



# **FRACTURES OF THE PELVIC LIMB**

# Proximal femoral fractures

## 1. Femoral head fractures

- rare, usually associated with hip dislocation
- mechanism of injury - indirect

### **Diagnosis:**

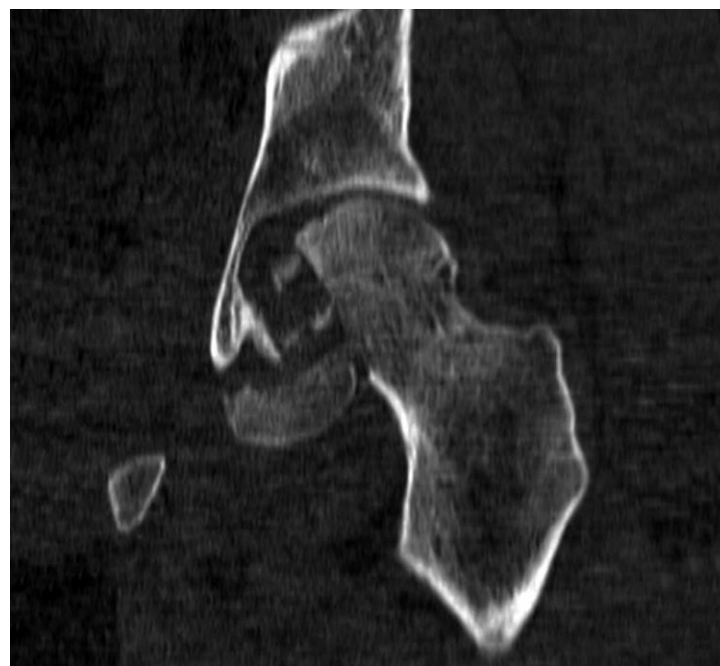
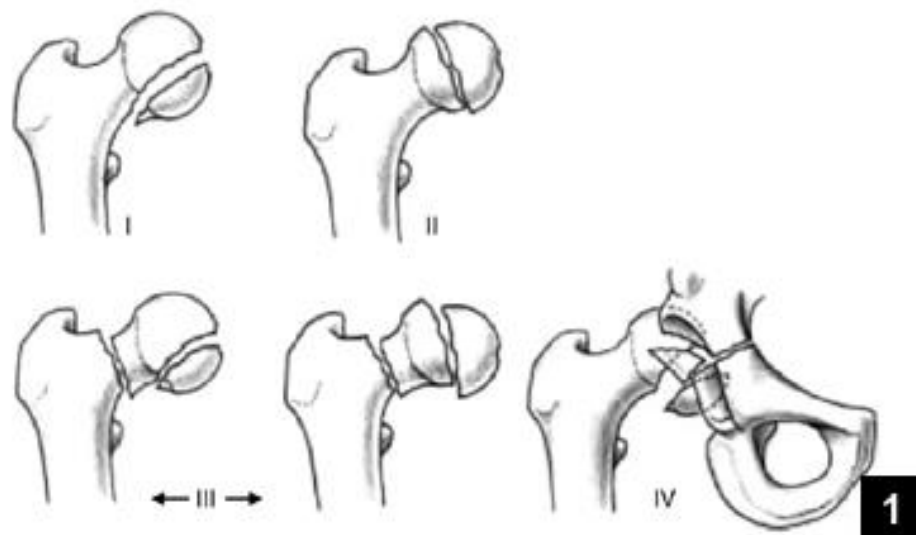
- Clinical resembles hip contusion
- No vicious position
- Pain at mobilization, in the triangle of Scarpa

+ X-ray: AP and lateral view

**Differential diagnosis:** hip contusion, OCD (in children)

### **Treatment:**

- Emergency - antalgic, immobilization
- In isolated fractures without displacement – bed rest 30-45 days
- In isolated fractures with displacement – ORIF (headless screws)
- Comminuted fractures – arthroplasty???



# Proximal femoral fractures

## 2. Femoral neck fractures

- Approximately 10% of total fractures
- Approximately 40% of femur fractures
- More common in the elderly, especially in women
- Osteoporosis - the most important risk factor



# Classifications

Numerous classifications have been described

- Delbet's classification (anatomical):
  - Basicervical
  - Mediocervical
  - Subcapital

