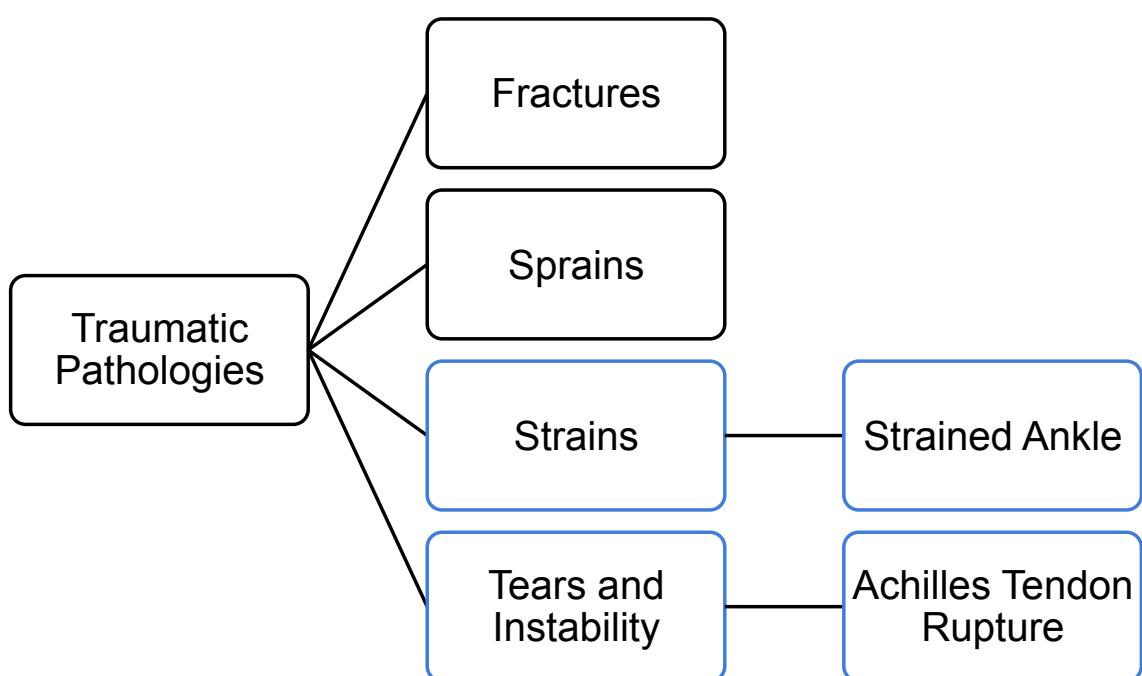
Xanthomas of Achilles Tendon

- Accumulation of cholesterol (inside macrophages) in the tendon
- Caused by disorder of lipid metabolism associated with hyperlipidemia
- Associated with familial Hypercholesterolemia



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Traumatic pathologies of the Muscles and Tendons



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Traumatic pathologies of the Ligaments

Strained Ankle:

- Syn.: Distortion, german Zerrung
- Acute type of injury that result from overstretching or over contraction of **muscles and tendons**

Causes:

- Tear
- Twist
- Pull



Symptoms similar to sprained ankle

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Traumatic pathologies of the Muscles and Tendons

Achilles Tendon Rupture:

- Achilles tendon is most commonly injured tendon
- Tendon rupture is a tearing and separating of the tendon fibres in a way that the tendon can no longer perform its normal function



Cause and pathogenesis:

- Acute trauma
- Degenerative changes in tendon
 - Overstressing
 - Aging
 - Diabetes
- Drugs (Cortisol, Antibiotics)



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Traumatic pathologies of the Muscles and Tendons

Achilles Tendon Rupture:

Epidemiology:

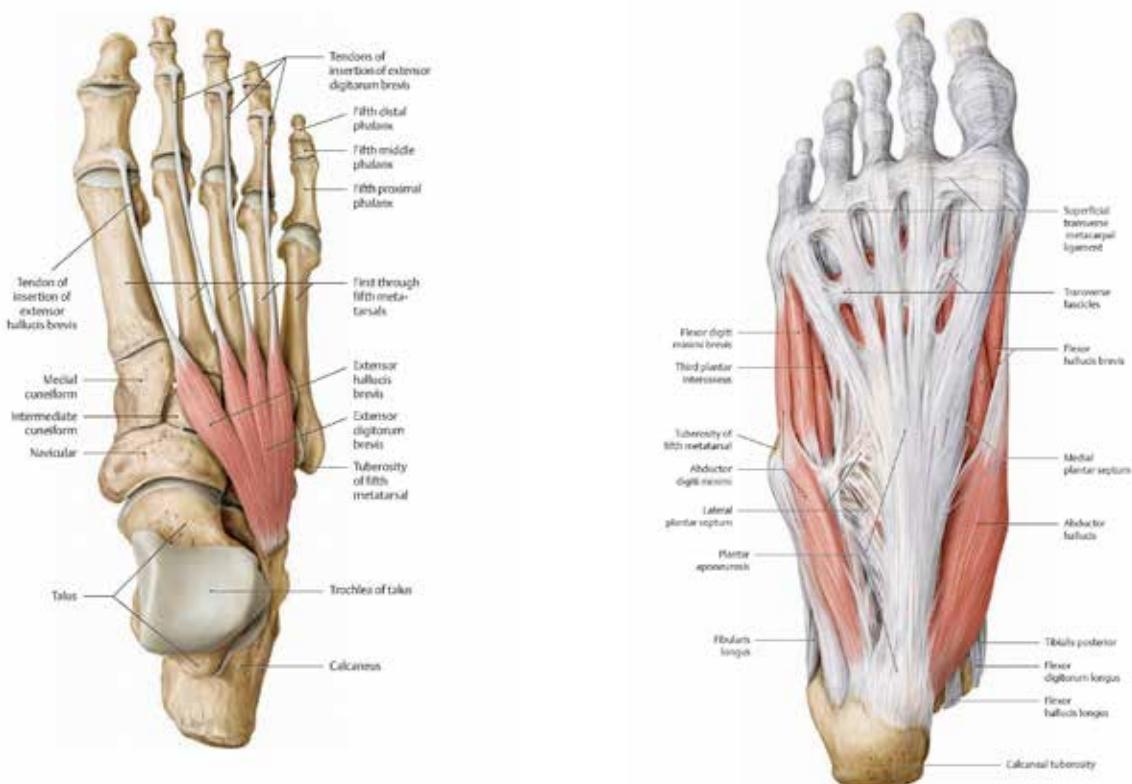
- Male:Female = 20:1
- 30 – 40 years old

Signs and Symptoms:

- Swelling
- Hematoma
- Crack of a whip (Peitschenknall)
- Gap above the heel
- No passive plantarflexion
- Unable to stand on toes

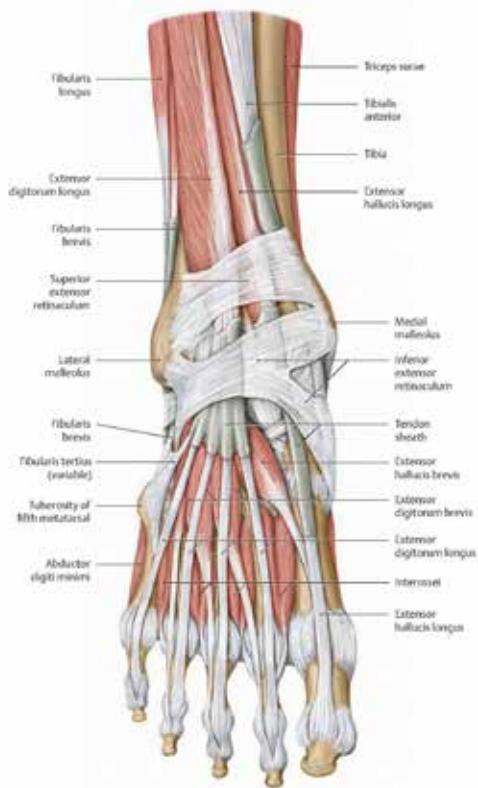


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C The dorsal muscles of the foot (extensor digitorum brevis and extensor hallucis brevis)
Right foot, dorsal view.

A The plantar aponeurosis of the right foot from the plantar view



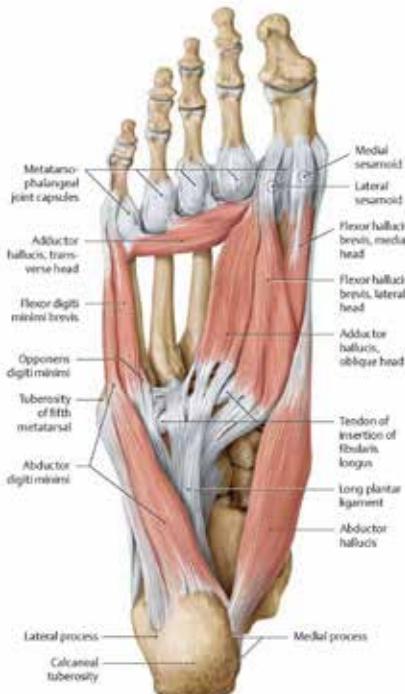
A The tendon sheaths and retinacula of the right foot from the anterior view

Illustrator: Karl Weicker

pp. 454–455

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D The plantar muscles of the medial and lateral compartments (abductor hallucis, adductor hallucis*, flexor hallucis brevis, abductor digiti minimi, flexor digiti minimi, and opponens digiti minimi)

Right foot, plantar view.

