Fractures

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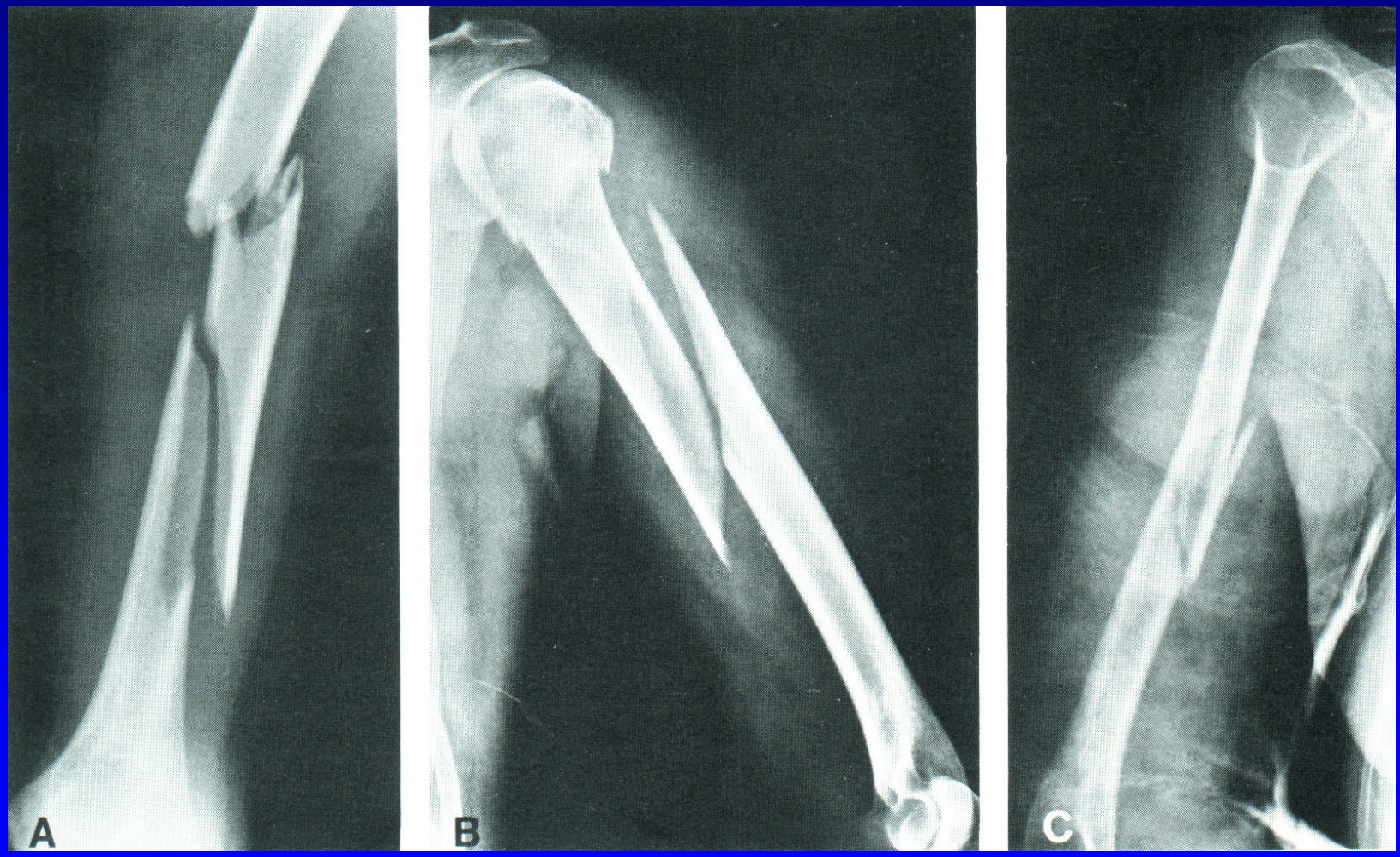
Fractures - etiology

- Traumatic (acute violence)
- Pathological (pathological lesion)
- Stress fractures

Traumatic fracture

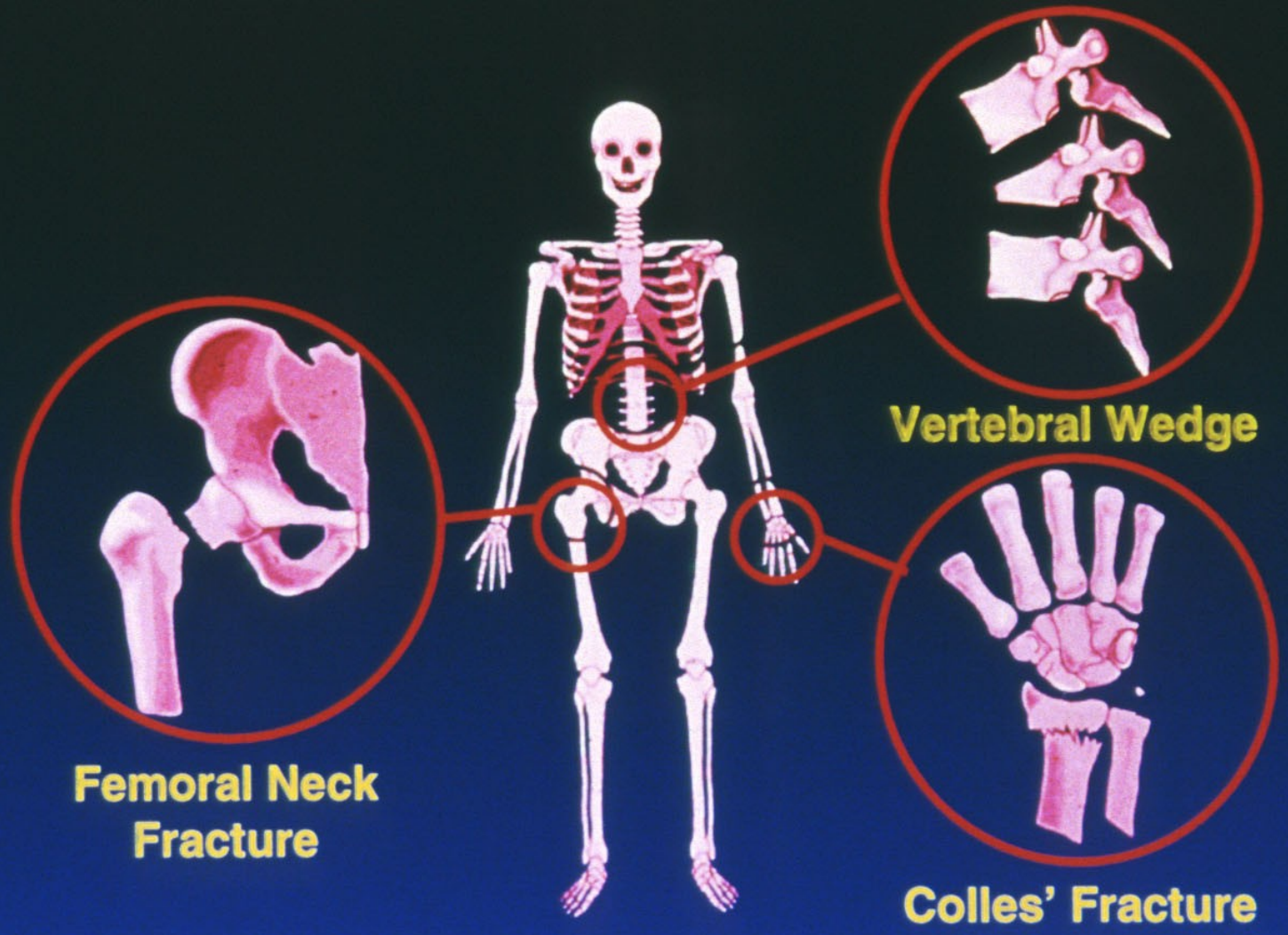


Pathological fracture

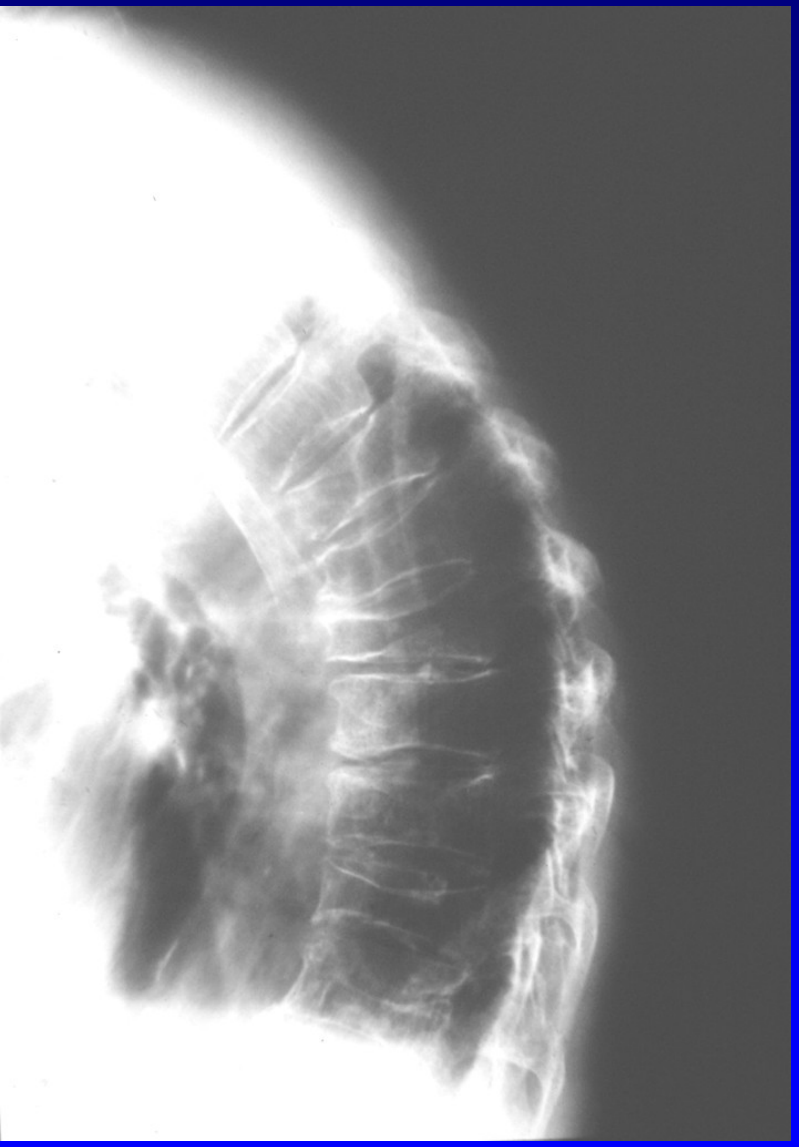
Tumors
Infections
Osteopaties
Congenital diseases