# Classifications

- Delbet



Subcapitale



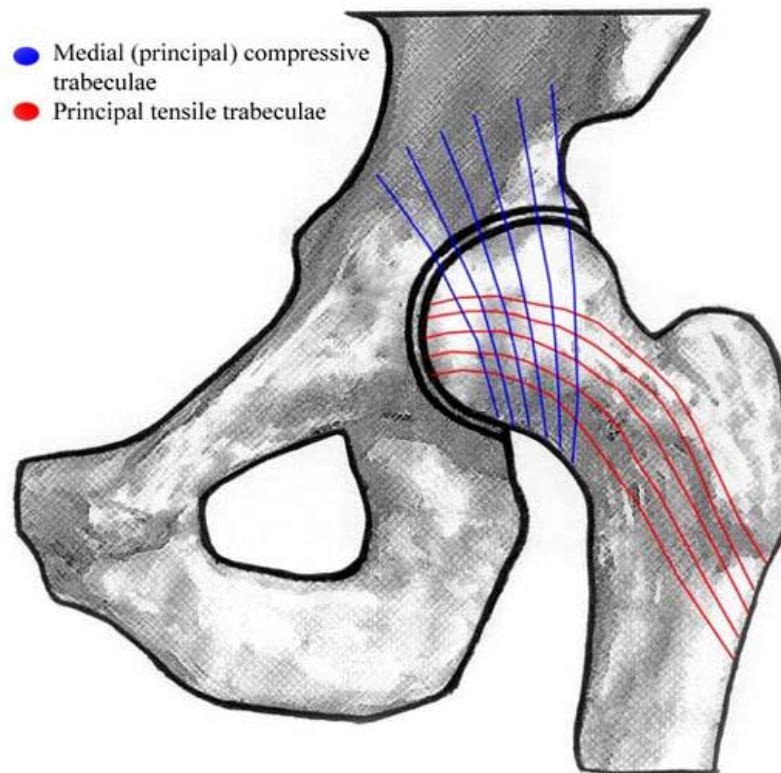
Mediocervicale



Bazicervicale

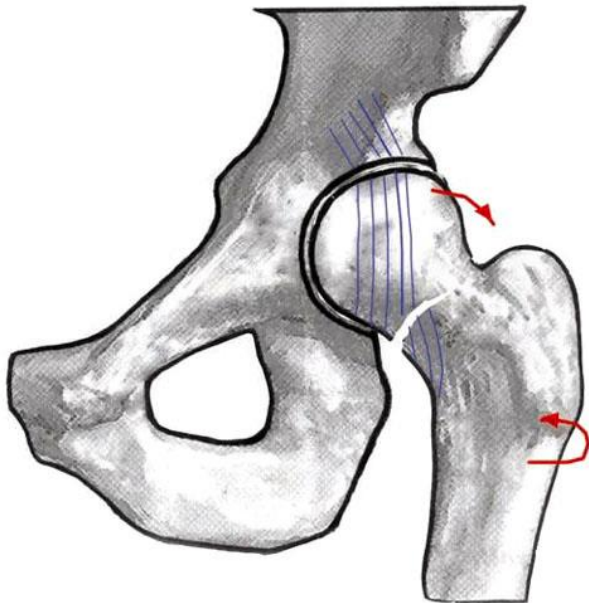
# ***Garden classification***

- The author takes as a classification criterion the trabecular system of the femoral neck
- Provides therapeutic and prognostic indications



## ***Garden type 1:*** incomplete fractures

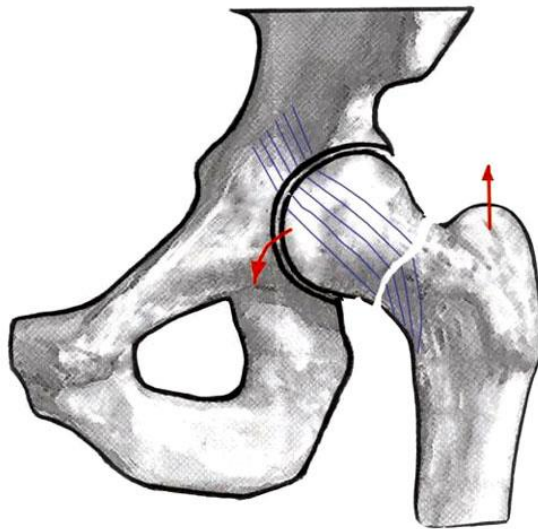
- bone trabeculae of the femoral head oriented in slightly valgus
- good prognosis





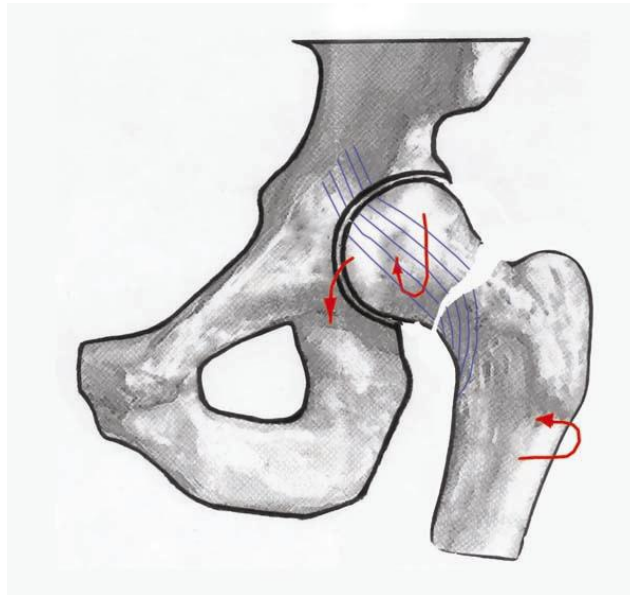
## ***Garden type 2 :***

- complete fractures, no displacement
- bone trabeculae interrupted, but with normal direction



### ***Garden type 3 :***

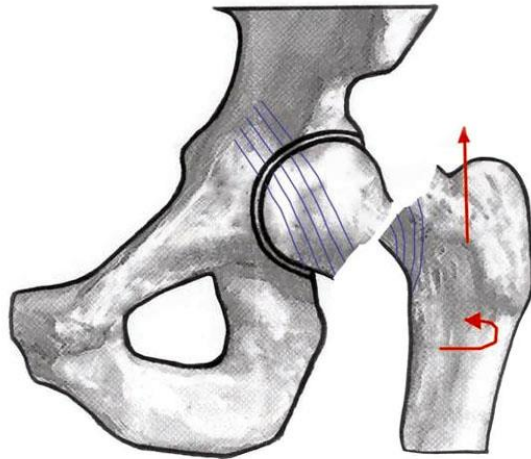
- complete fractures, partial displacement
- trabeculae - “gothic arch” – medially opened





## ***Garden type 4 :***

- complete fractures, completely displaced
- bone trabeculae – parallel
- unstable, difficult reduction