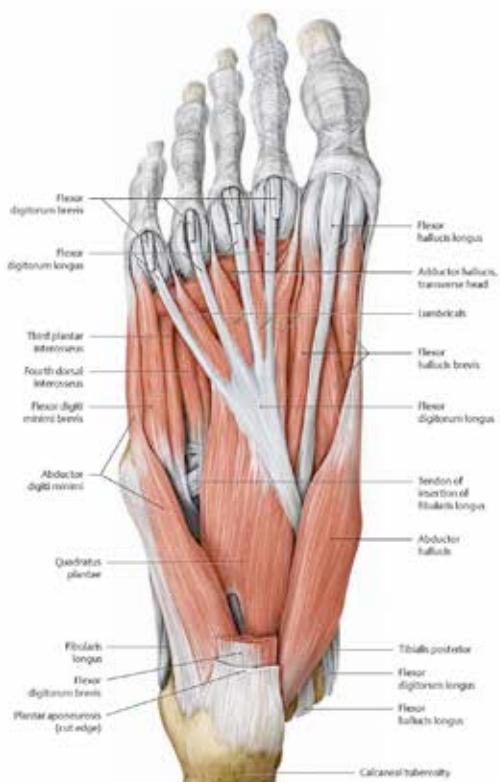
* The adductor hallucis is considered part of the central compartment.

Illustrator: Karl Weicker

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A The intrinsic muscles of the right foot from the plantar view

Illustrator: Karl Weicker

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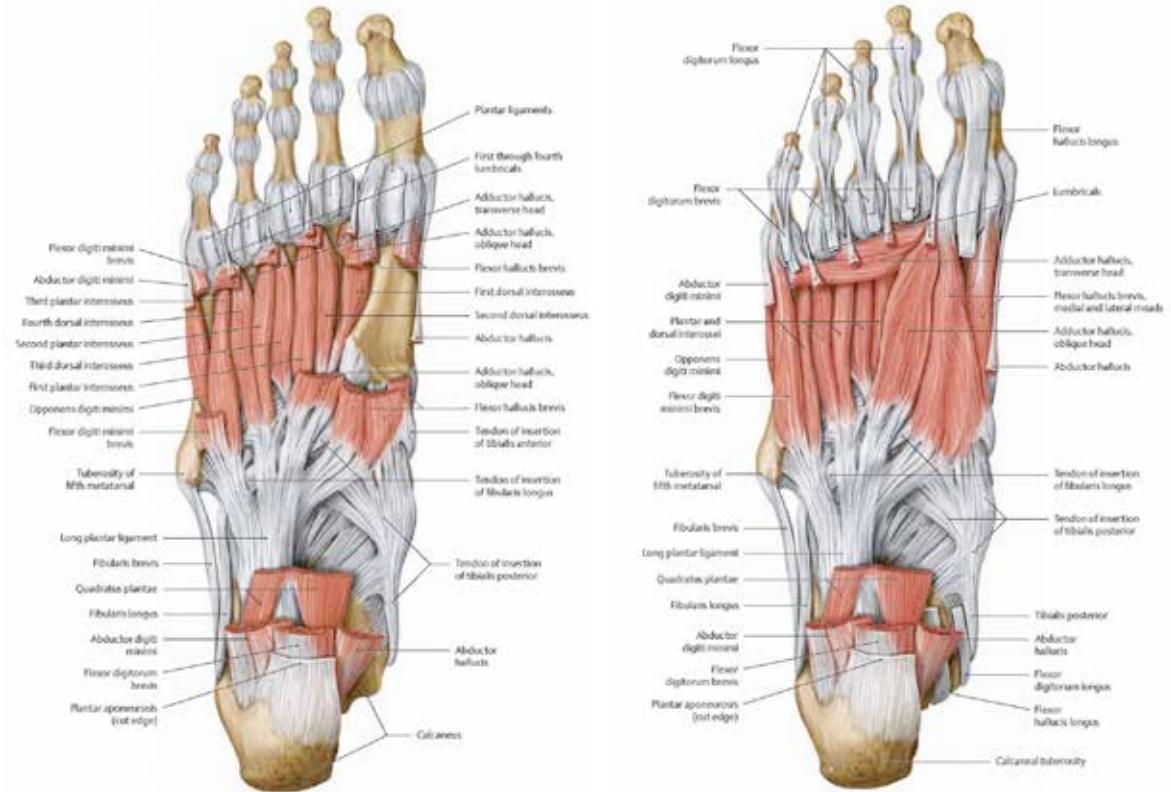
B The intrinsic muscles of the right foot from the plantar view

Illustrator: Karl Weicker

pp. 456–457

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A The intrinsic muscles of the right foot from the plantar view

Illustrator: Karl Wesker

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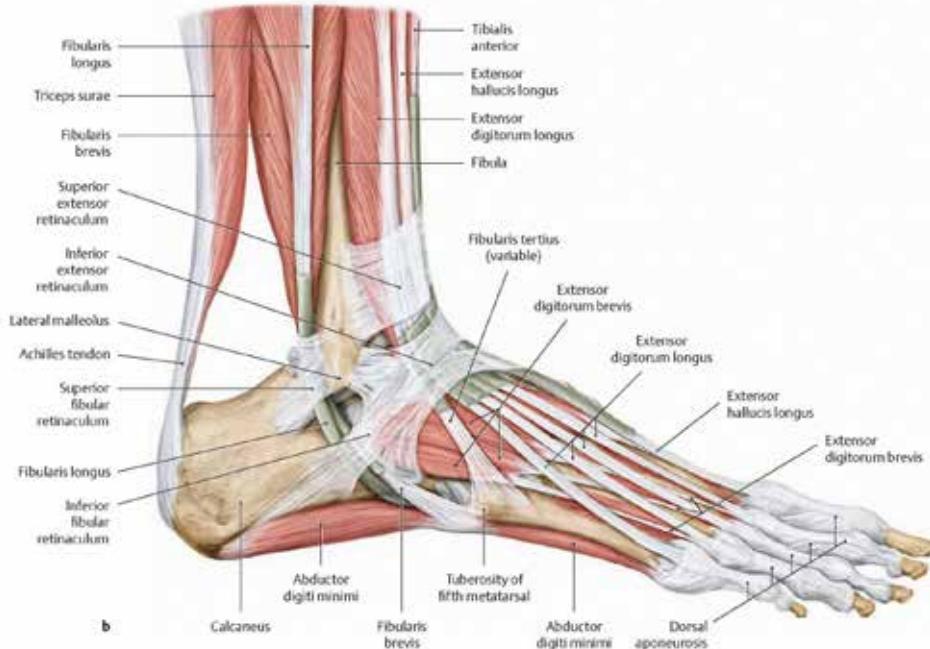
pp. 460-461
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B The intrinsic muscles of the right foot from the plantar view

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B The tendon sheaths and retinacula of the right foot

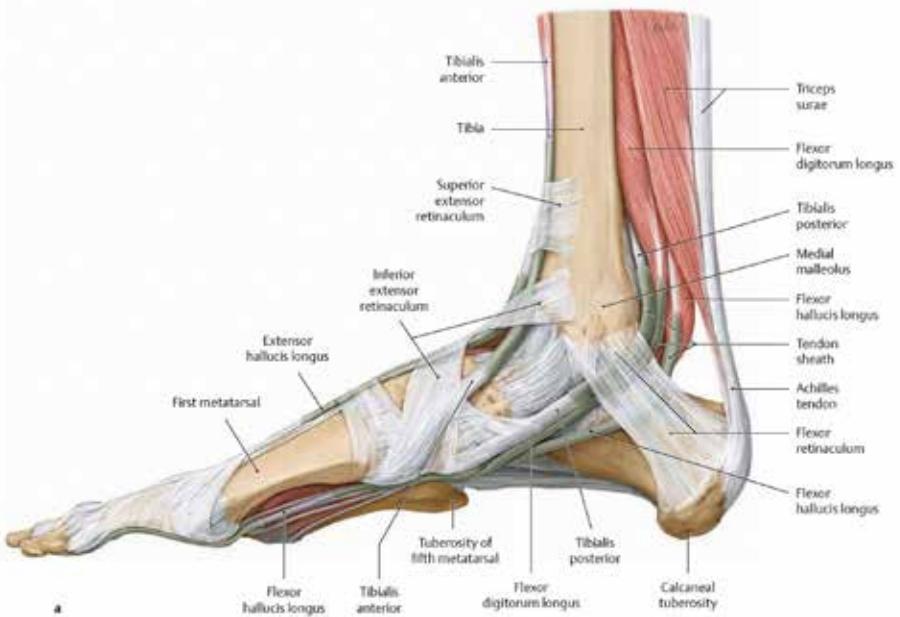
b Lateral view.