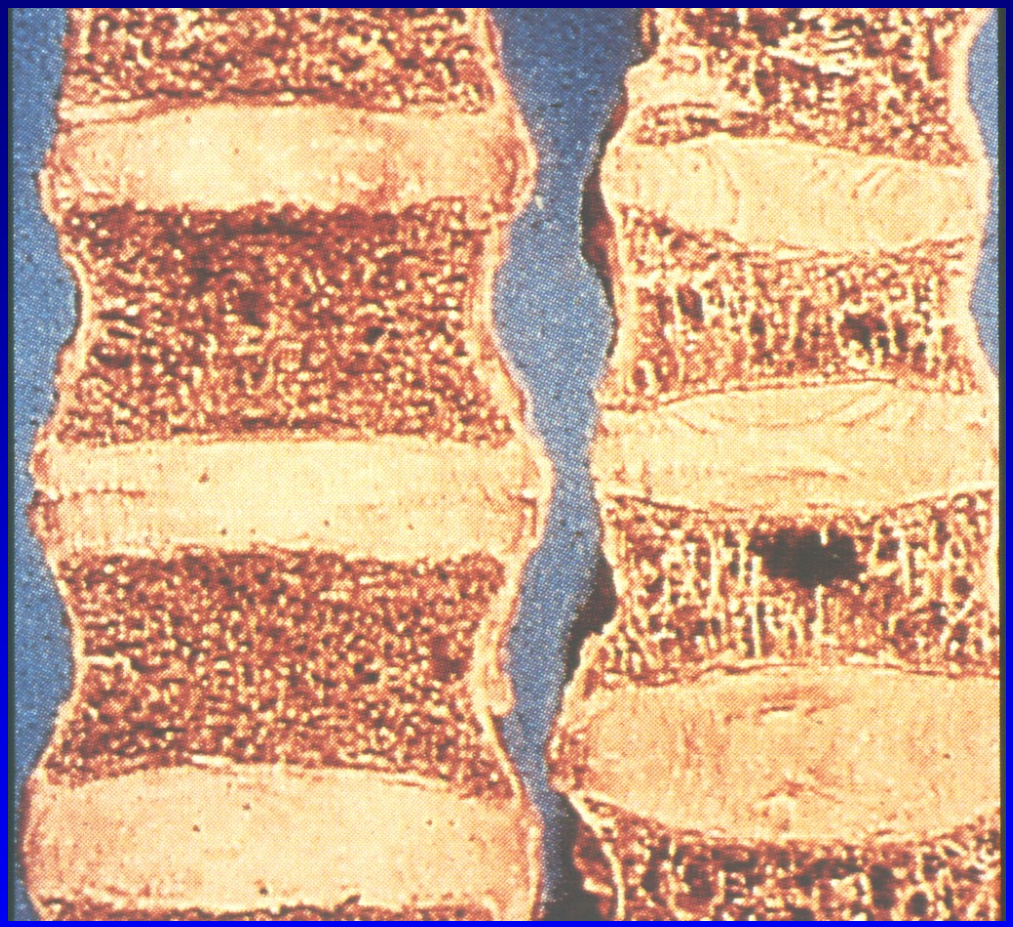
Stress fracture

THE COMMON FRACTURES OF OSTEOPOROSIS



Osteoporosis of vetebrae



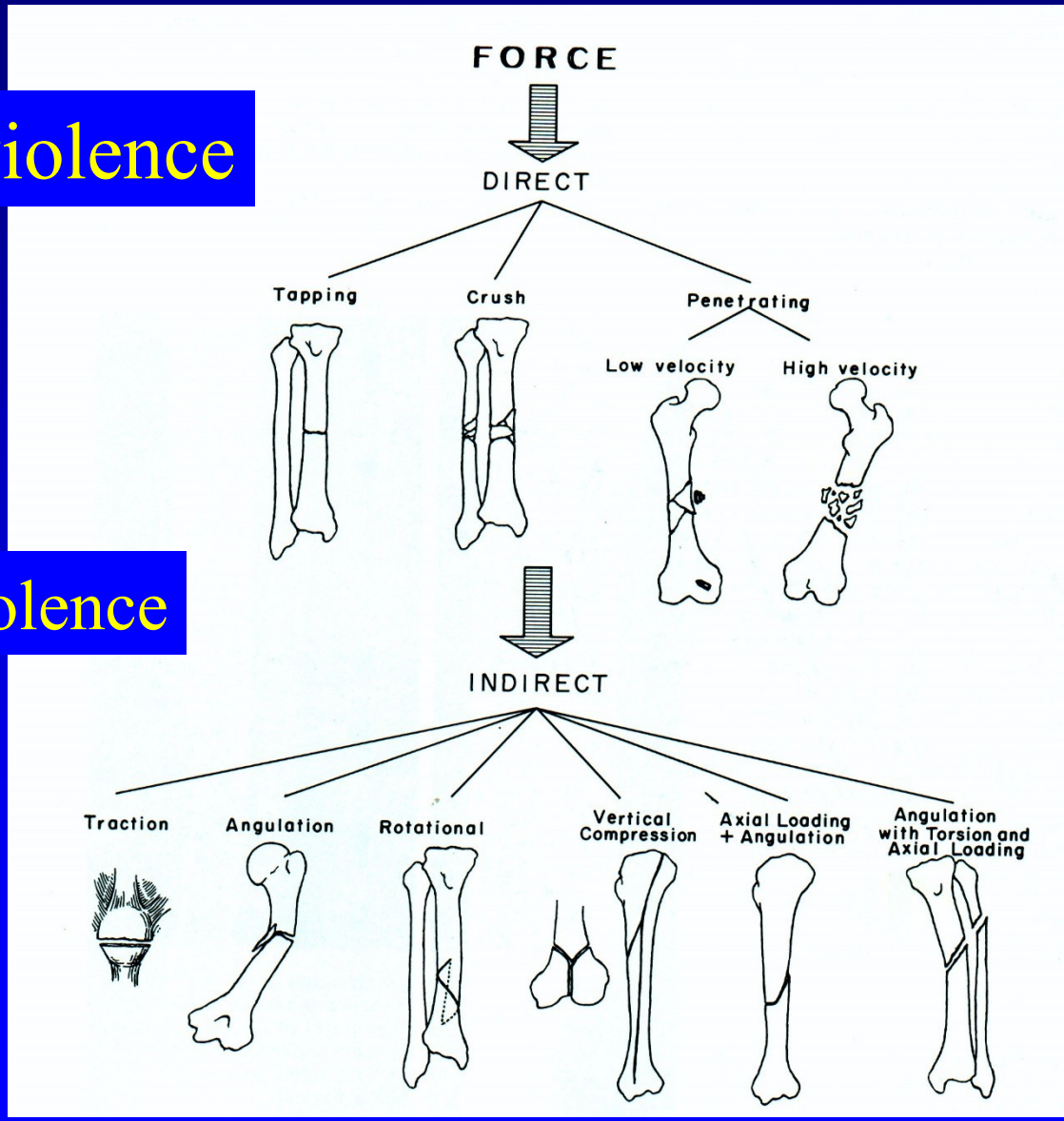


Mechanism of injury

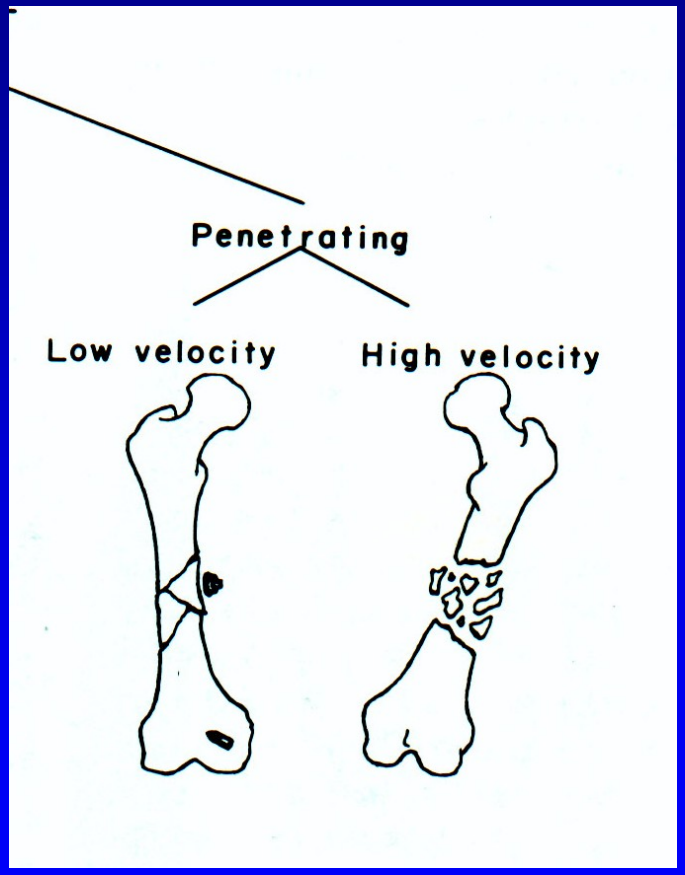
Fractures from direct violence

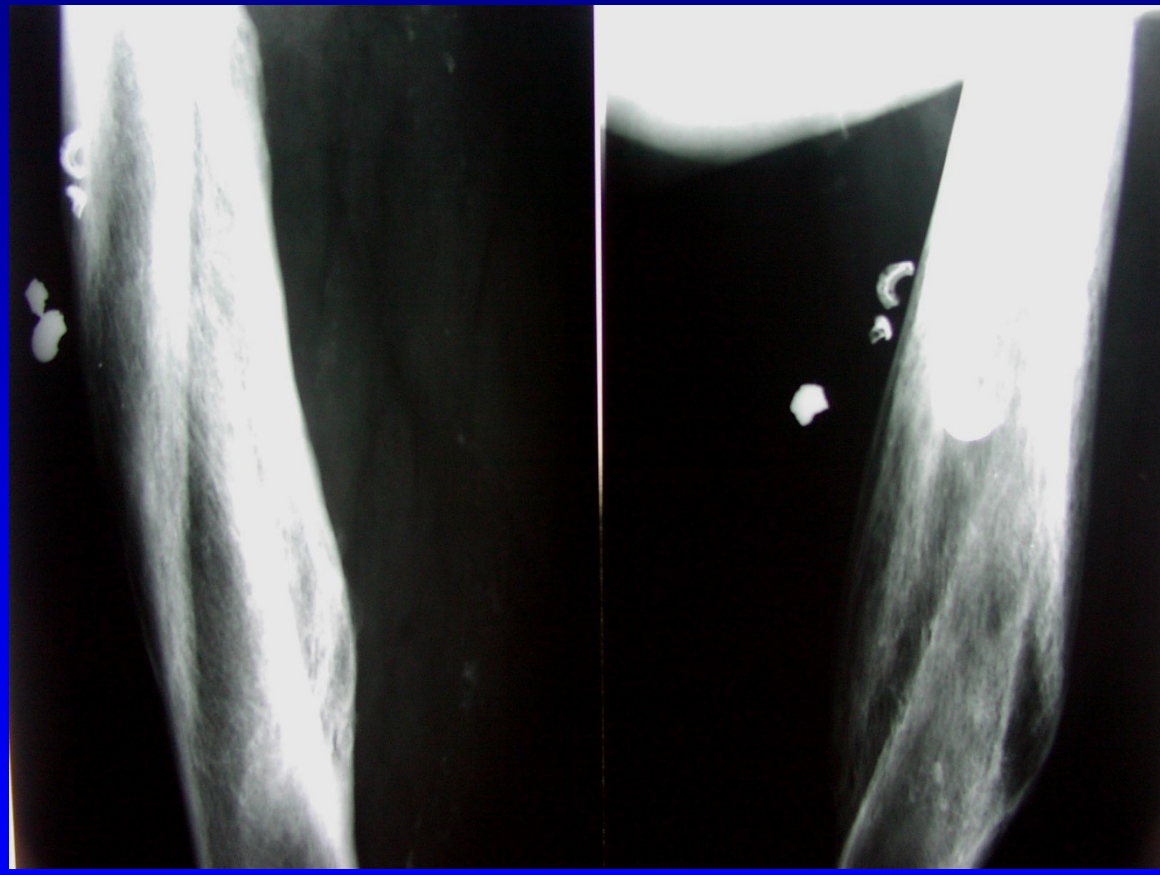
Fractures from indirect violence

traction
angulation
rotation
vertical compression
torsion



Missile fractures





Mechanism of injury

High energy trauma – large lesion of soft tissue

Low energy trauma - small lesion of soft tissue

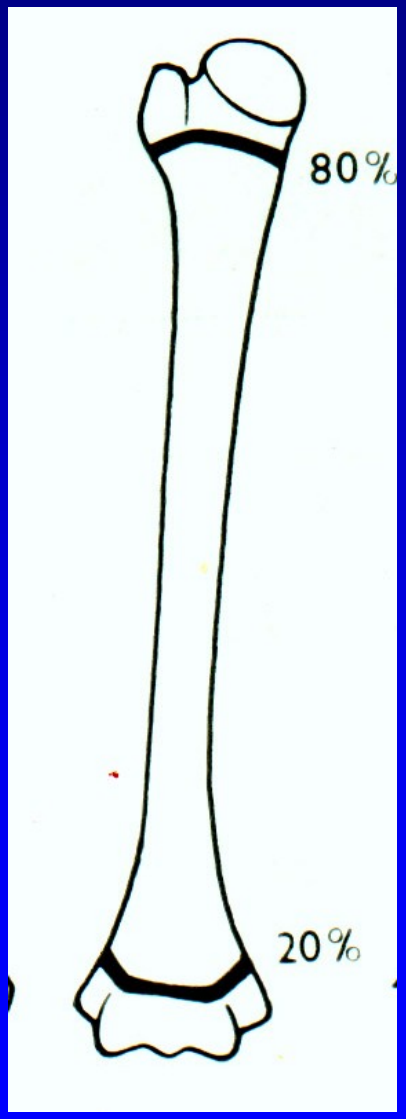
Classification of fractures

Complete

Incomplete:
- fissures
- infractions
- impressions
- subperiostal

Localisation of fractures

- Epiphyseal
- Metaphyseal
- Diaphyseal



epiphysis

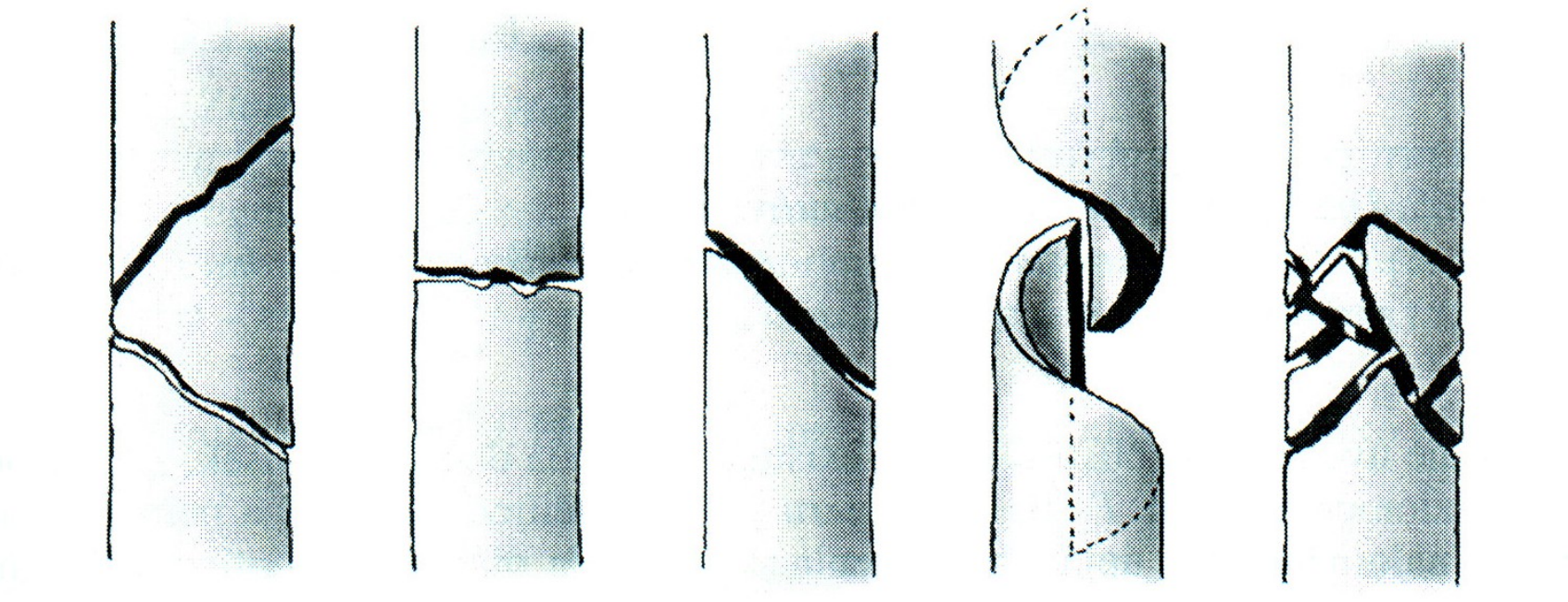
metaphysis

diaphysis

metaphysis

epiphysis

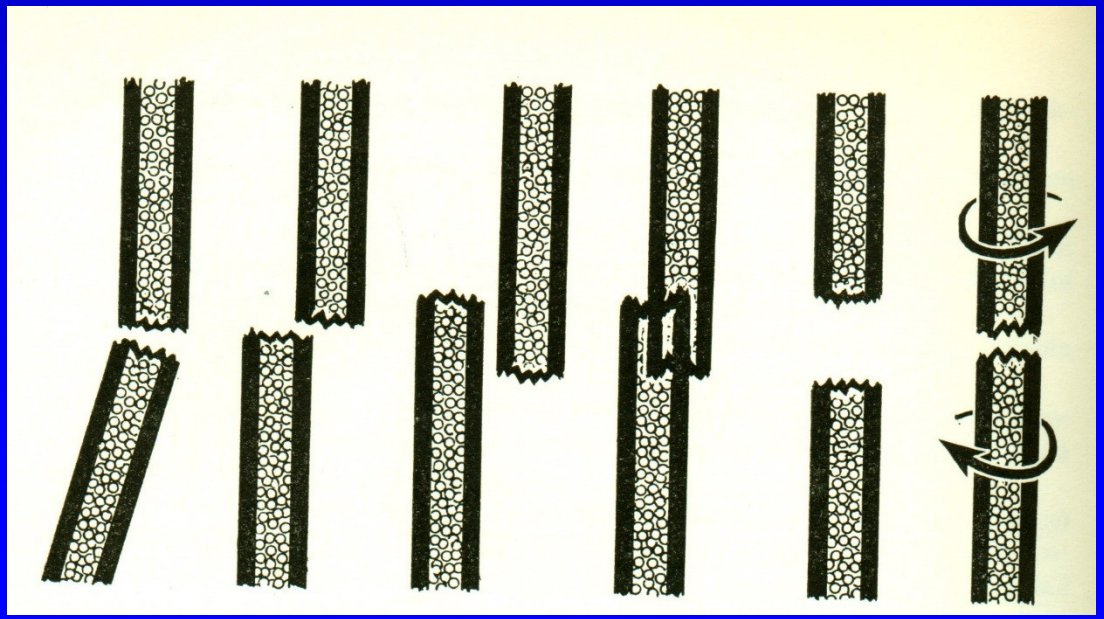
Fracture lines



interfragment
transverse
oblique
spiral
comminution

Dislocation