## ***Pauwels classification:***

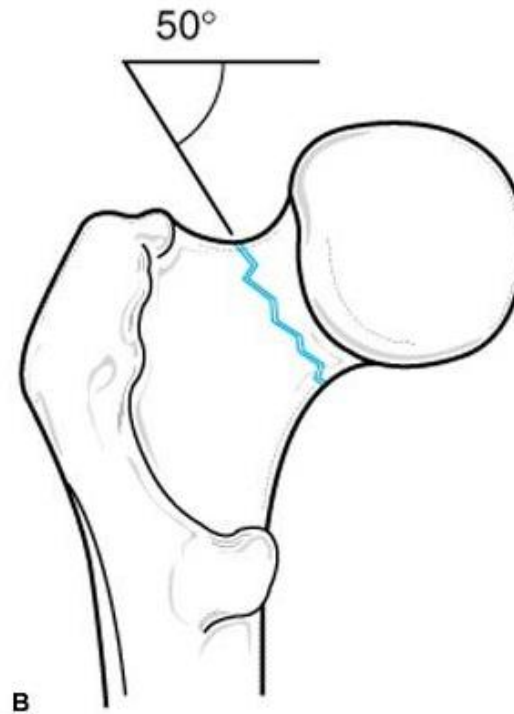
- Angle between fracture line and the horizontal through ASIS

## ***Pauwels classification:***

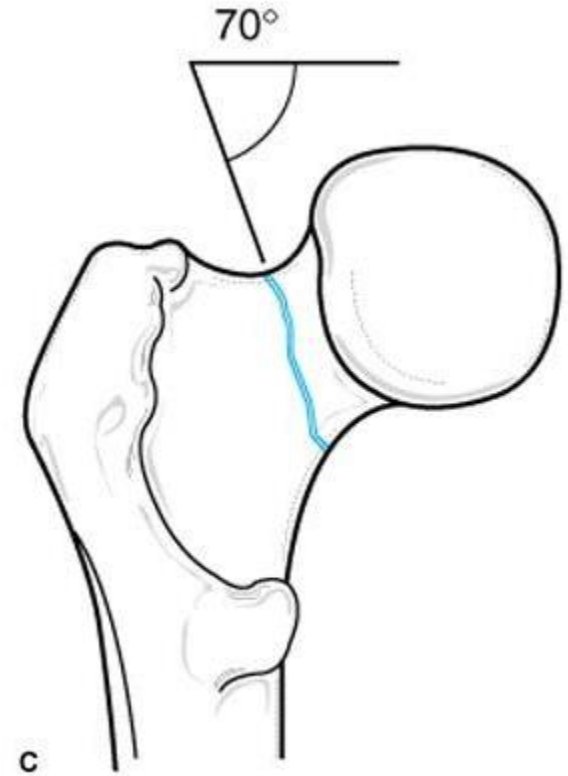
- Angle between fracture line and the horizontal through ASIS



Type I Pauwels  
 $<30^\circ$



Type II Pauwels  
30-70°



Type III Pauwels  
70-90°

# CLINICAL EXAMINATION

- ***INCOMPLETE OR NONDISPLACED***

- ☐ discrete signs
- ☐ moderate pain at the base of Scarpa's triangle
- ☐ moderate functional impotence
- ☐ fixed position, unchanged

- ***COMPLETE FRACTURES***

*Subjective:*

- ☐ **Pain**

- spontaneous at the fracture site
- amplified at palpation in the groin or trohanterian region, or at mobilization

- ☐ **Functional impairment**

- complete, does not lift the heel from the bed plane

# CLINICAL EXAMINATION

## *Objective*

- Vicious attitude:
  - adduction
  - external rotation
  - shortening
- Greater trochanter above Nelaton-Roser line
- “*Drawer sign*”- *Delbet* - shortening is reduced by traction in the limb axis, but returns after stopping

# Imaging

- **X-rays** – 2 views (AP and lateral)
- **Diagnosis**
  - based on clinical and imaging data
- **Differential Diagnosis**
  1. *Hip contusion*
    - greater trochanter – undisplaced proximally
    - pain and functional impairment will reduce
  2. *Hip displacement*
    - Anterior
      - ABD, ER
    - Posterior
      - ADD, IR
  3. *Acetabular fractures*
  4. *Femoral head epiphysiolysis* - children



*Fractures without displacement, with valgus impaction - good evolution*

*Fractures with displacement, with varus impaction, - unfavorable prognosis, even after appropriate treatment*