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B The tendon sheaths and retinacula of the right foot

a Medial view.

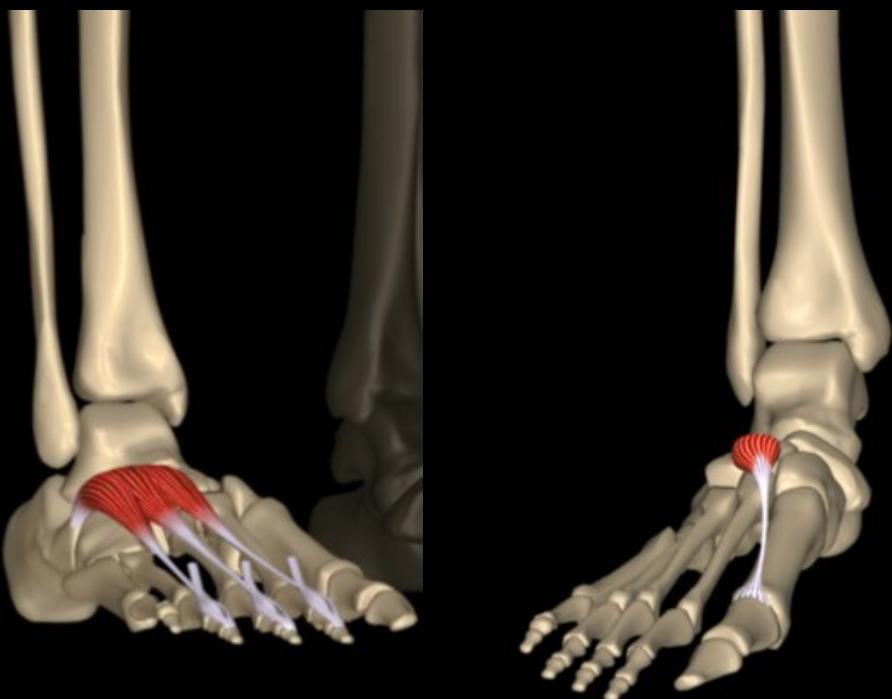
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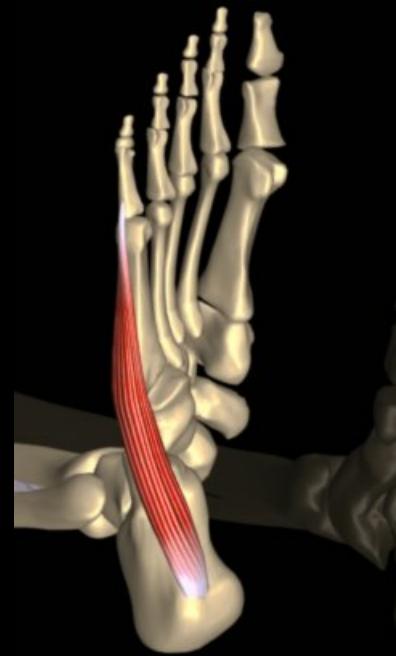
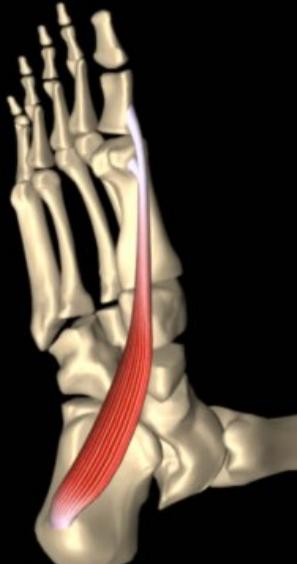
dorsal muscles of foot



m. court extenseur des orteils et de l 'hallux, (m. pédieux)