Dislocatio ad axim
Dislocatio ad latus
Dislocatio ad longitudinem cum contractione
Impactio
Dislocatio ad longitudinem cum distractione
Dislocatio ad peripheriam



Clinical symptoms of fractures

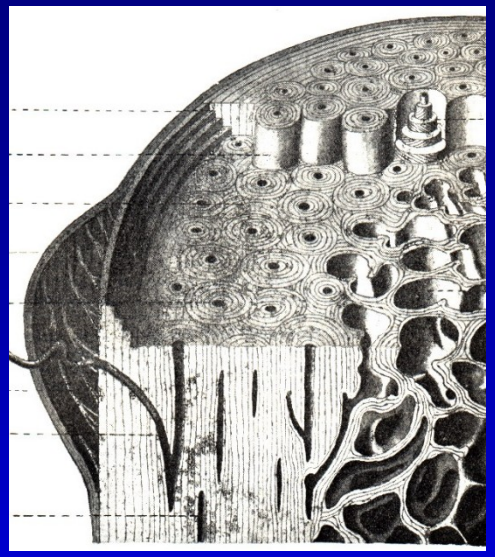
- Pain and tenderness
- Swelling, haematoma
- Impaired function
- Deformity
- Crepitation
- Pathological movements

Healing of fractures

Osteoblasts:

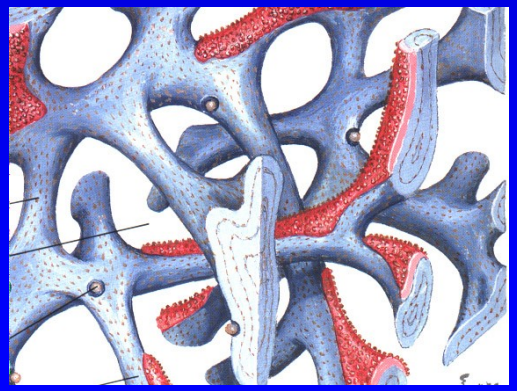
Cambian layer of periosteum and endosteum

Tratebulae in metaphyseal and epiphyseal region



Osteoprogenitor cells:

reticular, perivascular cells, monocyts

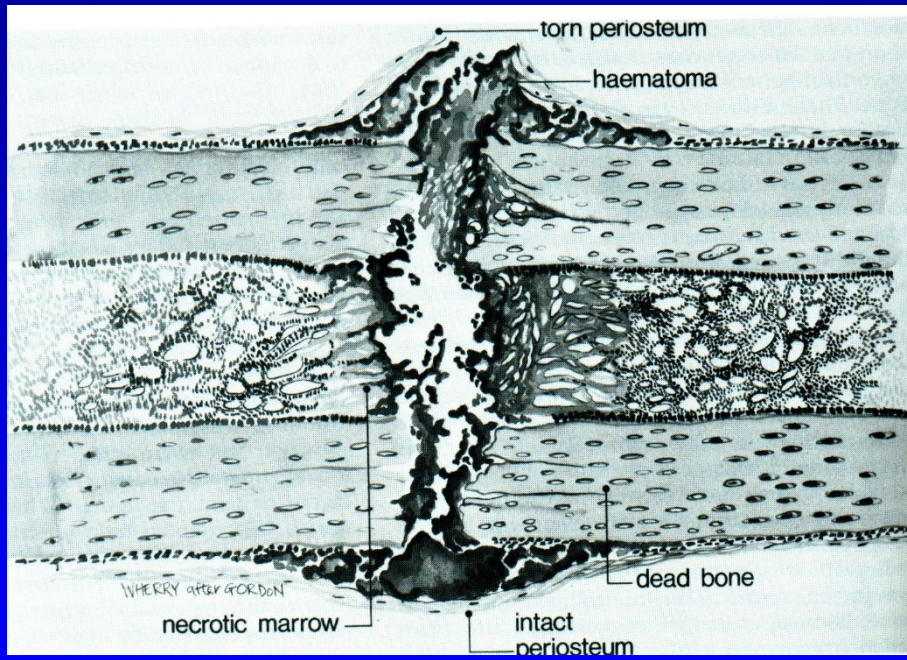


Diaphysis – longer period of healing

Epi and metaphysis – shorter period of healing

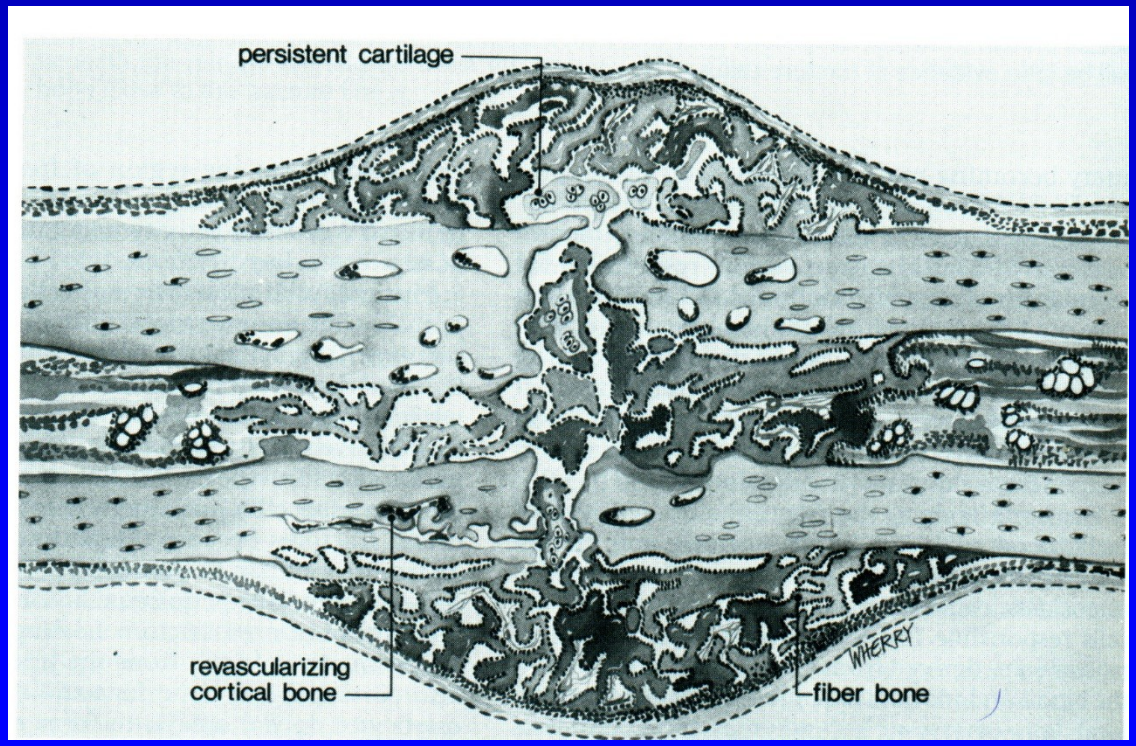
Secondary healing

1. Haematoma
2. Granulation tissue
3. Osteoid (since 5. day)
4. Primary callus formation
   - primary woven bone
   - fibrous tissue,
   - cartilage tissue
   - mineral layers after 6 days