## COMPLICATIONS

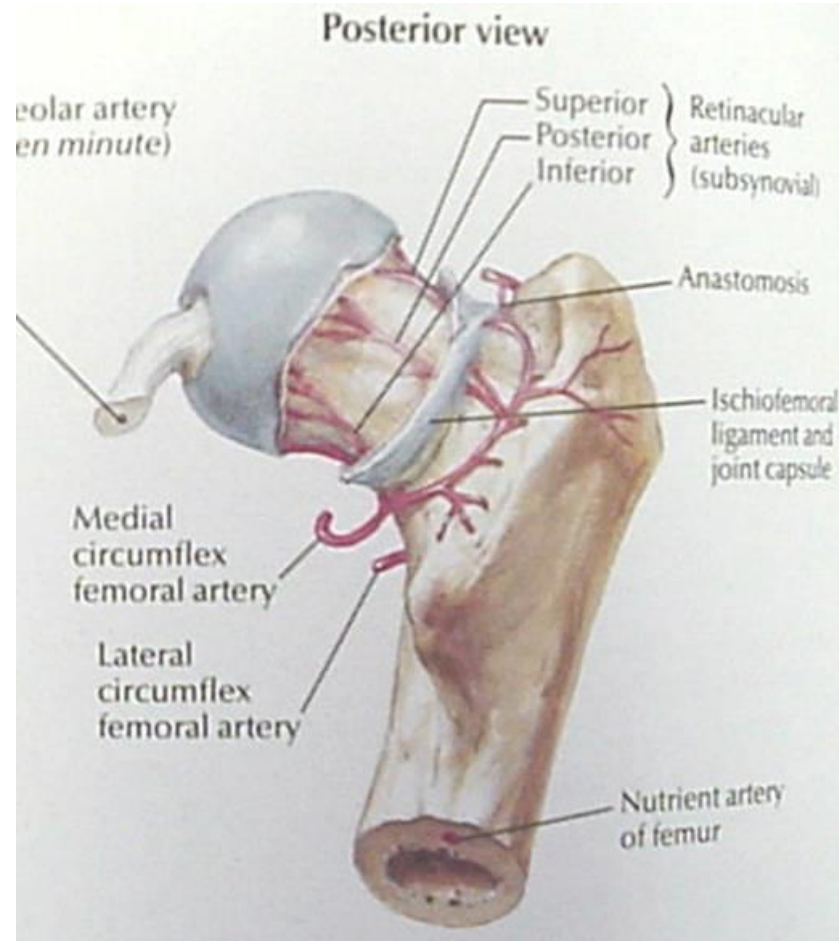
### 1. **Immediate**

- shockogenic in the first hours, then thrombogenic
- aggravation of pre-existing conditions complications of decubitus: bronchopneumonia, ulcers, urinary infections, TE

### 2. **Late**

- a. Nonunion - 30%
- b. femoral head avascular necrosis
- c. Posttraumatic hip osteoarthritis

# Vascularization



# Treatment

- ***Emergency***

- antalgic
- temporary immobilization

- ***Tratamentul ortopedic***

- it is not preferable to immobilize the patient in bed
- increased mortality

- ***Functional treatment***

- early mobilization of the patient, without taking care of the functional result
- very rare
- in weak patients, do not support surgery

## ***Surgical treatment***

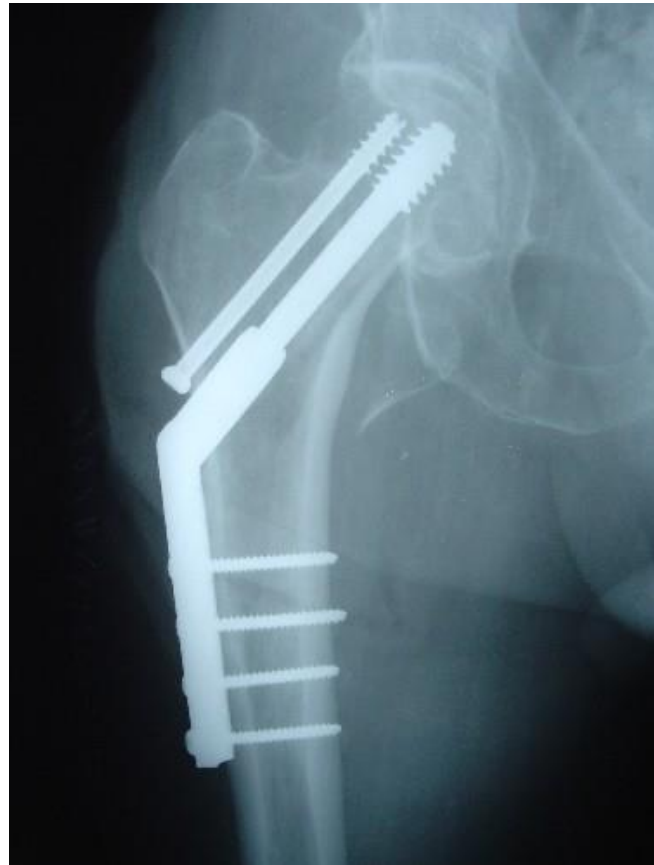
- In undisplaced fractures - “secure” the fracture site
- In displaced fractures , young patients:
  - CRIF under fluoroscopic control, **cannulated screws**



## **Postop**

- crutches - 2-3 weeks
- weight bearing after 4 months
- no union after 6 months – hemi or total hip arthroplasty

- ORIF – **Dynamic hip screw (DHS)**
- When CRIF is not possible in young patients (arthroplasty is not an option)