Short plantaris muscles

m. court fléchisseur des orteils



m. abducteur de l 'hallux

m. abducteur du petit orteil

Short plantar muscles



chair carré plantaire

mm. lombricaux

Short plantaris muscles



m. court fléchisseur de l 'hallux



m. adducteur de l 'hallux

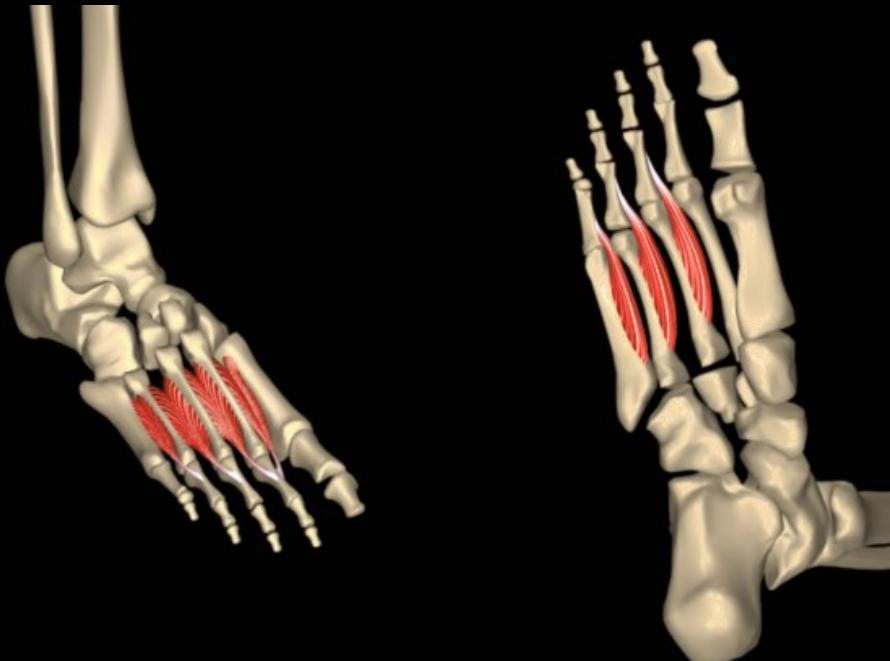
Short plantaris muscles



mm. court fléchisseur et opposant du petit orteil

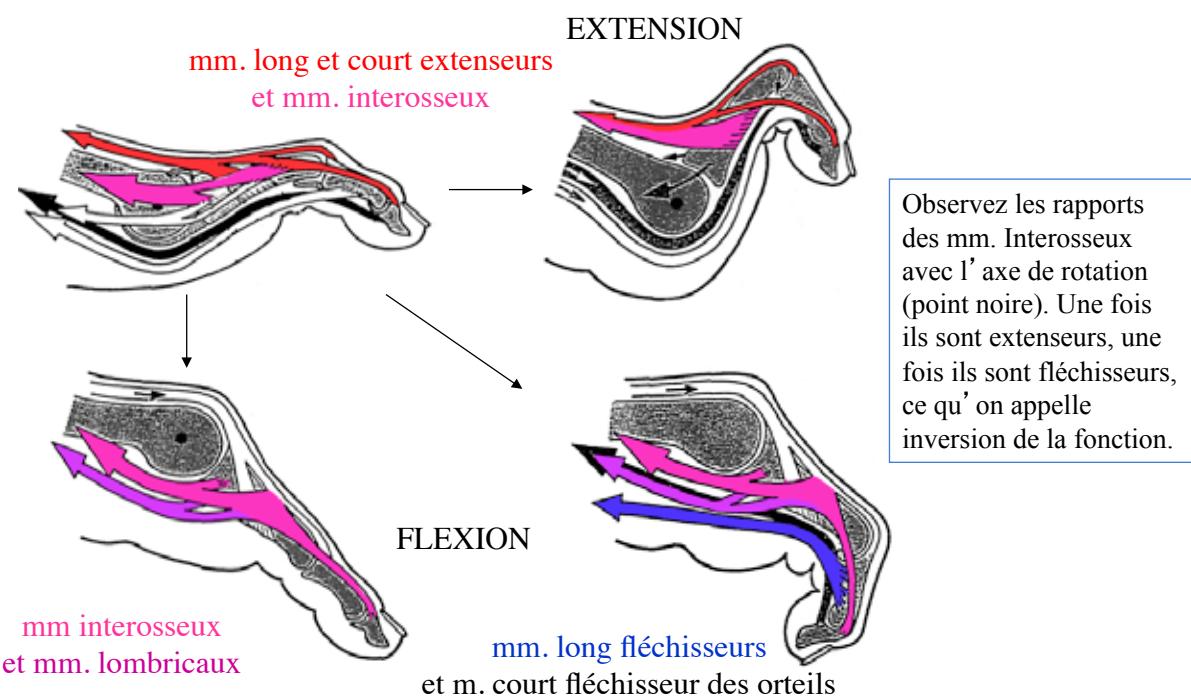


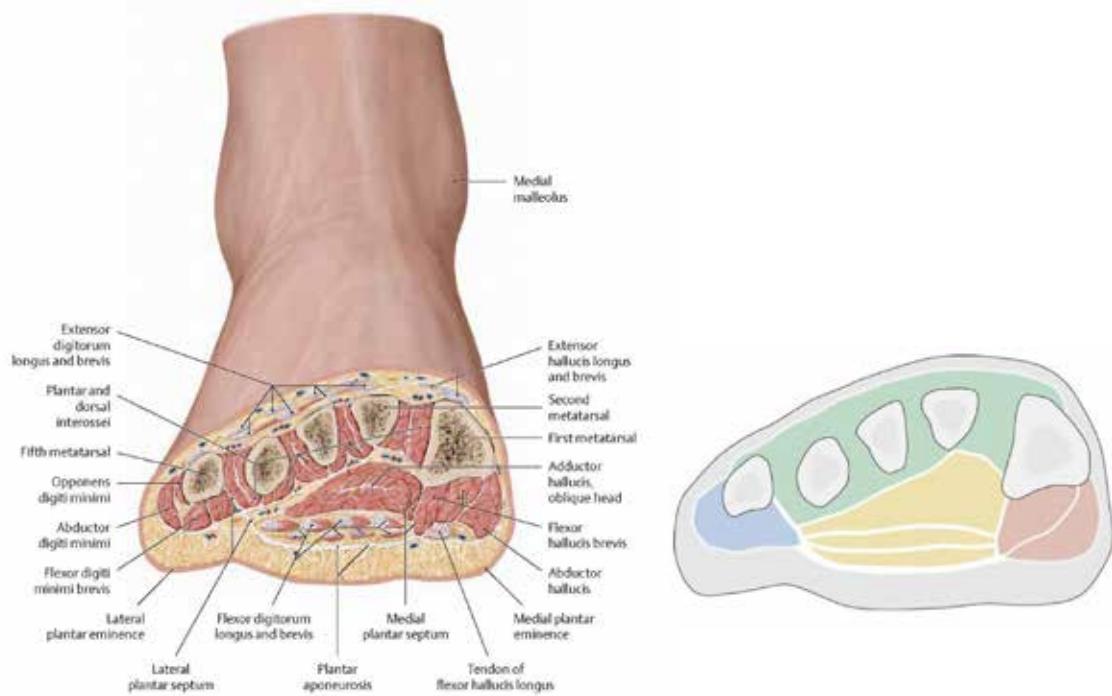
Interossi muscles



mm. interosseux dorsaux et interosseux plantaires

Mouvements des orteils





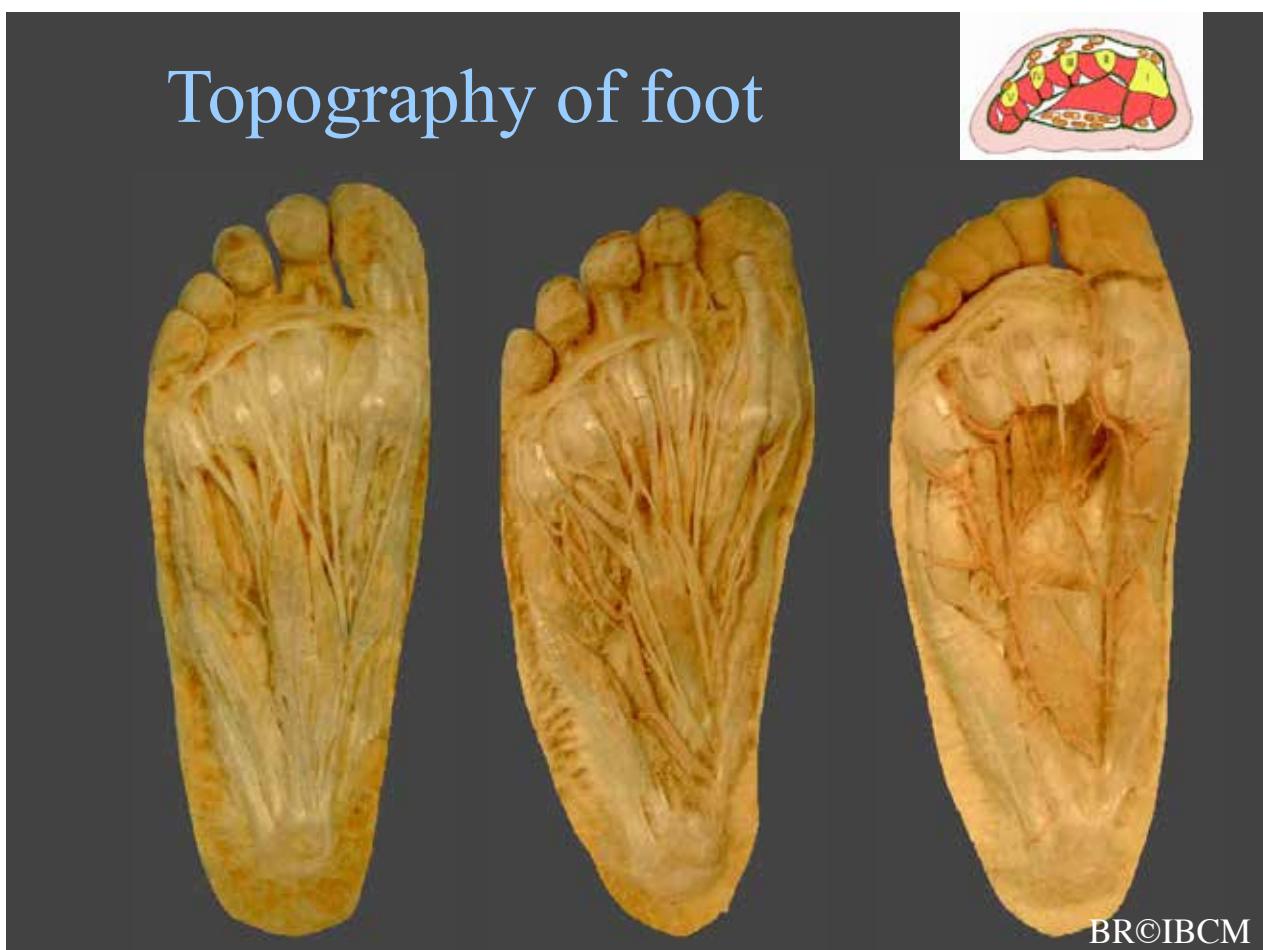
D Cross-section through the right foot at the level of the metatarsals
View of the distal cut surface.