Secondary healing

5. Secondary callus formation
   - woven bone is replaced by
     cortical and trabecular bone
6. Remodelation of callus



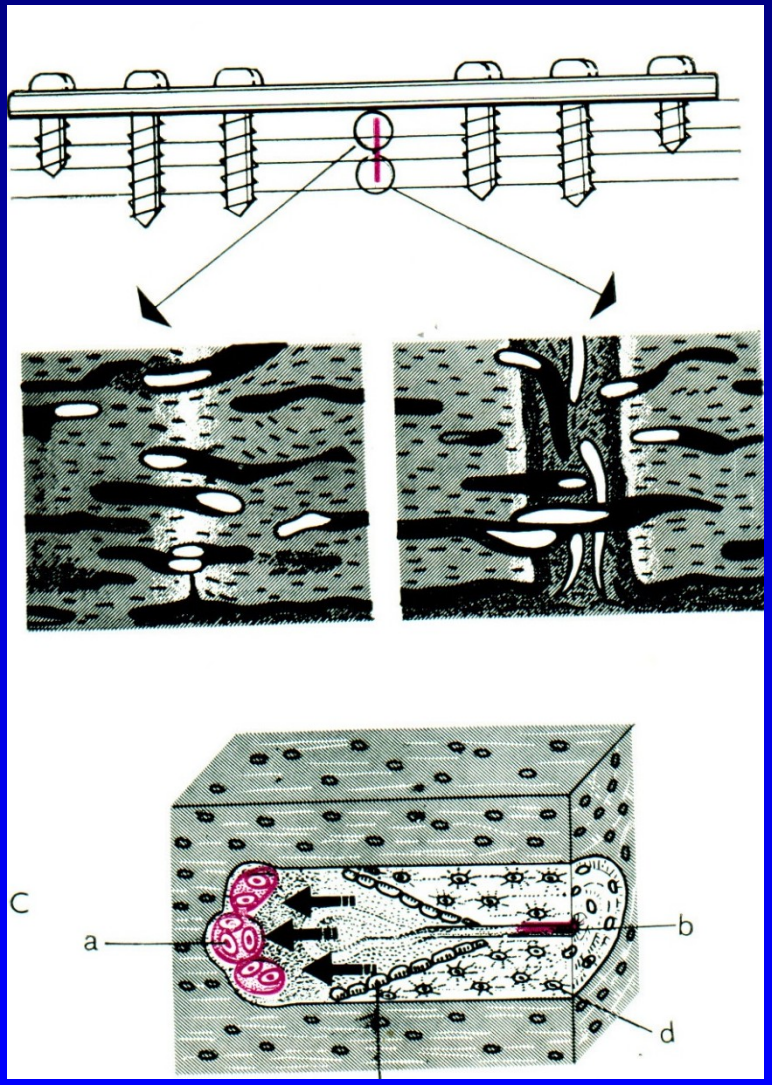
Primary healing

Prerequisity: stable fixation
It is intercortical healing
without callus formation

1. Contact

2. Gap

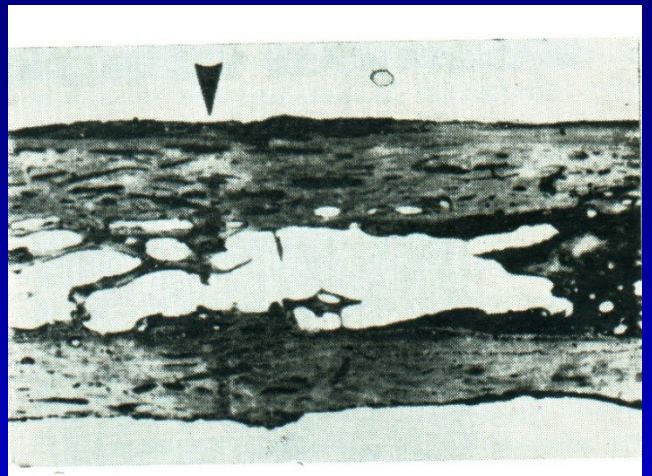
Osteon: osteoclasts, vessels, osteoblasts



Primary healing

Functional unit: osteon

Speed of osteons: 0,1 mm/day

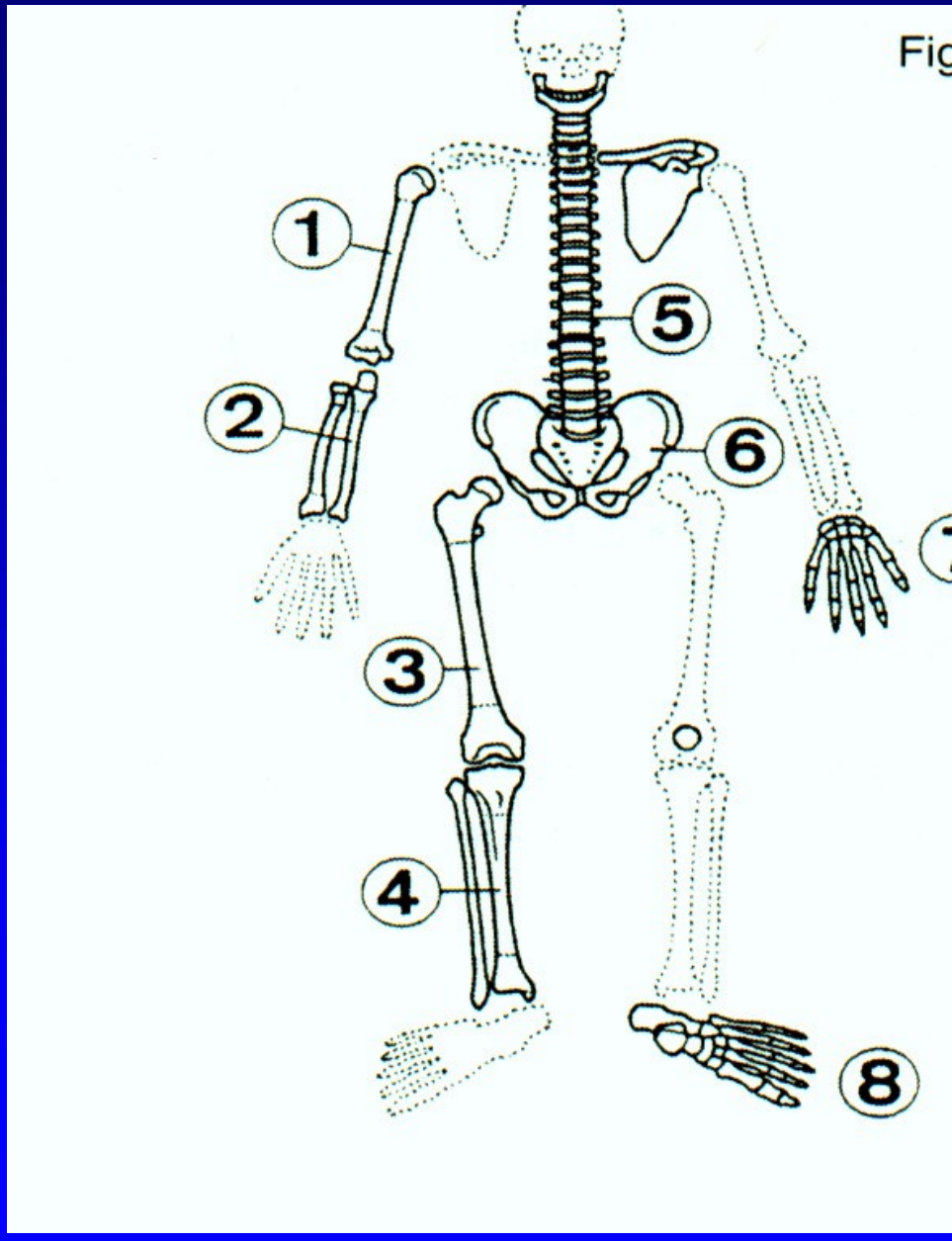


5. Makropreparát osteotomie radia psa fixovan
kompresní dlahou (stav po 6 týdnech). Je vytvo
řen minimální periostální a endostální svalek

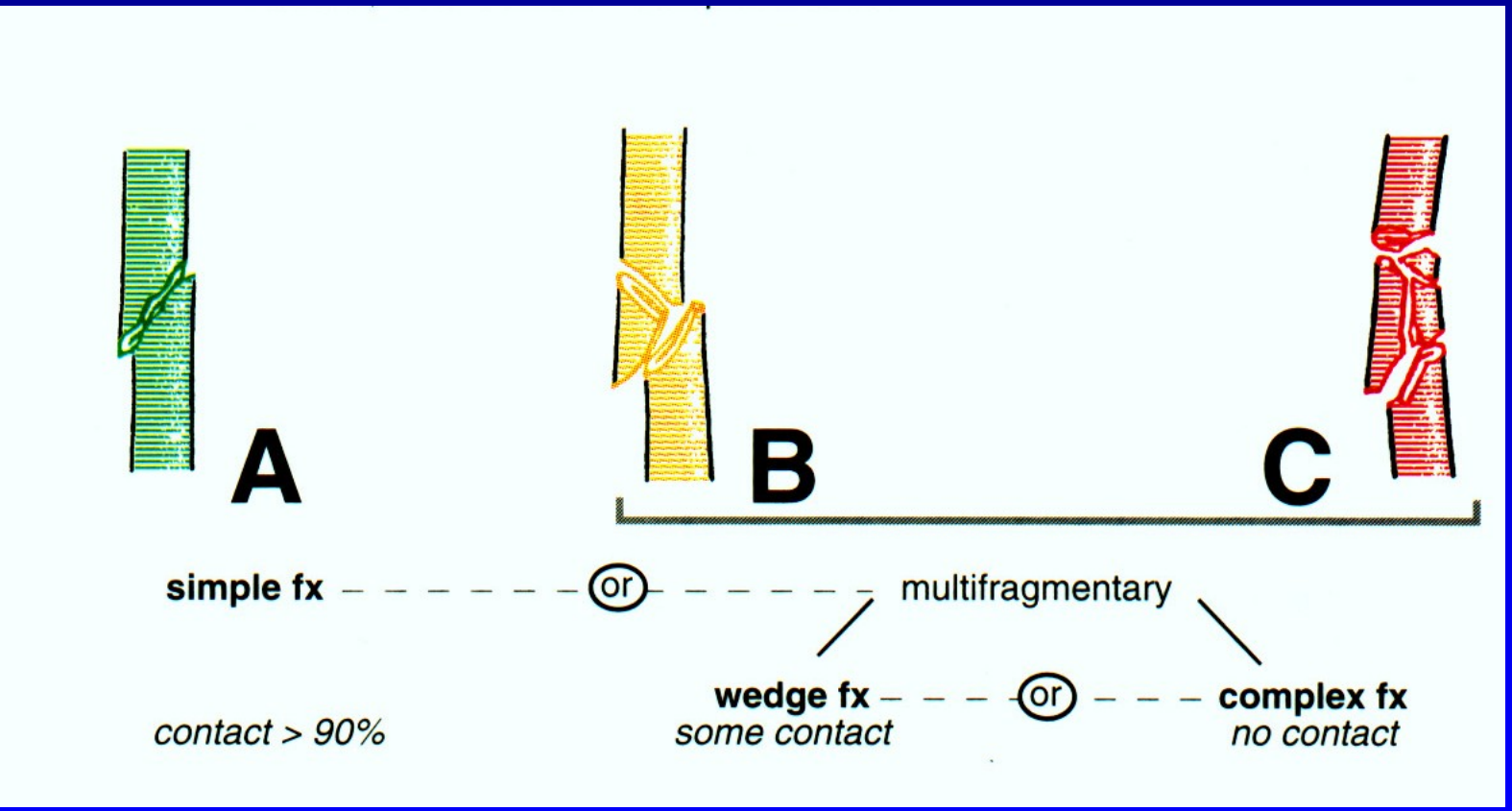
AO classification

Davos, 1958.