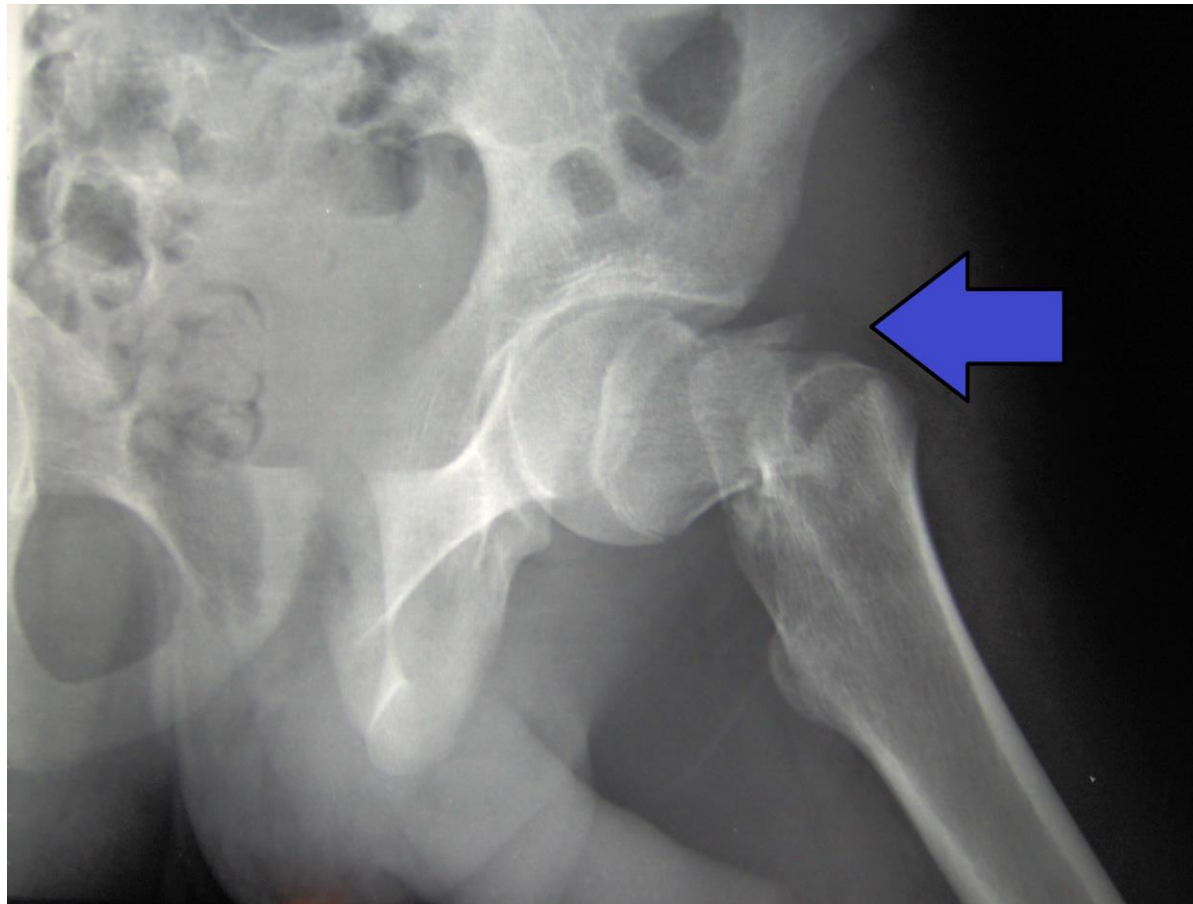


- **Hemiarthroplasty** – patients over 70 years???
- Uni (Austin-Moore prosthesis) or bipolar





- **THR (total hip arthroplasty)** – patients with femoral neck fractures and pre-existing hip osteoarthritis
- cemented or uncemented – depending on age and bone quality



## Postop :

- prevention of TE complications
- heparine cu greutate moleculara mică, până la 45 de zile postoperator
- antibiotherapy
- prevention of prolonged decubitus complications
- Physical Therapy – starting from day 2
- 5-7 days postop – patients starts walking with partial weight bearing



# Proximal femoral fractures

## 3. Greater trochanter (GT) fractures

- very rare isolated
- old patients – osteoporosis
- young patients – violent muscular contraction/direct trauma

Diagnosis:

- Inspection: swelling, ecchymosis
- affected limb in ADD and ER
- Pain – increases with palpation
- Displaced fractures
  - transverse groove can be palpated
  - crepitus
  - Nelaton-Roser line – displaced
  - complete functional impairment
- Undisplaced fractures
  - decreased symptoms
- X-ray – 2 views (AP and lateral)

# Treatment

- Undisplaced – 6 weeks immobilization
- Displaced - ORIF
  - Tension band wiring
  - Screws



# Proximal femoral fractures

## 4. Lesser trochanter (GT) fractures

- very rare
- young patients – violent contraction of iliopsoas muscle

### Diagnosis:

- severe pain – 4-5 cm sub inferior to groin region
- ecchymosis on the medial side of the thigh
- partial functional impairment
- Ludloff sign – patient can flex the thigh in supine position, but is not able to perform it while sitting

### Treatment

- Conservative – 4-6 weeks bed rest
  - lower limb in flexion and IR



# Proximal femoral fractures

## 5. Pertrochanteric fractures

- very frequent in old patients

### **Diagnosis:**

- severe pain increased by palpation
- partial/total functional impairment
- deformity of the limb: shortening, ER, ADD

### **Treatment:**

- Aims:
  - restauration of the cervico-cephalic angle
  - correction of the ER
- Conservative – continuous skeletal traction 6-8 weeks
- Surgical - CRIF





# Proximal femoral fractures

## 6. Subtrochanteric fractures

- below lesser trochanter
- oblique, transverse, spiroid or comminuted
- mechanism of injury – mostly indirect
- significant displacement of fragments – muscle contracture

### Diagnosis:

- Inspection – deformation of the proximal thigh, associated hematoma, ecchymosis
  - lower limb – ER, flexion, significant shortening
- Palpation: tip of the proximal fragment may be palpated anterior on the proximal thigh
  - crepitus, abnormal mobility of the limb
- Complete functional impairment

## Differential diagnosis:

- Pertrochanteric fractures

## Complications:

- open fractures
- neuro-vascular injury
- malunion
- nonunion
- osteitis, osteomyelitis

## Treatment:

- Conservative – fracture reduction, immobilization
- Surgical
  - CRIF - Intramedullary interlocking nail
  - ORIF - Plate and screws – rare
  - External fixator – open fractures



# Femoral shaft fractures

- 5cm below lesser trochanter and 12 cm above the knee articular line
- direct or indirect mechanism of injury

## Pathoanatomy

- medium 1/3 – most frequent

## Classification:

- ✓ spiroides
- ✓ transverse
- ✓ short/long oblique
- ✓ comminuted
- ✓ bifocale

## Diagnosis:

- thigh deformity, ecchymosis, hematoma
- abnormal mobility, crepitus
- complete/partial functional impairment
- limb position: ER, shortening
- distal 1/3 – possible knee effusion = hiderthrosis
- X-ray 2 views: AP and lateral

## Complications:

- Immediate
  - neuro-vascular injury
  - open fractures
  - hypovolemia
  - TE
- Late
  - nonunions
  - malunions
  - osteomyelitis – especially after open fractures
  - knee ankyloses – prolonged immobilization