Illustrator: Karl Wesker

pp. 462-463

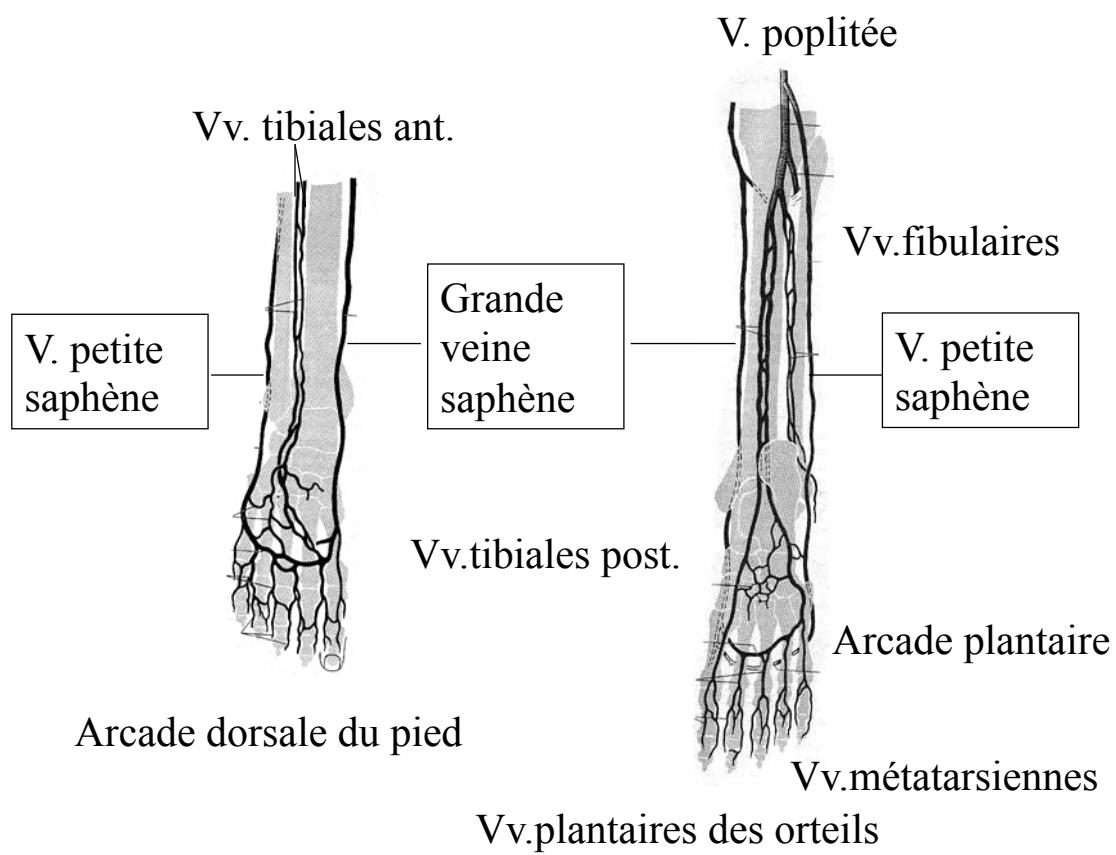
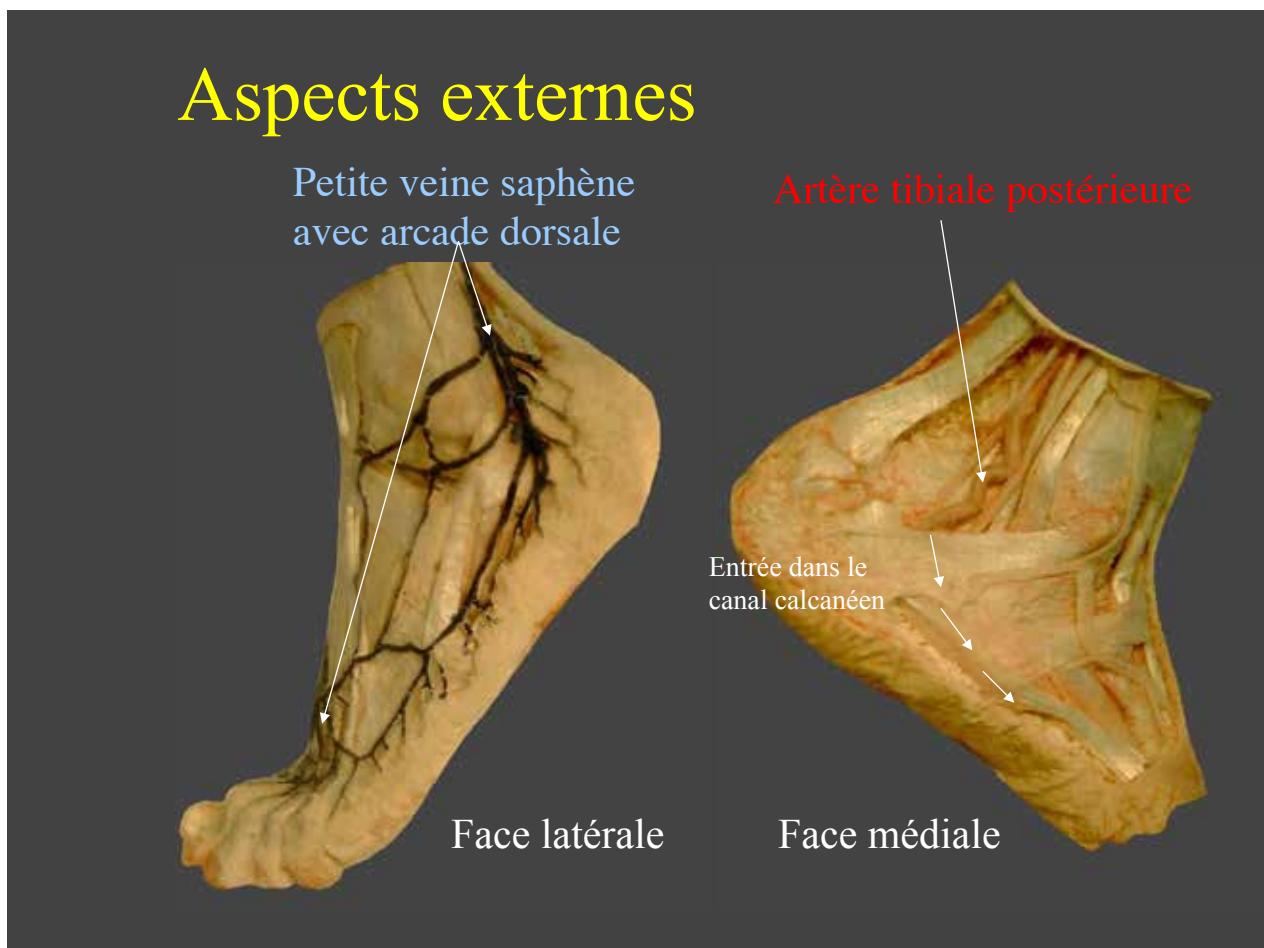
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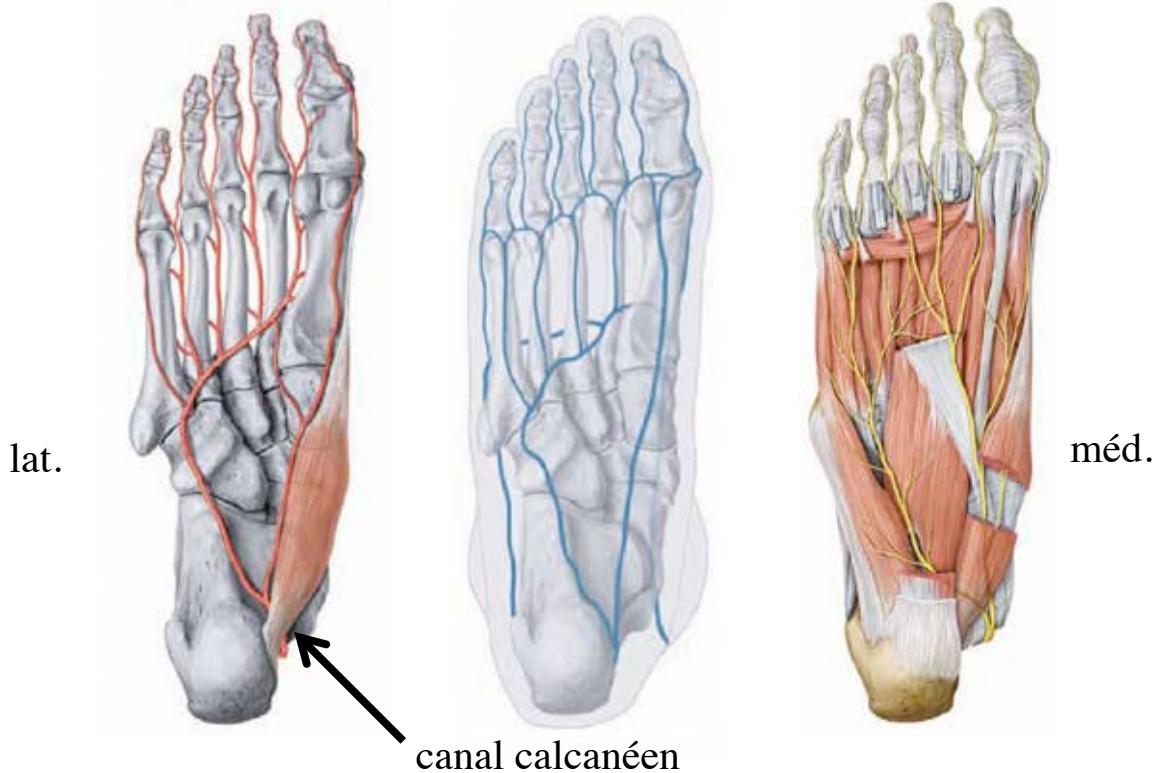


BR©IBCM

Aspects externes



Artères, veines et nerfs plantaires



MUSCLES DE LA JAMBE

LOGE DES EXTENSEUR

m.tibial antérieur	n. fibulaire profond
m. long extenseur des orteils	n. fibulaire profond
m.long extenseur de l'hallux	n. fibulaire profond
m.3 ^{ème} fibulaire	n. fibulaire profond

LOGE DES PERONIERS LATERAUX

m.long fibulaire	n. fibulaire superficiel
m.court fibulaire	n. fibulaire superficiel

LOGE POSTERIEUR, plan superficiel

m.triceps sural (jumeaux et solaire)	n.sciatique poplité interne (n.tibial)
m.plantaire (grèle)	n.sciatique poplité interne (n.tibial)