E. Műller
M. Allgőver
H. Willenegger

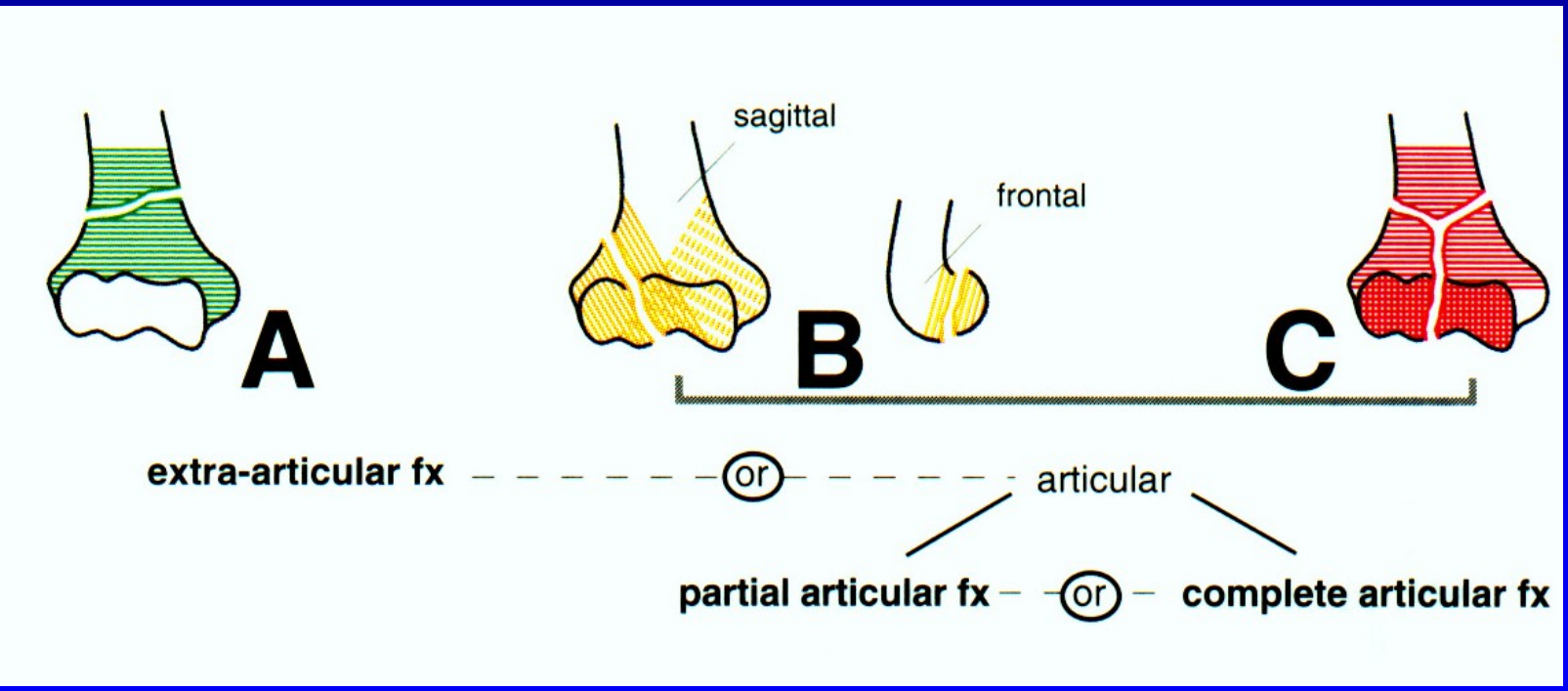


AO classification - diaphysis



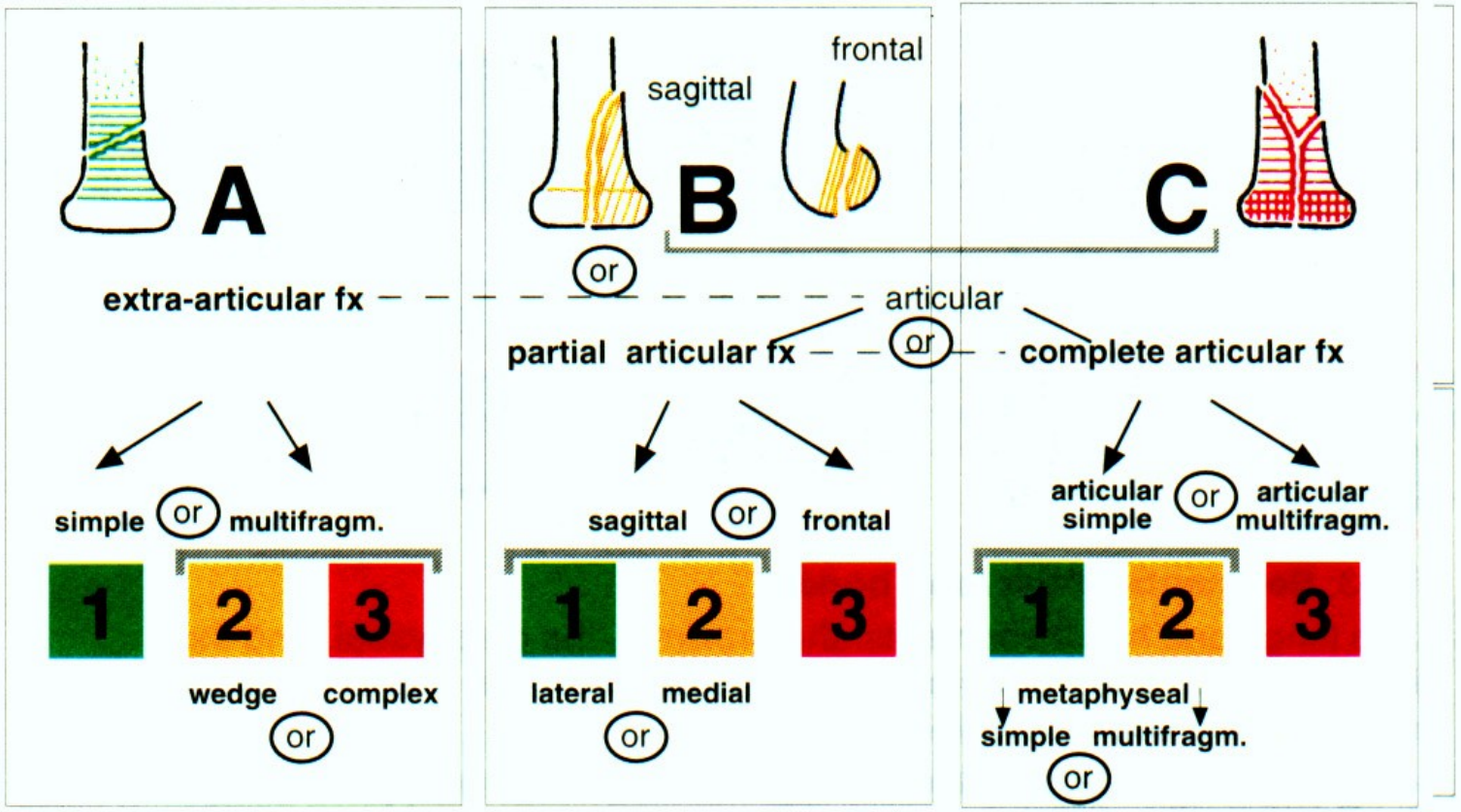
Type

AO classification
- metaphysis, epiphysis



Type

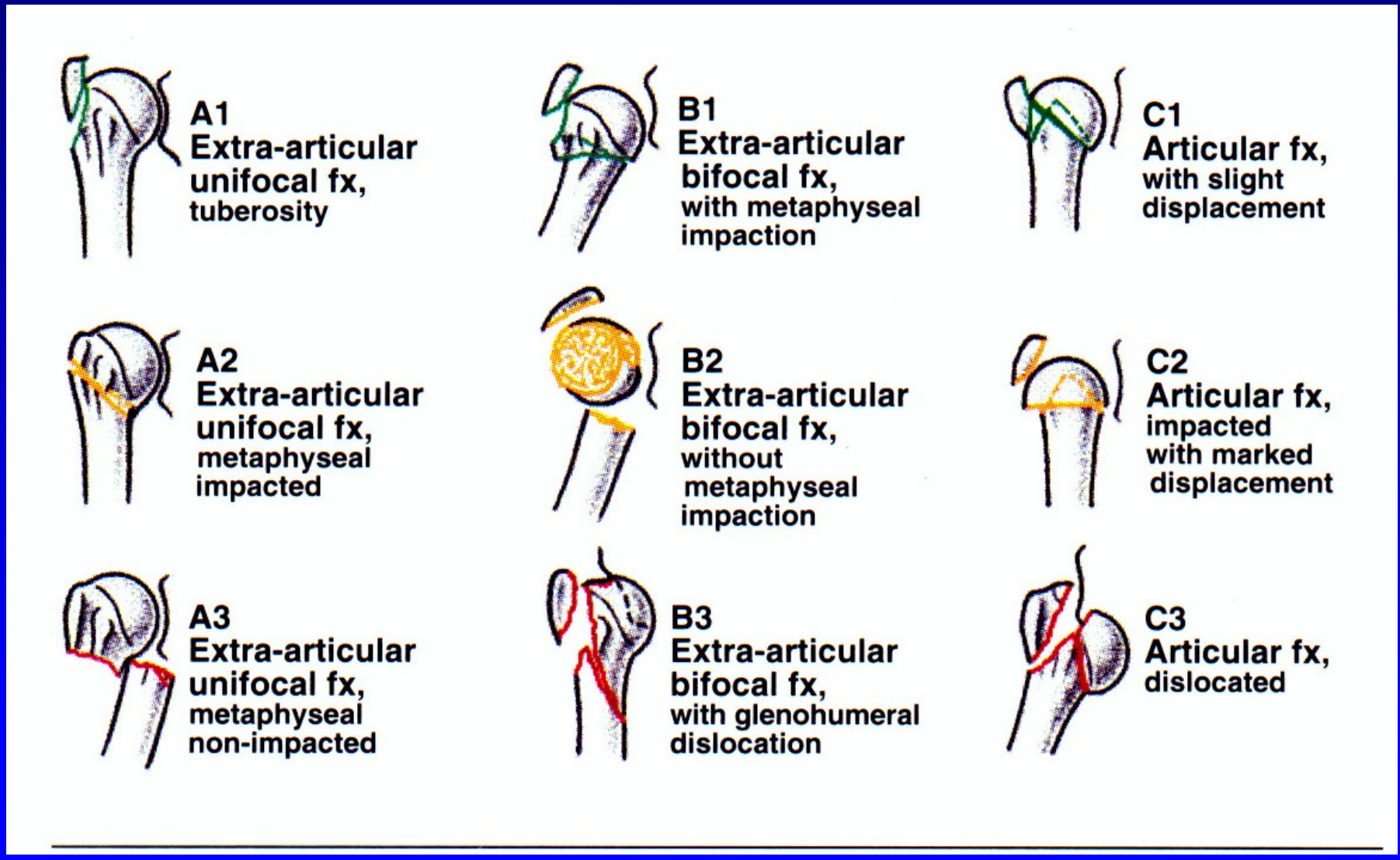
AO classifications



Type

Group

AO classification – proximal humerus

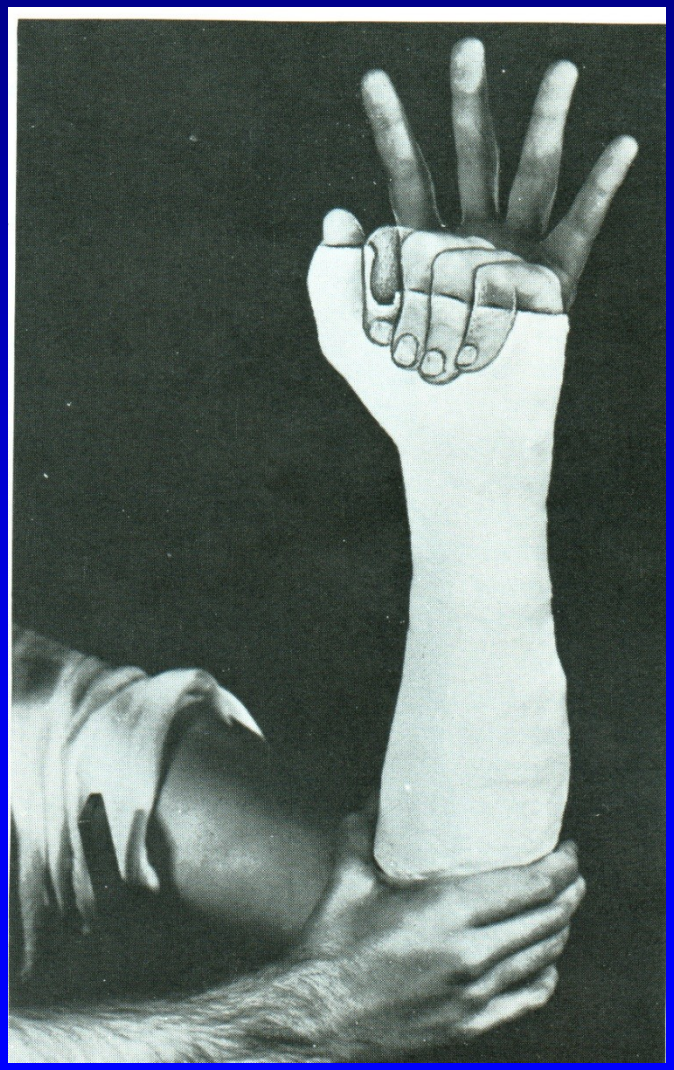


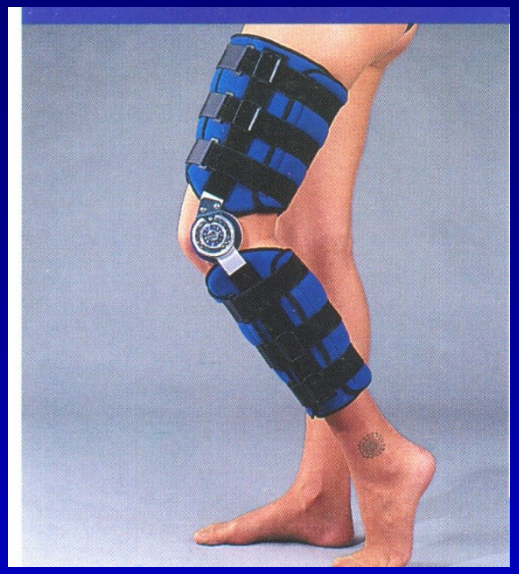
Management of fractures

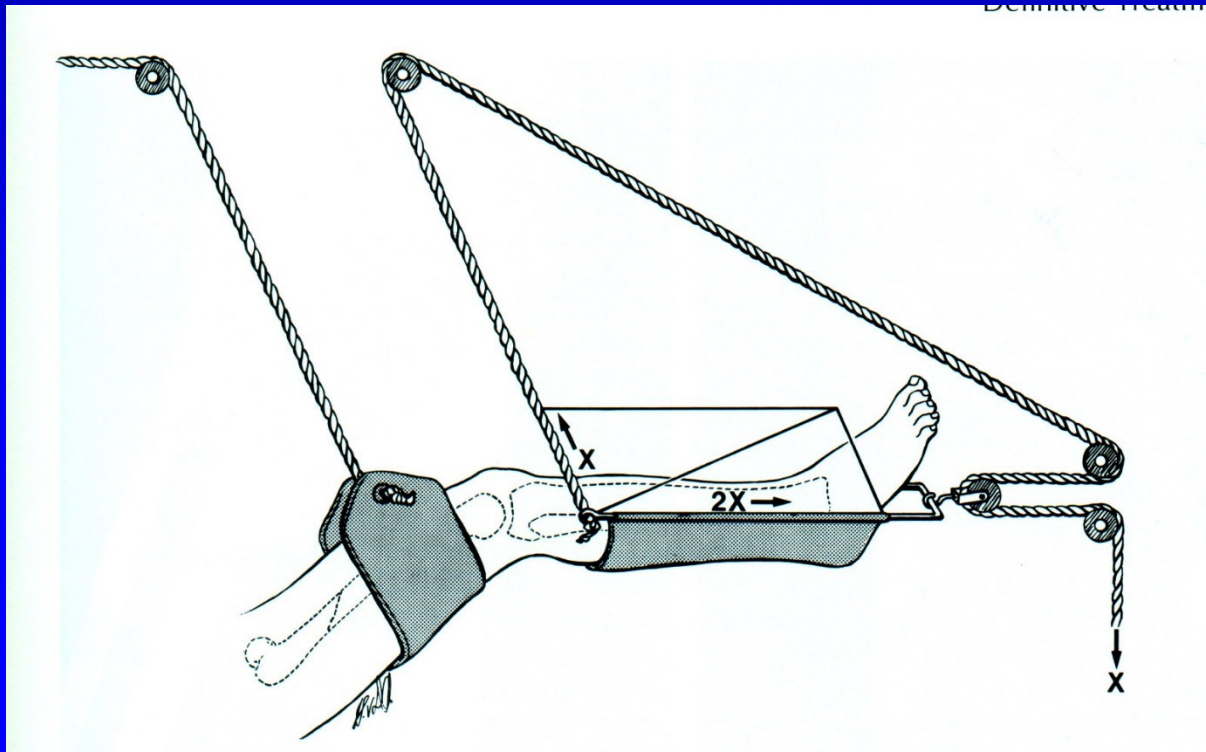
Conservative:

- 1. Reduction
- 2. Retention (immobilisation)