# Treatment

- Emergency: analgesic , immobilization
- Conservative – transskeletal traction – usually provisoral
- Surgical – whenever it's possible
  - CRIF - Intramedullary interlocking nail
  - ORIF - Plate and screws – rare
  - External fixator – open fractures
- healing/callus formation - 3-4 months



# Distal femoral fractures

- involve - 12cm distal femur
- mechanism of injury
  - direct – rare
  - indirect – most frequent, “dashboard fracture”

## Pathoanatomy

- Extraarticular – supracondylar fractures
- Supra and intercondylar fractures
- Diaphyso-metaphyso-epiphyseal fractures
- Isolated condylar fractures

# Distal femoral fractures

## 1. Extraarticular fractures - supracondylar

- may leave functional sequelae

### Diagnosis:

- Inspection
  - swelling of the knee joint – hyarthrosis, hematoma
  - deformity of the distal thigh – ER, shortening
- Palpation
  - proximal fragment may be palpated anterior
  - abnormal mobility
  - crepitus
  - peripheral pulse and sensibility – not to be missed!!!

## Differential diagnosis

- knee soft tissue injuries (ligament injury)
- distal femoral epiphysiolysis (children)

## Complications

### ● Immediate

- neuro-vascular injury (popliteal artery, common peroneal nerve)
- open fracture
- knee injury

### ● Late

- malunions, nonunions
- genu recurvatum – flexion limitation
- residual shortening
- osteitis, osteomyelitis, septic arthritis
- knee ankylosis



## Treatment

- Emergency: immobilization, analgesic
- Conservative – nondisplaced fractures - 6-8 weeks immobilization
- Surgical – displaced fractures
  - retrograde nail
  - plate and screws
  - DCS – dynamic condylar screw





# Distal femoral fractures

## 2. Intraarticular fractures – isolated condylar

- rare
- uni or bicondylar

### Diagnosis:

- unicondylar:
  - massive swelling - hemarthrosis
  - valgus or varus deformity depending on the affected condyle
  - pain, crepitus, complete functional impairment
- bicondylar:
  - all the above signs +
  - ER deformity, shortening (up to 4-5 cm)

### Differential diagnosis:

- tibial plateau fractures
- patellar fractures
- ligament injuries – knee joint

## Complications

- Vascular injuries – popliteal artery or vein
- nervous injury – deep or superficial peroneal nerve
- muscular interpositions
- open fracture/joint

## Treatment

- conservative
  - undisplaced fractures
  - immobilization – 4 weeks, followed by PT
  - gait allowed at 2 months - protected
- surgical
  - displaced fractures
  - ORIF: plate, screws
- ! Attention – intraarticular fractures – anatomic reduction - mandatory



# Patellar fractures

- articular fractures !!!
- mechanism of injury: direct, indirect (quadricipital contraction)
- transverse, vertical, apical, parcelar, comminuted

## Diagnosis:

- swelling, severe pain, ecchymosis
- interfragmentary groove – pencil sign
- abnormal mobility, functional impairment (lack of active extension)
- X-ray: AP and lateral

## Associated lesions:

- other fractures, ligament injuries
- open fractures

## Complications:

- Immediate:
  - open fracture
- Late
  - quadricipital atrophy,
  - secondary patello-femoral osteoarthritis
  - infection
  - hardware complication (migration, pain)

## Treatment

### Conservative

- undisplaced, incomplete fractures
- immobilization - 4-6 weeks followed by PT

### Surgical - displaced fractures

- ORIF (tension band wiring, screws)
- partial/total patellectomy – comminuted fractures





tension band wiring



# Proximal tibial fractures

- mechanism of injury:
  - direct – rare
  - indirect
    - forced valgus/varus
    - axial compression – fall from height
- Pathoanatomy
  - unicondylar – medial or lateral
    - split
    - depression
    - mixt
  - bicondylar
    - simple fracture patterns – T, Y, V
    - complex/comminuted

!!! take care at the associated soft tissue injuries

## Diagnosis:

- severe pain, knee swelling, ecchymosis, hemarthrosis
- deformity of the knee joint (varus/valgus deviation)
- abnormal mobility, crepitus
- peripheral pulse and sensibility testing – mandatory!!!
- X-ray: AP and lateral; CT-3D Reco- scan very important

## Complications:

- Immediate – open fractures, neuro-vascular injuries
- Late – malunions, limitation of movement, secondary osteoarthritis

## *Treatment*

- Conservative
  - nondisplaced fractures
  - immobilization – 3 weeks, followed by PT
  - weight bearing at 3 months
- Surgical:
  - screws, plate and screws, external fixator



A



B



C



D



E

plate and screws – bicolumnar fixation

# Tibial and fibular shaft fractures

- 5 cm distal from knee joint line and 5 cm proximal from ankle joint line
- mechanism of injury
  - direct – direct blow (car vs pedestrian)
  - indirect: flexion, torsion
- Pathoanatomy:
  - transverse, short/long oblique, spiroid, bifocal, comminuted, 3<sup>rd</sup> fragment (butterfly)

## Diagnosis

- pain, swelling, complete functional impairment,
- abnormal mobility, crepitus, shortening
- in this type of fracture we have all signs of a fracture – superficial bone
- X-ray: AP and lateral



## Complications:

### Immediate

- neuro-vascular injuries
- open fracture (most frequent site for OF)
- TE

### Late

- nonunion, malunion, delayed union
- osteitis, osteomyelitis, Volkmann syndrome

## Treatment

- Emergency - immobilization, analgesic
- Conservative
  - stable, undisplaced fractures
  - immobilization – 6-8weeks (Sarmiento cast)
- Surgical
  - unstable, displaced fractures
  - CRIF – nail, LISS plates
  - ORIF – plates and screws
  - ExFix – open fractures

intramedullary interlocking nail



LISS - plate

# Ankle fractures

## Distal tibial fractures (pylon fractures)

- distal 5 cm of tibia (excluding malleoli)
- mechanism of injury
  - fall from height – most frequent
  - position of the foot - different fracture type