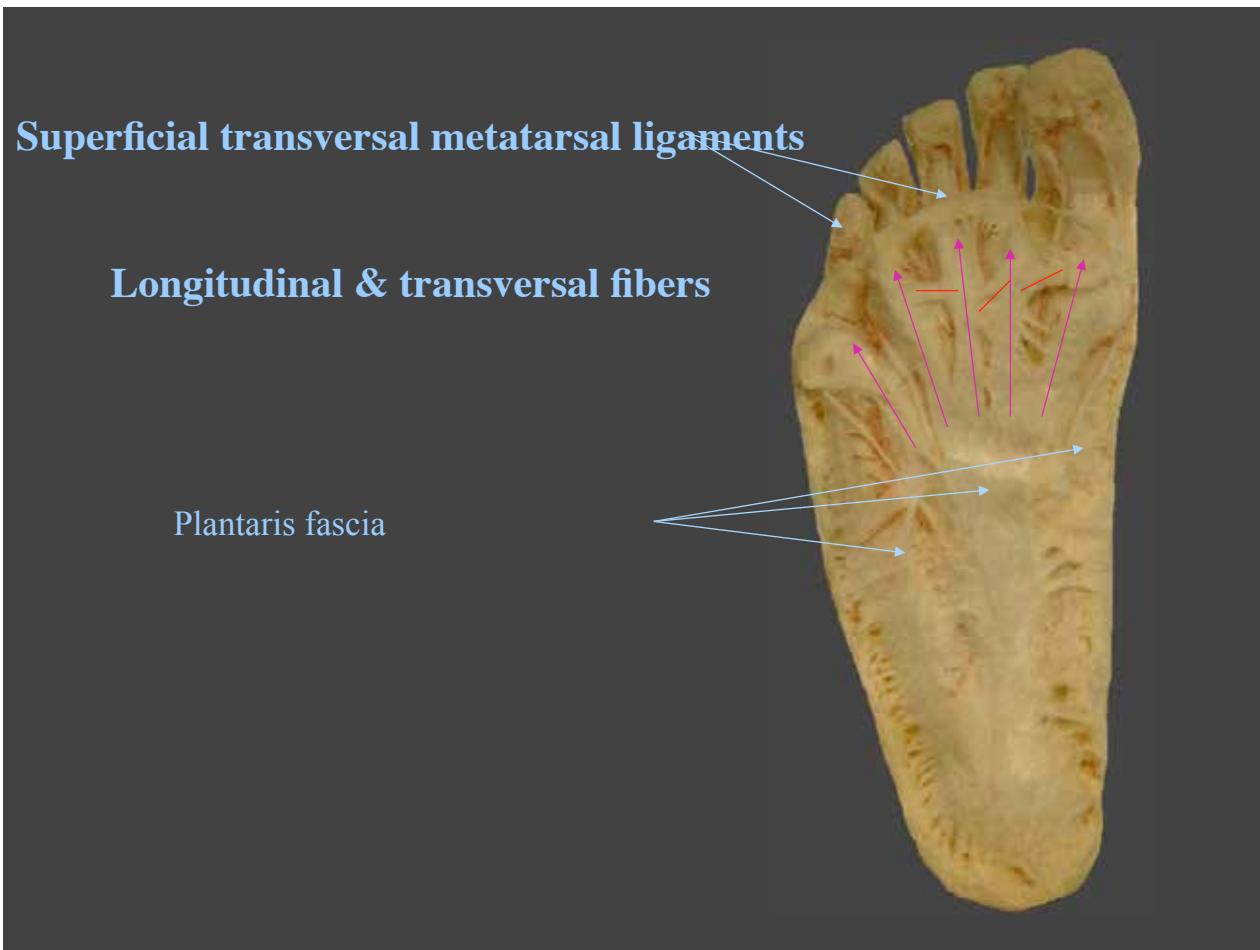
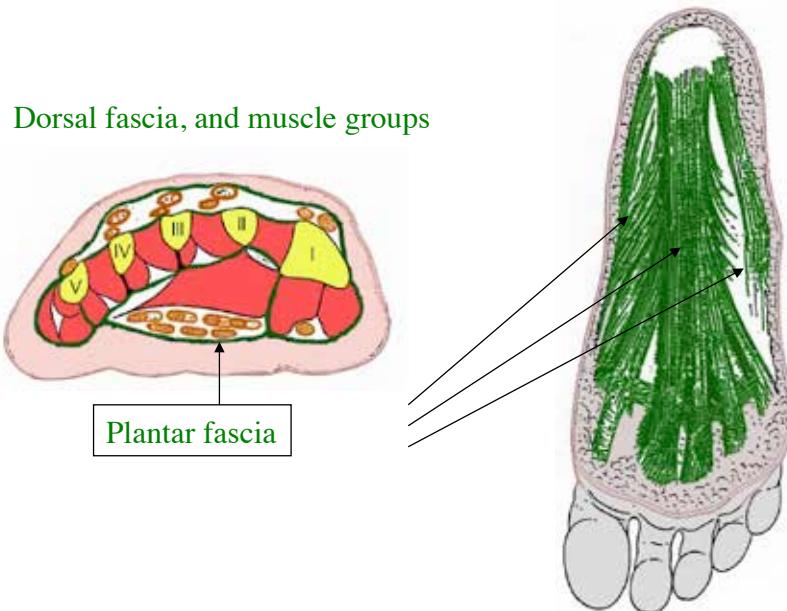
LOGE POSTERIEUR, plan profond

m.tibial postérieur	n.tibial
m.long fléchisseur de l'hallux	n.tibial
m.long fléchisseur des orteil	n.tibial
m.poplité	n.tibial

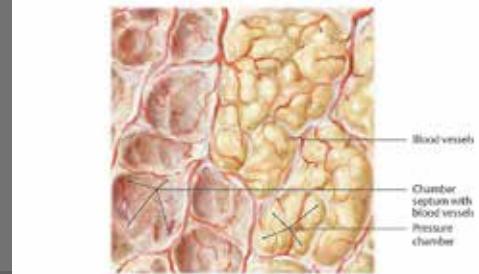
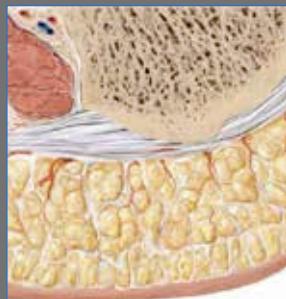
MUSCLES COURTS DU PIED

m. court fléchisseur plantaire	n. plantaire médial
m. court extenseur des orteils	n. fibulaire profond (tibial antérieur)
m. court extenseur de l'hallux	n. fibulaire profond (tibial antérieur)
m. abducteur de l'hallux	n. plantaire médial
m. court fléchisseur de l'hallux	n. plantaire médial
m. adducteur de l'hallux(oblique&transverse)	n. plantaire latéral (br. profonde)
m. opposant du petit orteil	n. plantaire latéral
m. court fléchisseur du petit orteil	n. plantaire latéral
m. abducteur du petit orteil	n. plantaire latéral
m. carré plantaire	n. plantaire latéral
m. interosseux plantaires	n. plantaire latéral (br. profonde)
m. interosseux dorsaux	n. plantaire latéral (br. profonde)
m. lombriques (1-3)	n. plantaire médial
..(4e)	n. plantaire latéral (br. profonde)

Fasciae of the foot



Sagittal section



C Structure of the pressure chambers.
Detail from B.

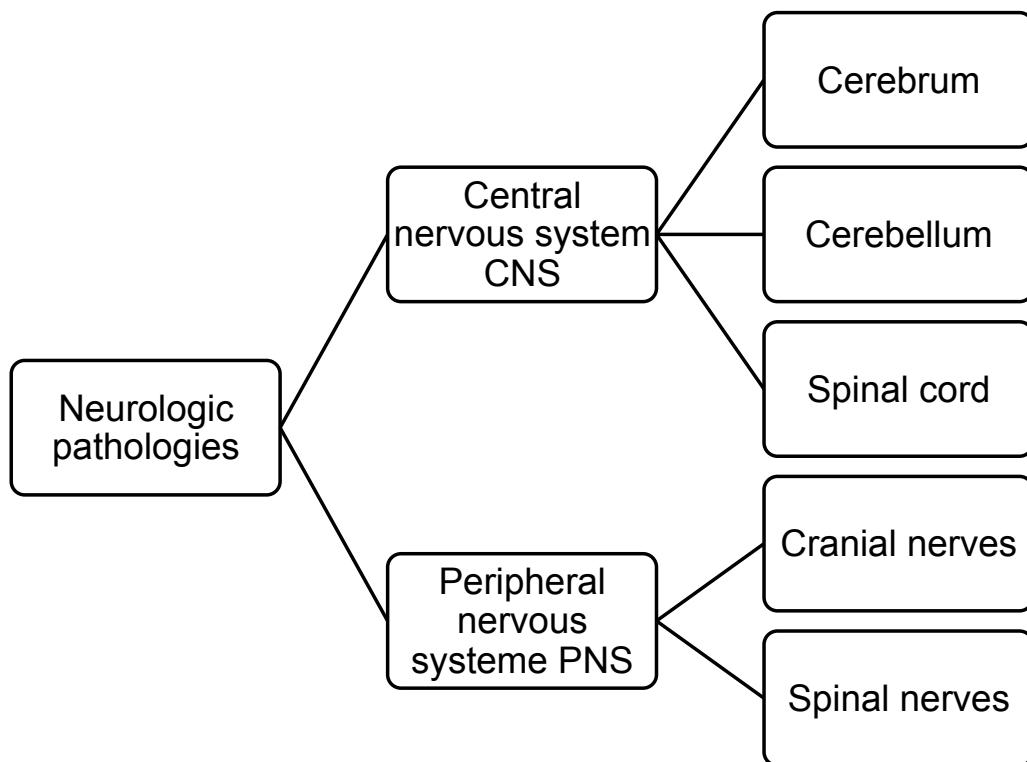
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pp. 418-419