- 3. Physiotherapy

Conservative management







Operative treatment

In all cases, in which we get advantage against conservative treatment

- Intraarticular fractures
- Dislocated fr. – not redusable by closed reduction
- Fr. of proximal femur
- Diaphyseal fr.
- Open fr.

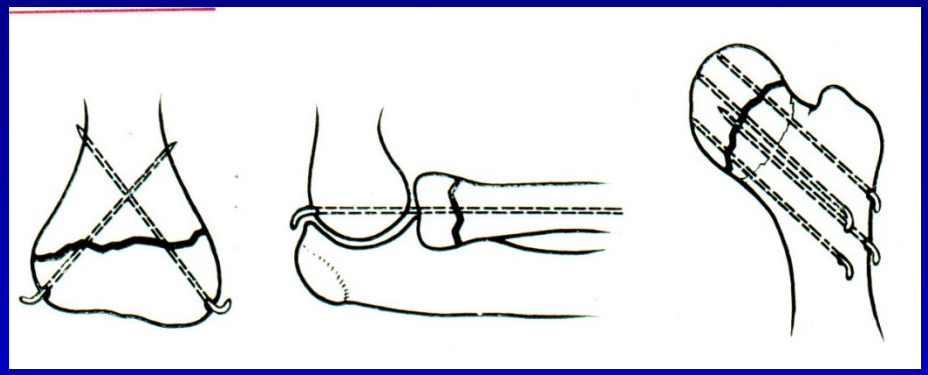
Osteosynthesis

- Aim – anatomical reduction
- Absolute stability (AO plate)
- Relative stability

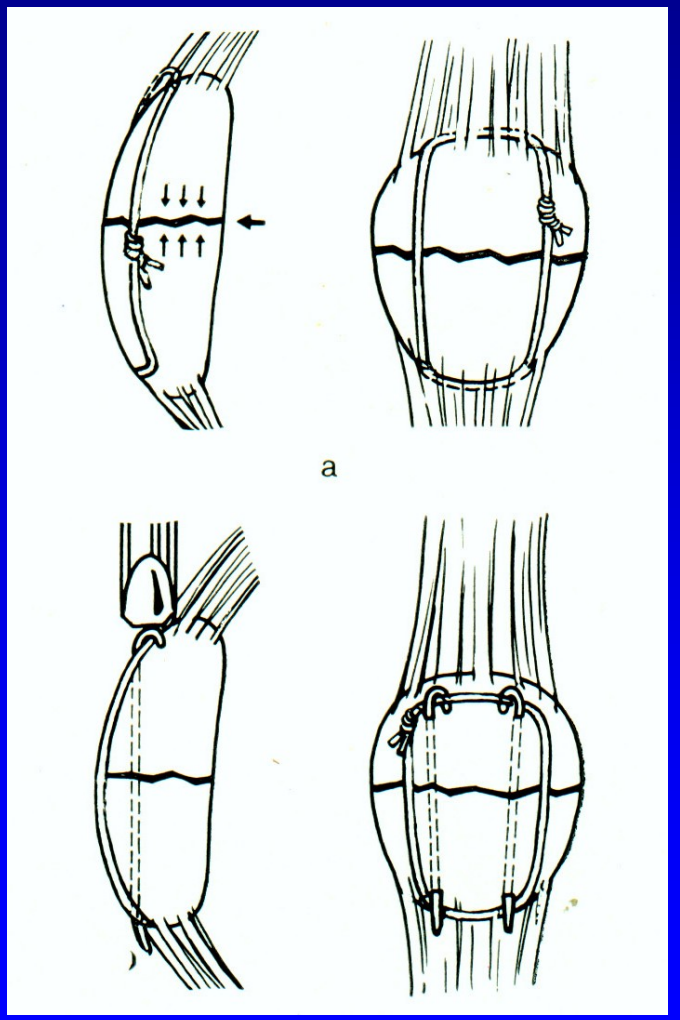
  + secondary healing with periosteal and endosteal callus (intramedullary nails)