### Pathoanatomy

- marginal anterior
- marginal posterior
- comminuted

### Diagnosis

- pain, swelling, functional impairment of the ankle
- X-ray: AP and lateral, CT scan – frequent needed



## Complications:

- Immediate
  - open fracture
  - associated ankle dislocation
  - neuro-vascular injuries
- Late
  - residual osteoarthritis of the ankle



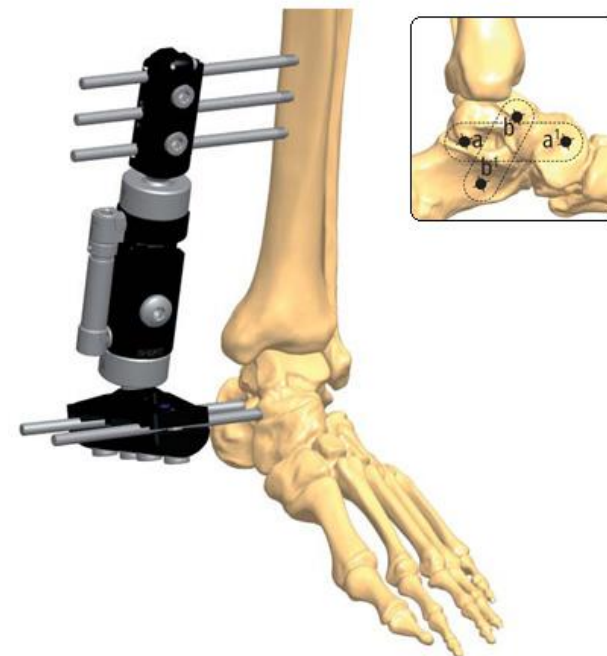
## Treatment

- Conservative:
  - cast immobilization 6 weeks
  - weight bearing at 3 months
- Surgical
  - more frequent
  - ORIF – plate and screws, screws
  - ExFix – definitive treatment – protection of soft tissues





Fig. 10.10. Intramedullary nail, locking plate, and chain.





M, 45 YO, fall from height  
Comminuted distal 1/3 tibia fracture. Fibular shaft fracture  
ORIF distal tibia: LCP-distal tibia I  
ORIF fibular shaft: plate and screws

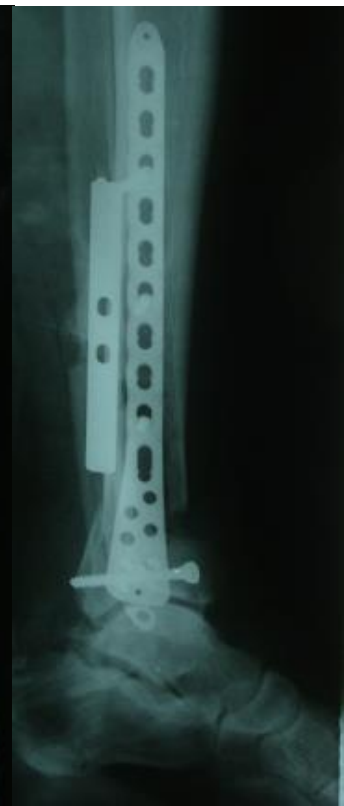


Preop



Postop

M, 48 YO, comminuted distal tibial fracture. Fibular shaft fracture. Bilateral calcaneus fracture. Fall from height.  
ORIF distal tibia: LCP-distal tibia plate  
ORIF fibula: plate and screws



# Ankle fractures

## Malleolar fractures

### Pathoanatomy

- unimalleolar: tibial/fibular
- bimalleolar: tibial and fibular
- trimalleolar (posterior malleolus)
- associated ligament injuries – tibio-fibular diastasis – syndesmosis ligaments

### Diagnosis

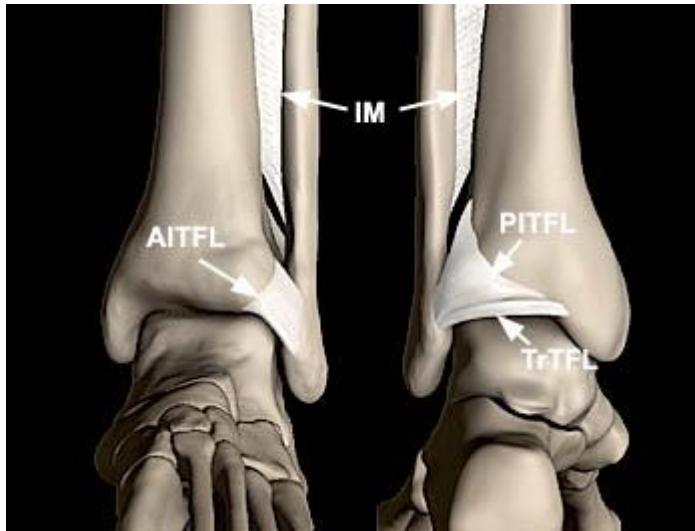
- swelling, pain, crepitus
- functional impairment

Dg tibio-fibular diastasis:

- widening of the joint
- pain between distal tibia and fibula
- talar instability