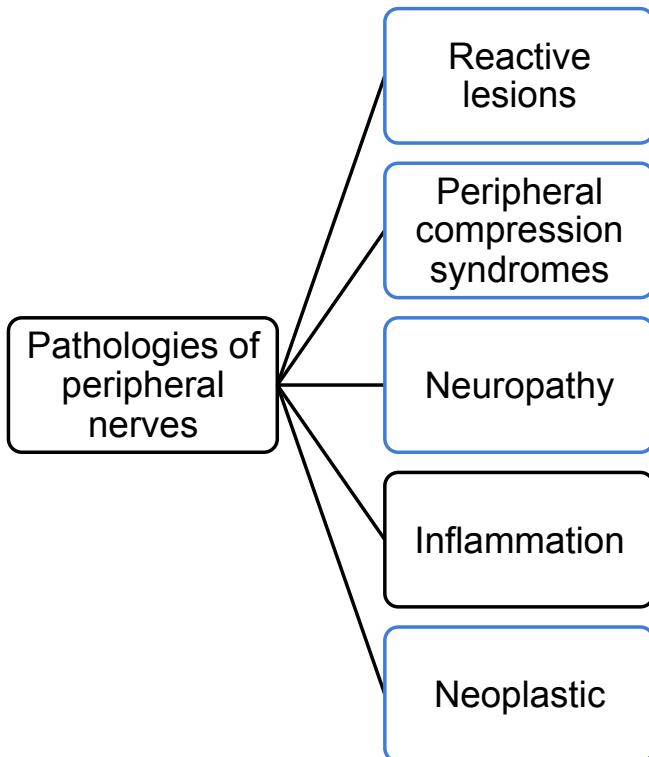
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Pathologies of the nerves



Pathologies of the nerves

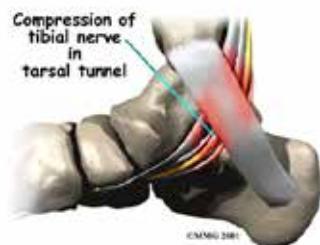


191

Compression of peripheral nerves

Tarsal tunnel syndrome TTS:

- Syn.: Posterior tibial neuralgia
- Compression neuropathy (mononeuropathy) of the tibial nerve as it passes through the tarsal tunnel causing irritation of the nerve



Symptoms radiate to 1st, 2nd, 3rd, 4th toe

- Numbness
- Pain
- Burning
- Electrical sensation (nerves!!!)
- Weakened toe flexion



Etiology and Pathogenesis:

- Unclear
- Everything that creates pressure

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Neoplastic and neoplastic-like Pathologies of the nerves

Neuroma:

- Growth of nerve tissue (from greek „swelling of the nerve“)

Classifications:

- Neoplastic Neuromas
 - Neurinoma = benign neoplasia of the Schwann cells
 - Ganglioneuroma = benign or malignant neoplasia of sympathetic nerve fibres
- Non-neoplastic Neuromas
 - Traumatic neuroma
 - Morton's neuroma

193

Reactive Lesions of the peripheral Nerves

Traumatic Neuroma:

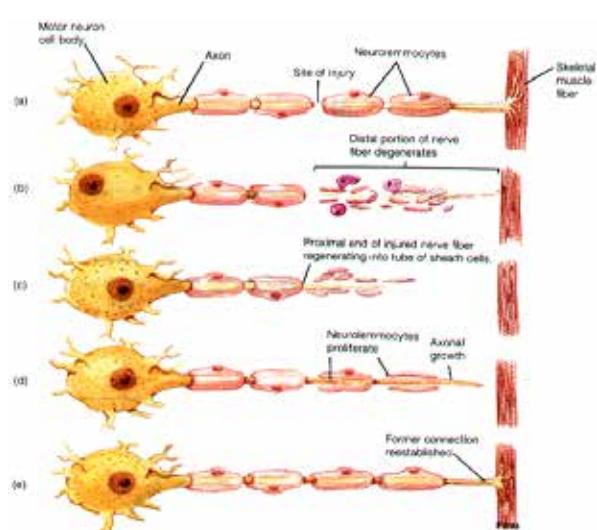
- Syn.: Amputation neuroma, Scar neuroma, pseudoneuroma
- Growth of nerves due to prior injury of the nerve

Causes:

- Surgery (very often)
- Trauma

Pathogenesis:

- Form often next to scar (superficial or deep)
- Trauma damages nerve fibres
- End of nerves show ineffective, unregulated regeneration



194

Reactive Lesions of the peripheral Nerves

Traumatic Neuroma:



195

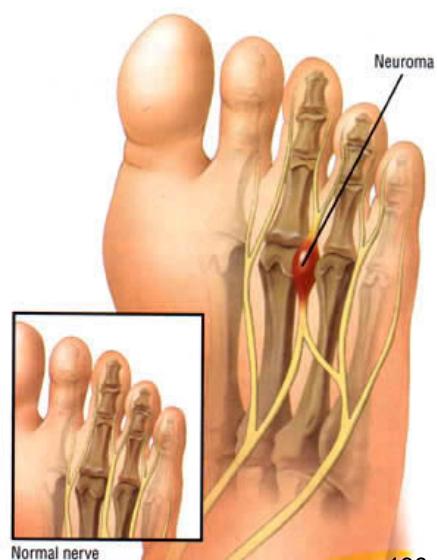
Reactive Lesions of the peripheral Nerves

Morton's Neuroma

- Better name = Durlacher's Perineural Fibrosis
- Syn.: Morton's Metatarsalgia, Morton's Neuralgia, plantar neuroma, intermetatarsal neuroma
- Benign growth of an intermetatarsal plantar nerve (N. tibialis)
- Most often 2nd (15%) or 3rd (80%) intermetatarsal space

Pathogenesis:

- Enlargement of joining nerves in 3rd IMS
- Restricted space (risk for compression and friction)
 - Metatarsal bone
 - Deep transverse metatarsal ligament
- Chronic mechanic irritation causes
 - Concentric perineural fibrosis of the nerves (scar tissue around the nerve)
 - Thickening of arterioles (risk for thrombosis)



196

Reactive Lesions of the peripheral Nerves

Morton's Neuroma



197

Reactive Lesions of the peripheral Nerves

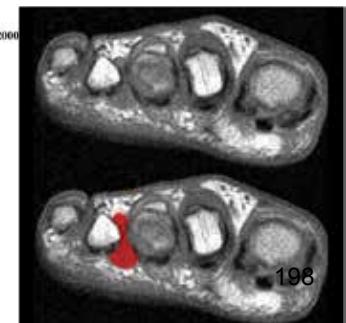
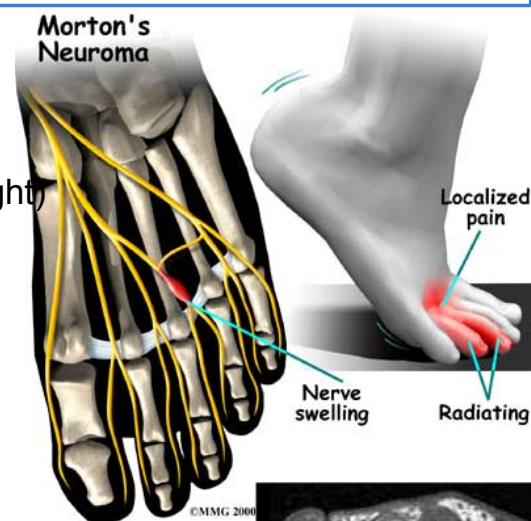
Morton's Neuroma

Signs and Symptoms:

- Pain (especially when bearing weight)
- Numbness
- Burning
- Paresthesia

Therapy:

- Properly fitting shoes
- Anti-inflammatory Drugs
- Supporting pad (orthotics)
- Cortisone
- Surgery



Neuropathy of the peripheral Nerves

Peripheral Neuropathy:

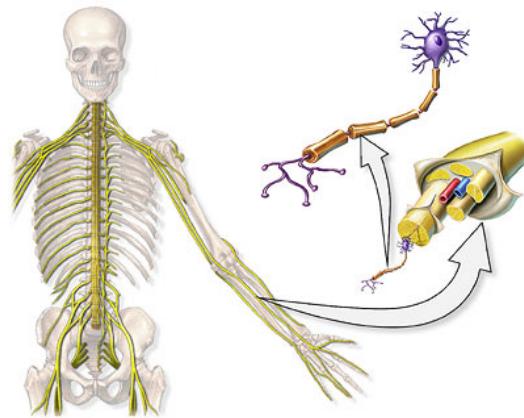
- Collective term for diseases of the peripheral nervous system with various etiologies, localizations and symptoms

Distribution:

- Proximal or distal
- Symmetrical or asymmetrical
- Mono- or polyneuropathy

Pathogenesis

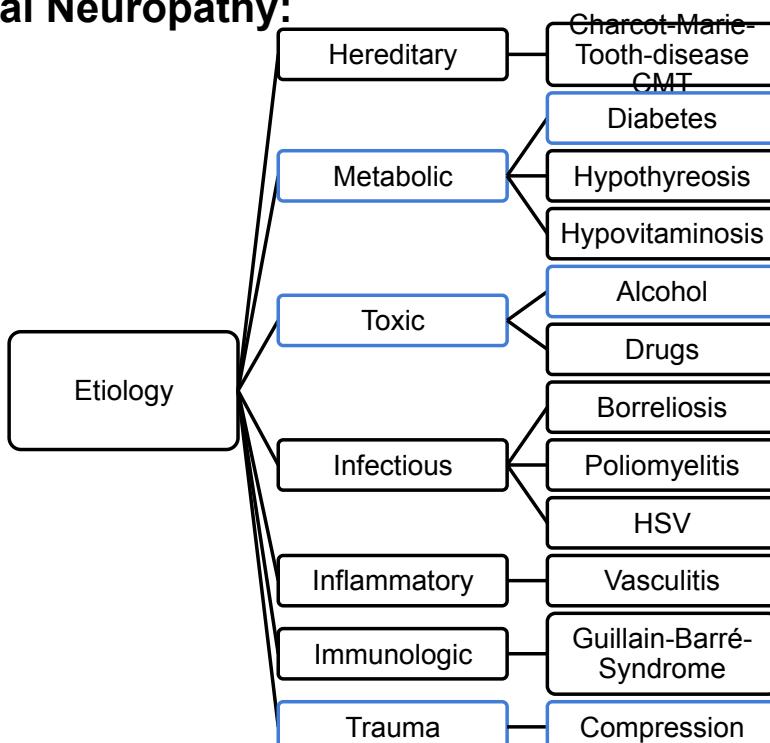
- Axonopathy (often toxic or metabolic)
- Demyelination (often metabolic)
- Neuronopathy (component of CNS)
- Ischemia (often metabolic)



199

Neuropathy of the peripheral Nerves

Peripheral Neuropathy:



200

Neuropathy of the peripheral Nerves

Peripheral Neuropathy:

Signs and symptoms:

- Motor nerves
 - Loss of function (negative symptoms)
 - Muscle Atrophy
 - Paresis
 - Gain of function (positive symptoms)
 - Fasciculation, cramps
 - Myalgia (pain)
- Sensory nerves
 - Loss of function (negative symptoms)
 - Paresthesia (numbness)
 - Tremor
 - Gait abnormality
 - Gain of function (positive symptoms)
 - Hyperesthesia (tingling, pain, itching, pins and needles)

201

Neuropathy of the peripheral Nerves

Peripheral Neuropathy:

Signs and symptoms:

- Autonomic nerve
 - Bladder
 - Bladder incontinence
 - Urine retention
 - Cardiovascular system
 - Tachycardia / bradycardia
 - Orthostatic hypotension
 - (...)
 - Digestive tract
 - Dysphagia (swallowing)
 - Vomiting
 - Constipation
 - Faecal incontinence
 - (...)
 - Genital organs
 - Impotence
 - (...)

202

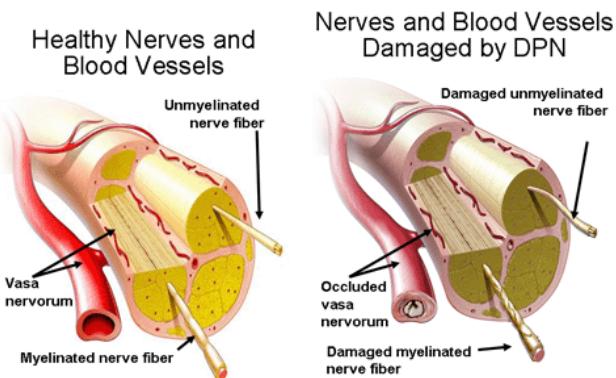
Neuropathy of the peripheral Nerves

Diabetic Polyneuropathy:

- Proximal symmetrical metabolic neuropathic disorder due to hyperglykemia
- Complication in 60 to 70% of diabetics

Pathogenesis:

- Microvascular changes:
 - Damage of Vasa nervorum (destruction of nerve → slow conduction velocity)
 - Damage of autonomic vessel nerves (reduced flow → Ischemia)
- Longer sensory nerve fibres predominantly
 - Longer > short (conduction)
 - Sensory > autonomic, motor (???)



203

Neuropathy of the peripheral Nerves

Diabetic Polyneuropathy:

Signs and Symptoms:

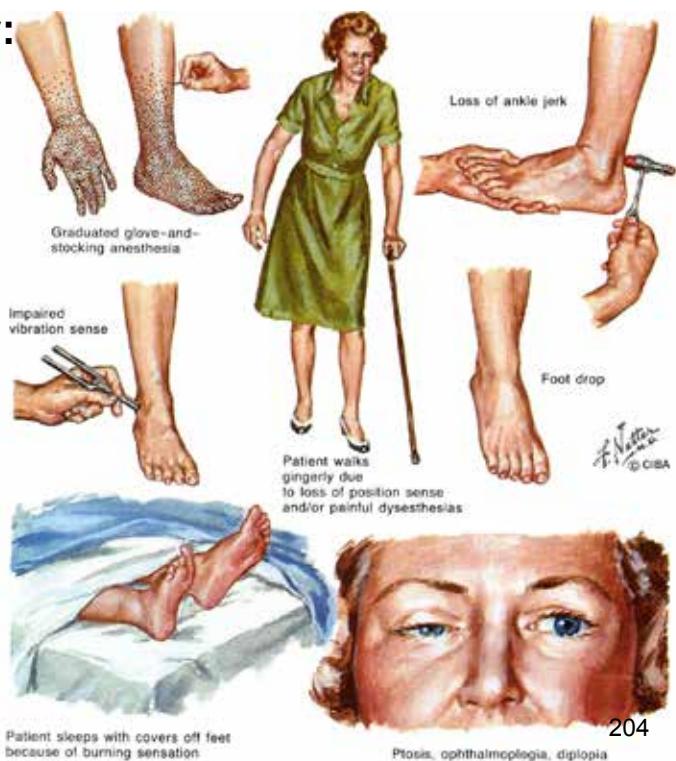
- Loss of sensibility
- Numbness
- Tingling

Gloves and Stockings Sign:

- From distal to proximal
- Symmetrical

Complications:

- Problematic gait → Falls
- Wounds (no feeling + no healing)
- Diabetic foot



204

Pathologic conditions of arterial blood supply

Ischemic Foot:

- Condition of inadequate arterial blood supply of the foot (arterial insufficiency)

Causes:

- Atherosclerosis (cholesterol deposits)
- Arterial blood clots
- Arterial spasms
- Arterial injury

Symptoms: The five Ps

- Pain
- Pulsless
- Pale in color
- Paresthesia (burning, tingling)
- Paralysis

Complications:

- Ischemic necrosis
- Gangrene



205

Pathologic conditions of venous blood drainage

Venous Stasis:

- Slow blood flow in the veins

Cause:

- Cardiovascular diseases
- Chronic venous insufficiency CVI
- Immobility (plane, car, hospital)
- Venous blockage

Symptoms:

- Pressure pain (tenderness on palpation)
- Heat
- Red colour
- Feeling of heavy and tense leg
- Swelling, Aching
- Worse when standing



Risk:

- Deep vein thrombosis DVT
- Venous ulcers

206

Pathology of the skin

Warts

- Thickening of the skin due to viral infection
- Often mistaken for calluses/corns
- Often harmless, sometimes painful



Calluses / Corns

- Area of hard thickened skin on the sole, the heel or outer side of the big toe (Callus), on the toes (Corns) respectively
- Caused by friction and pressure against bone (spurs etc.)
- Compression of nerves and bursal sacs beneath cause pain and soreness

Cysts

- Fluid filled masses under the skin
- Often synovial, ganglia and cutaneous mucoid cysts
- Painful to pressure (shoes)



207

Pathology of the skin

Allergies

- Allergic contact dermatitis = Inflammatory reaction to sensitization to allergens
 - Dyes of socks
 - Shoe materials
 - Adhesive tape
- Primary irritant dermatitis = Inflammatory irritant substance
 - Chemicals
 - Oils
 - Cement



Infections

- Athlete's Foot (Tinea pedis) = fungal infection of the foot
- Fungal nail infections



Pathology of the skin appendage

Ingrown toenail

- Condition where toe nail grows into the skin
- Often due to short trimming of the nails
- Cause pain, swelling and tenderness
- Risk for infection



Nail fungus (Onychomycosis)

- Fungal infection of the toe nail, characterized only by change in colour (yellow, brown), thickening of the nail and foul smelling
- Often Dermophytes
- Very common
- In most cases without symptoms



Black Toenails

- Bruising of the nail
- Caused by trauma
- Risk for fungal infection