Osteosynthesis

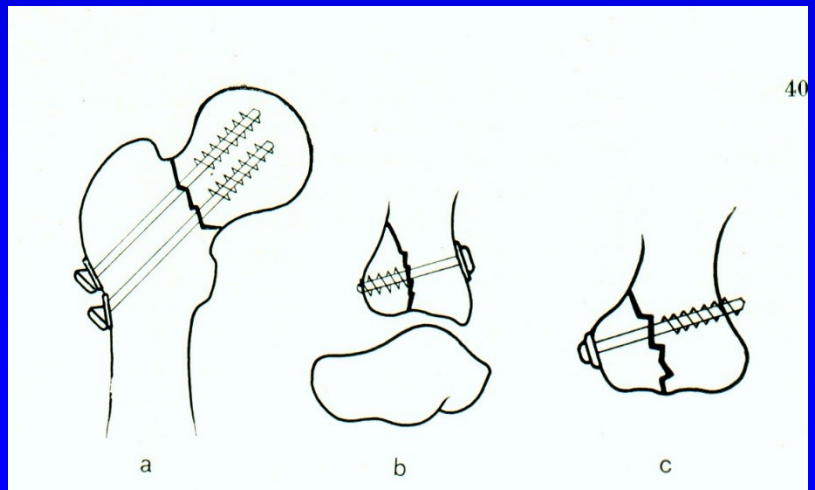
Kirschner wires



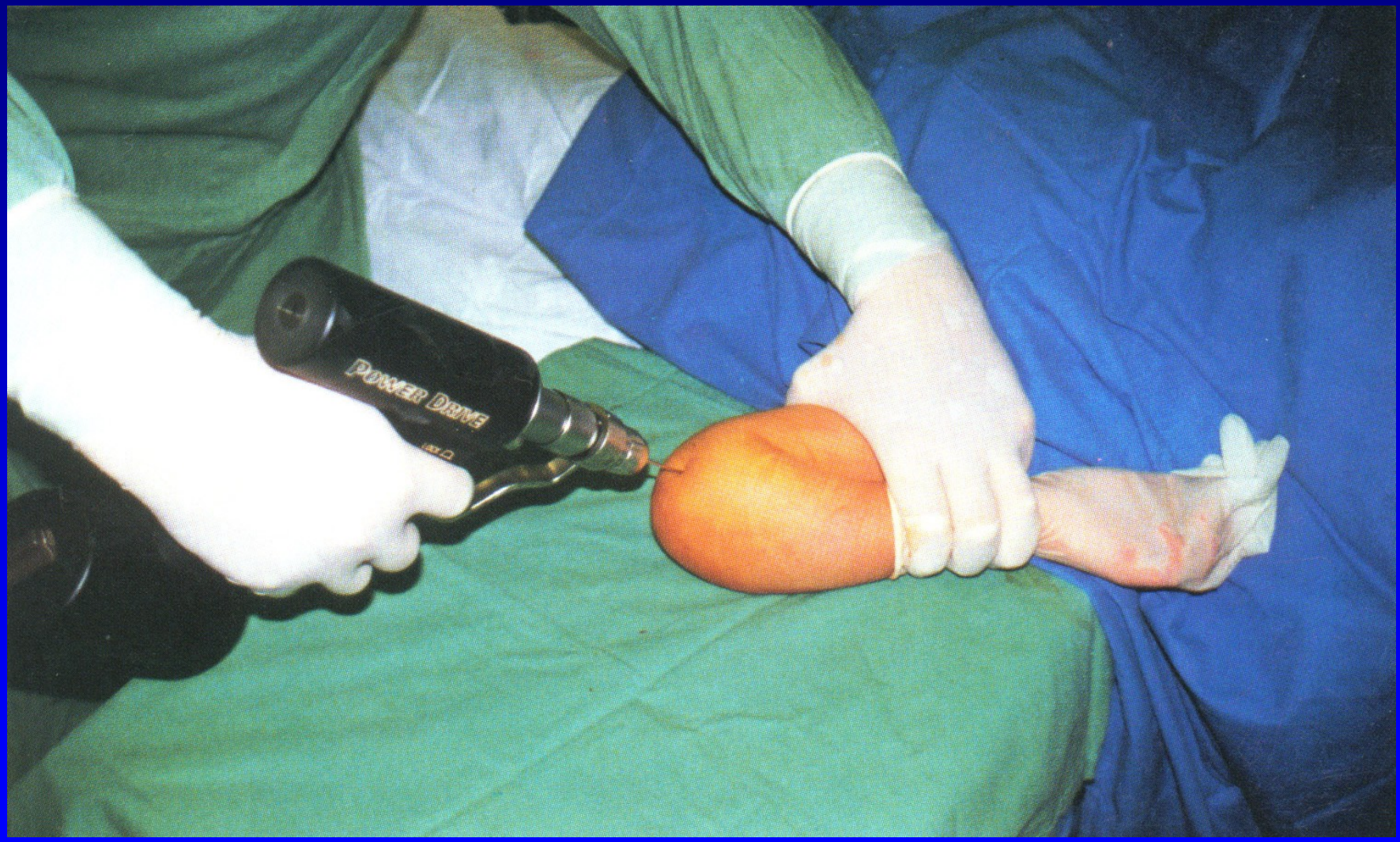
Tension band wiring



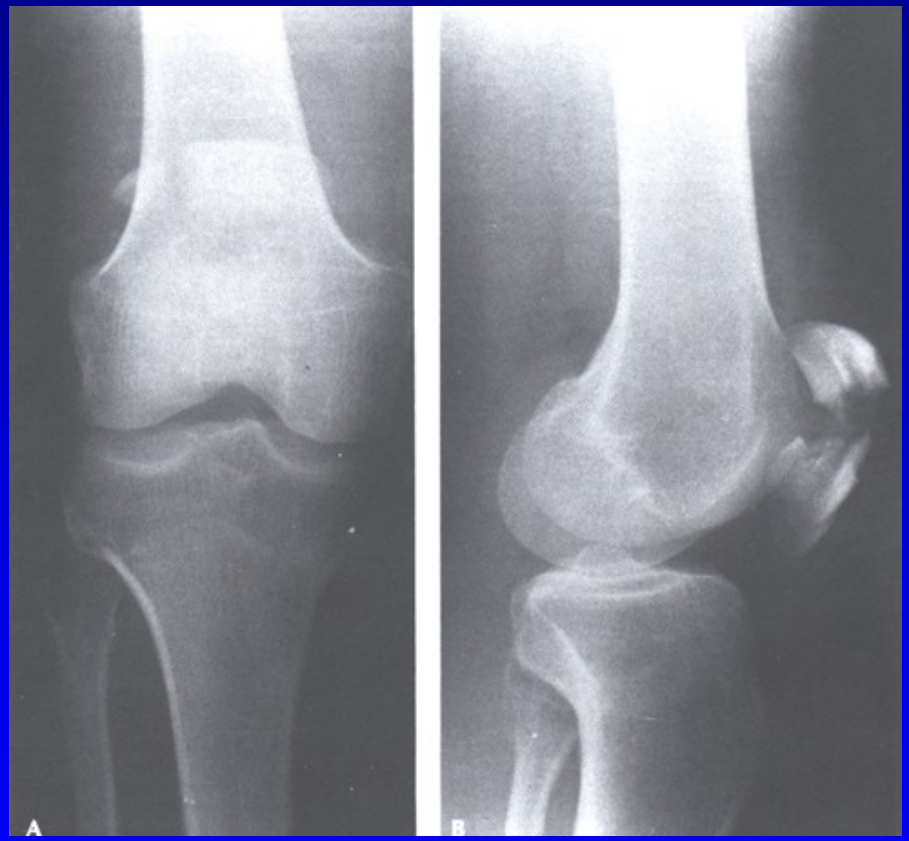
AO screws cortical cancellous

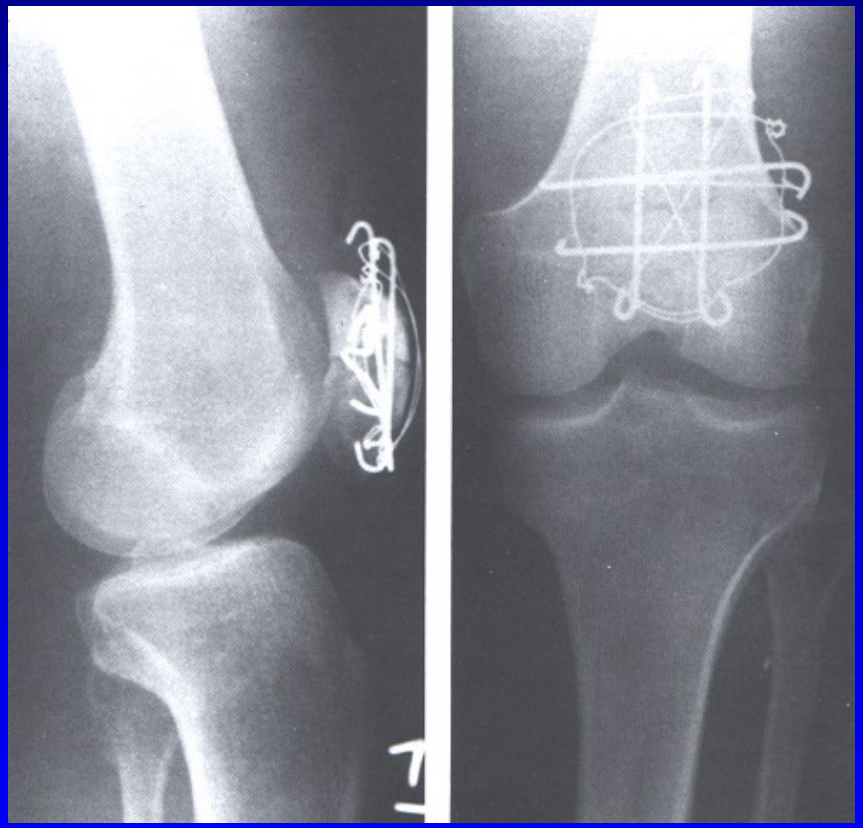


K- wires



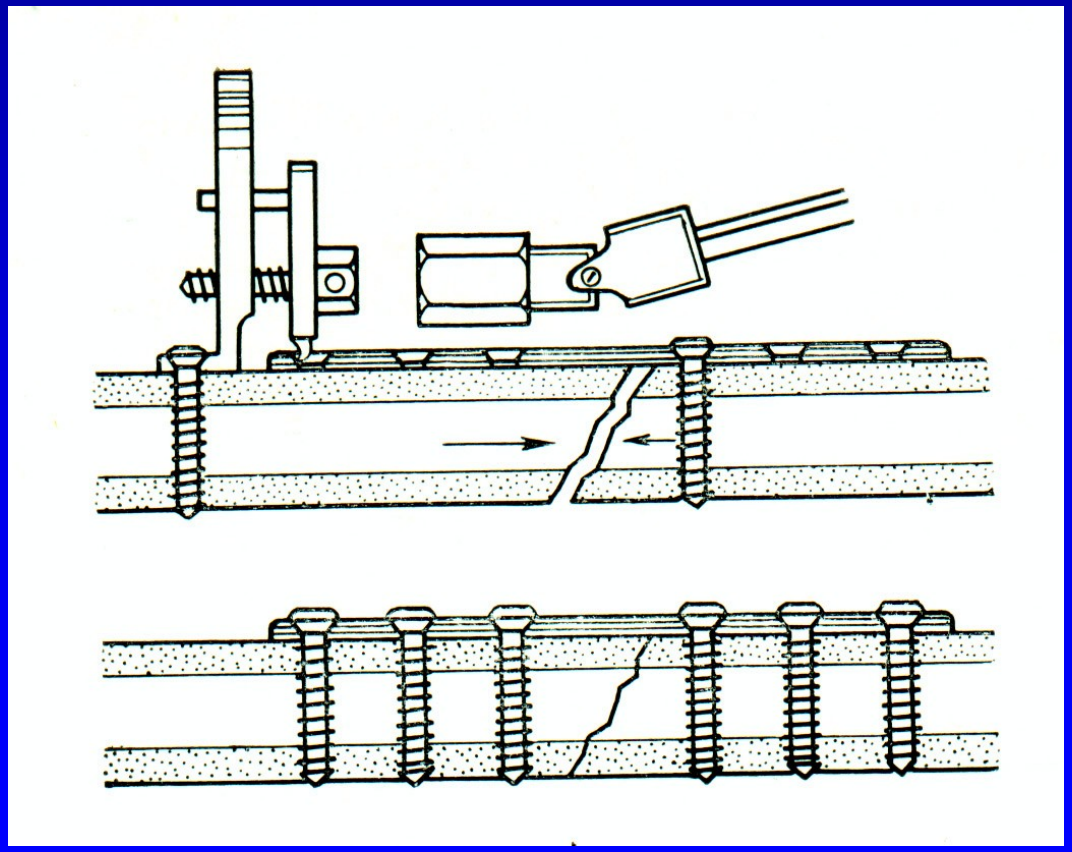
Tension band wiring of patella



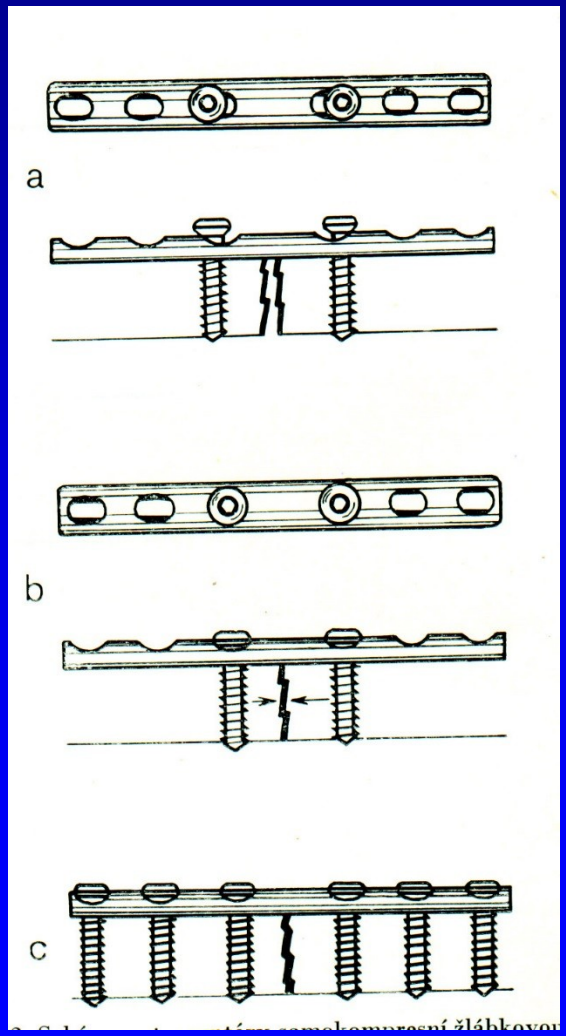


AO plates

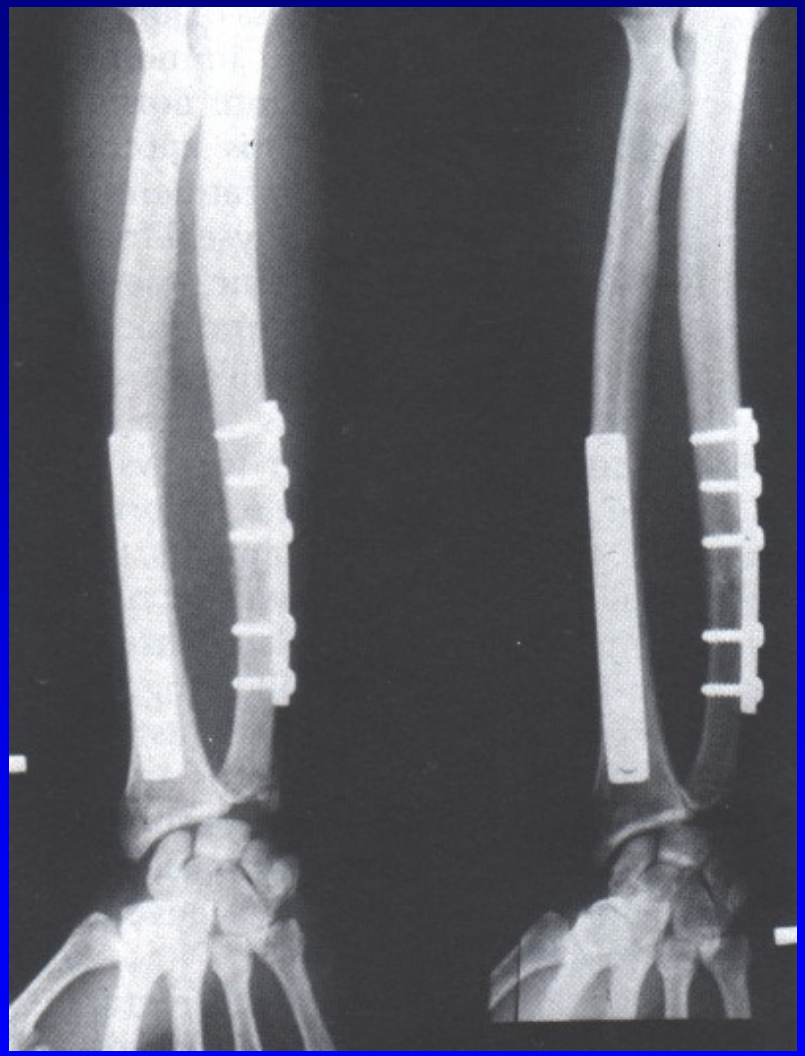