# Treatment

- Conservative
  - nondisplaced, unimalleolar – immobilization 4-6 weeks
  - nondisplaced bimalleolar - immobilization 2-3 weeks above knee cast followed by 5-6 weeks below knee
- Surgical
  - displaced uni/bi/trimalleolar
  - associated dislocation of the ankle joint
  - fibular malleolus – plate and screws, K-wire
  - tibial malleolus – screws, TBW
  - posterior malleolus – screws, plate and screws
- Postoperative
  - non weight bearing walking – immediate
  - partial WB at 6 weeks
  - full WB at 3 months



- in case of tibio-fibular diastasis – additional screw
- the tibio-fibular screw has to be extracted at 8 weeks (before weight bearing)





M 47ani, accident rutier

Bimaleolar fracture with tibio-fibular diastasis

ORIF – TBW – tibial malleolus, plate + additional screw through the plate fibula



Preop



Postop

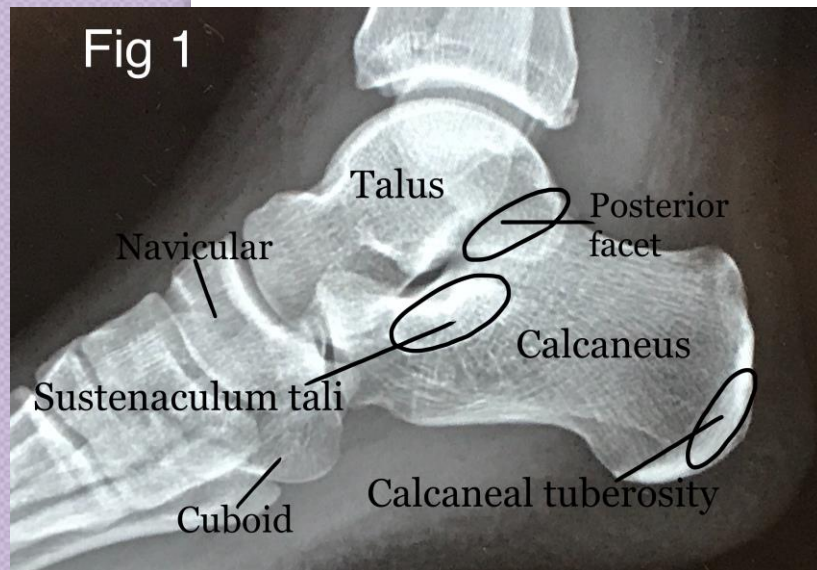
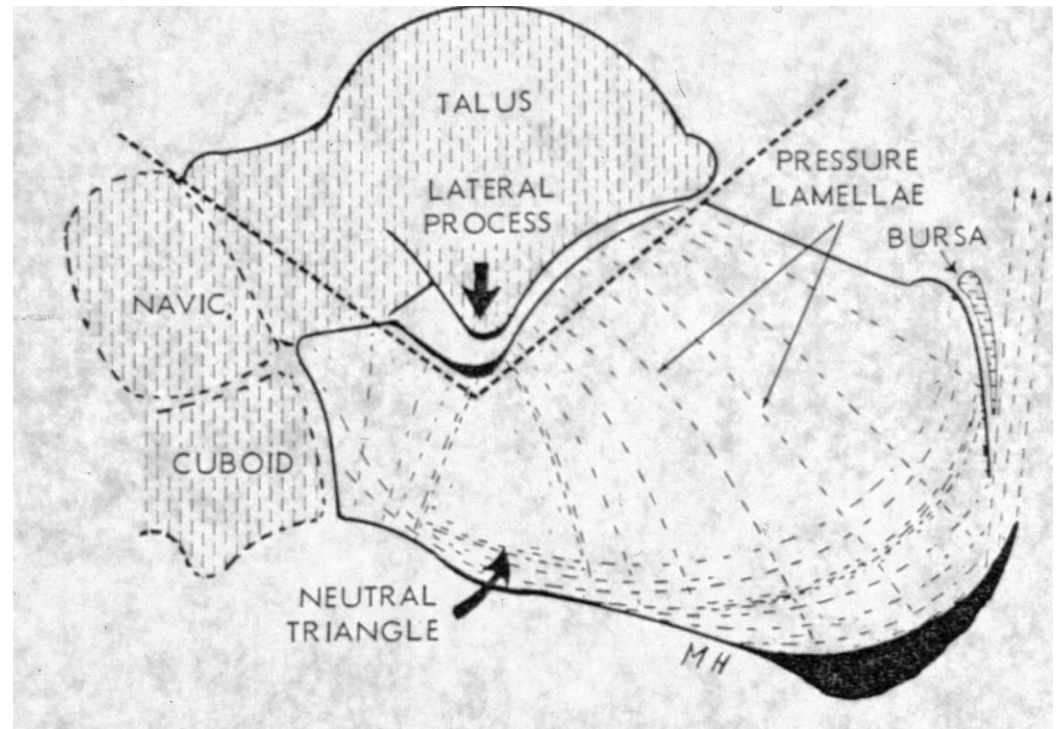


# Calcaneus fracture

- mechanism of injury – fall from height
1. Intraarticular fractures
    - undisplaced
    - horizontal depression
    - vertical depression
    - comminuted
  2. Extraarticular fractures
    - isolated or associated with intraarticular fr.

# Diagnosis

- severe pain in the calcaneal region
- swelling – “elephant foot” – increased transverse diameter – widening of the calcaneus
- varus deformity
- plantar ecchymosis – Mondor sign – first 8 hours
- X-ray - 3 views: AP, lateral and axial
- CT scan very important - understanding the fracture





vertical depression



horizontal depression







Extraarticular  
- emergency – skin necrosis



# Treatment

- Emergency: immobilization, analgesic, soft tissue management
- Conservative:
  - most frequent
  - weight bearing at 10-12 weeks
- Surgical
  - displaced , intraarticular fractures
  - results – mediocre
  - screws, anatomical plates



# Extraarticular



# Intraarticular

