Compression AO plate



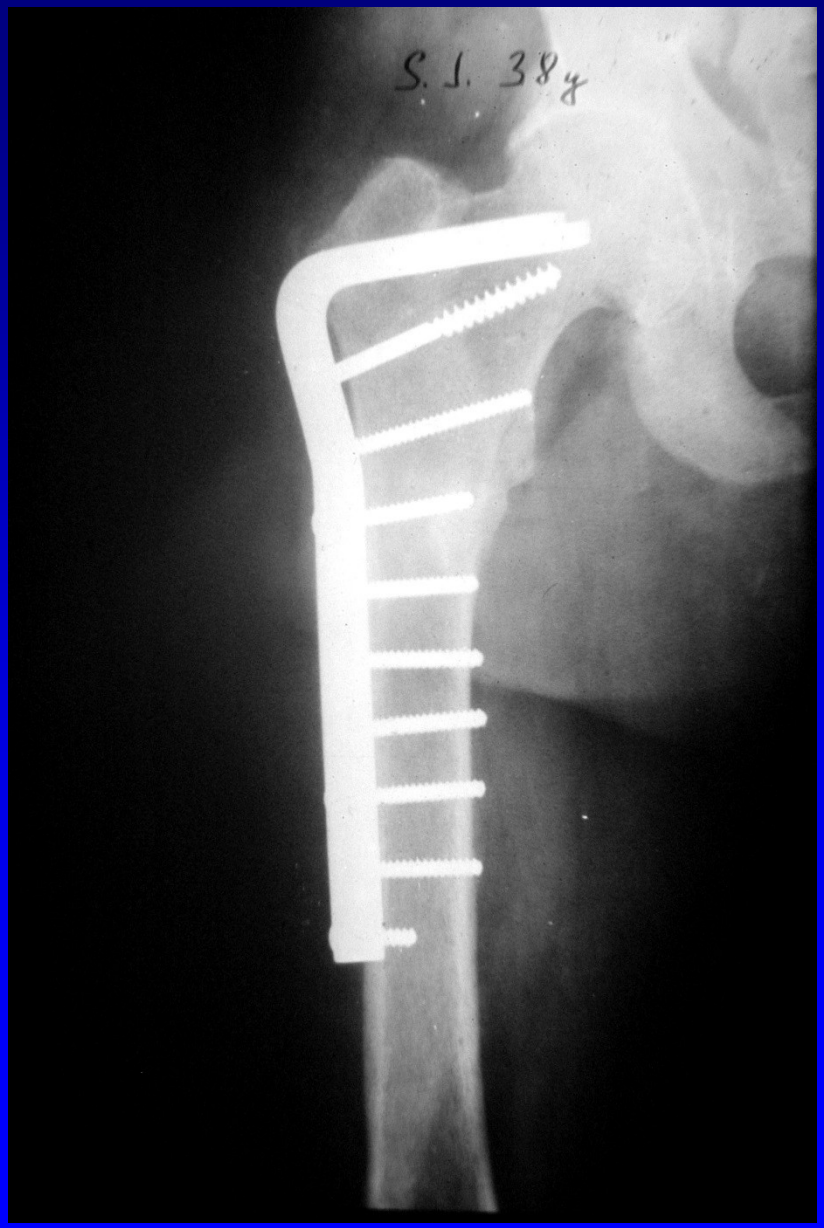
Self- compression AO plates



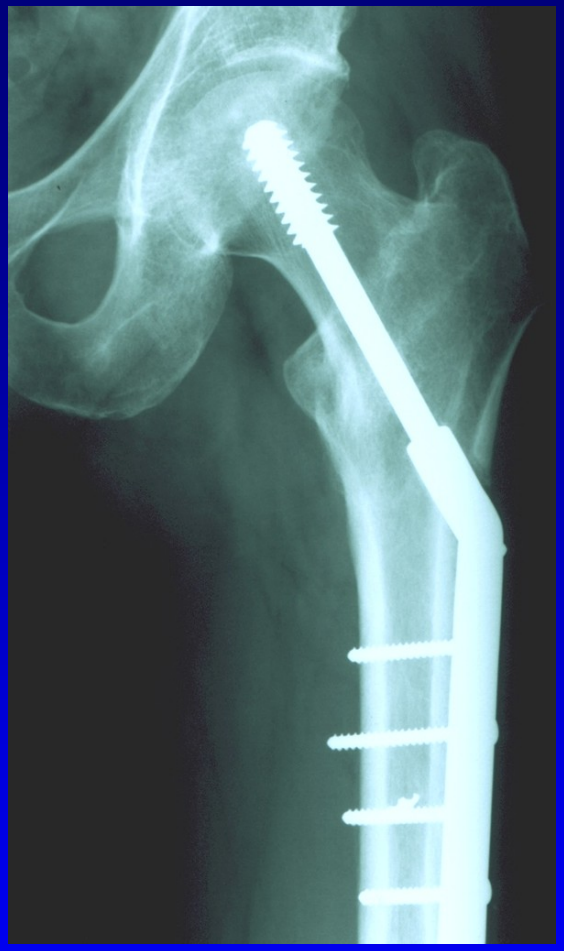
Osteosynthesis of radius and ulna



AO plate of proximal femur

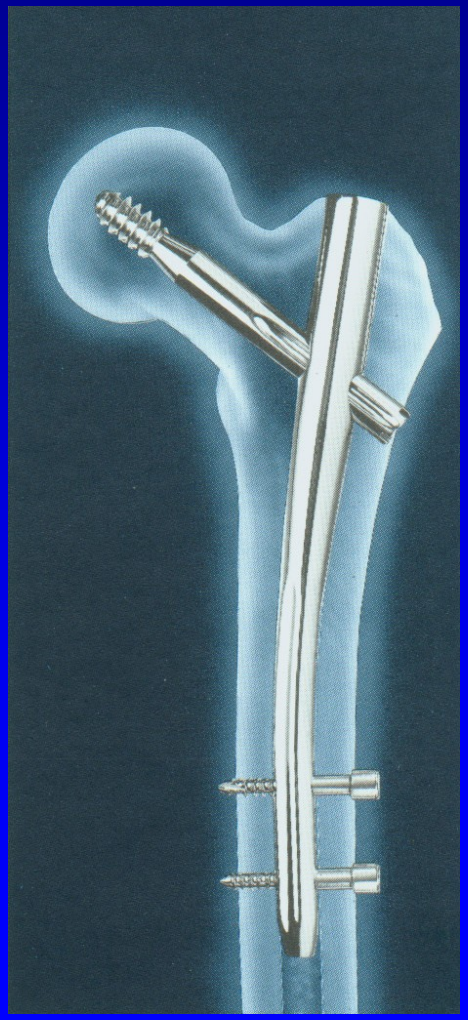


DHS
Dynamic hip screw

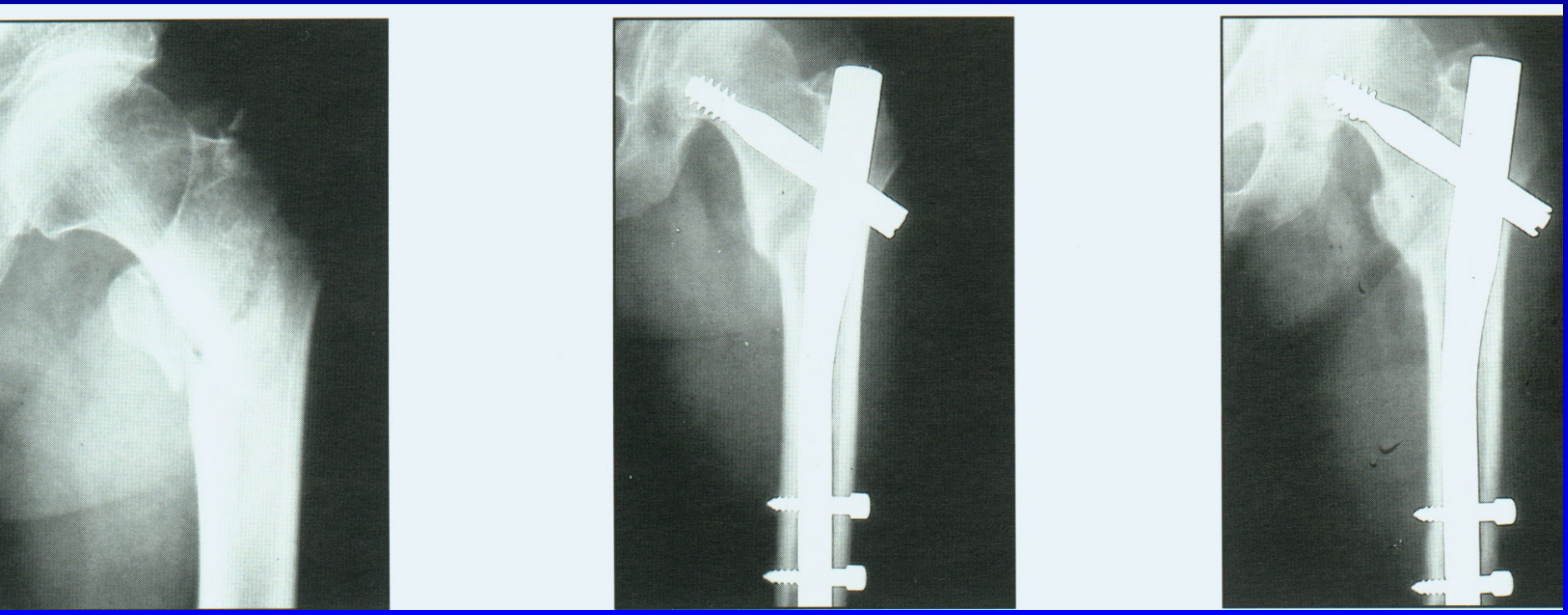


DCS
Dynamic condylar screw

Gamma locking nail



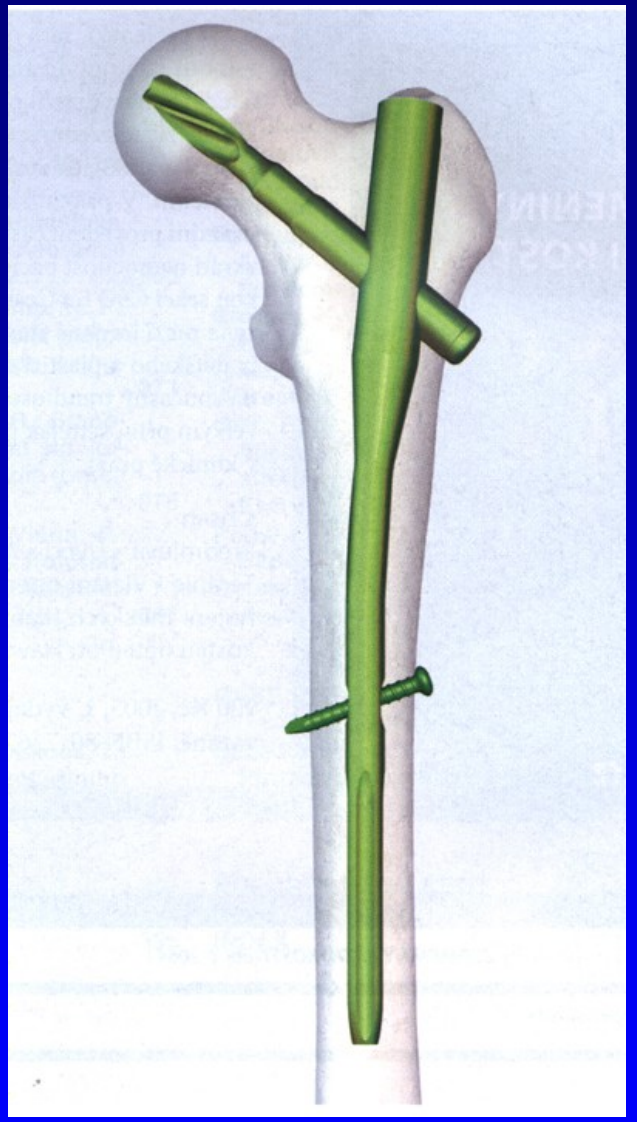
Gamma locking nail



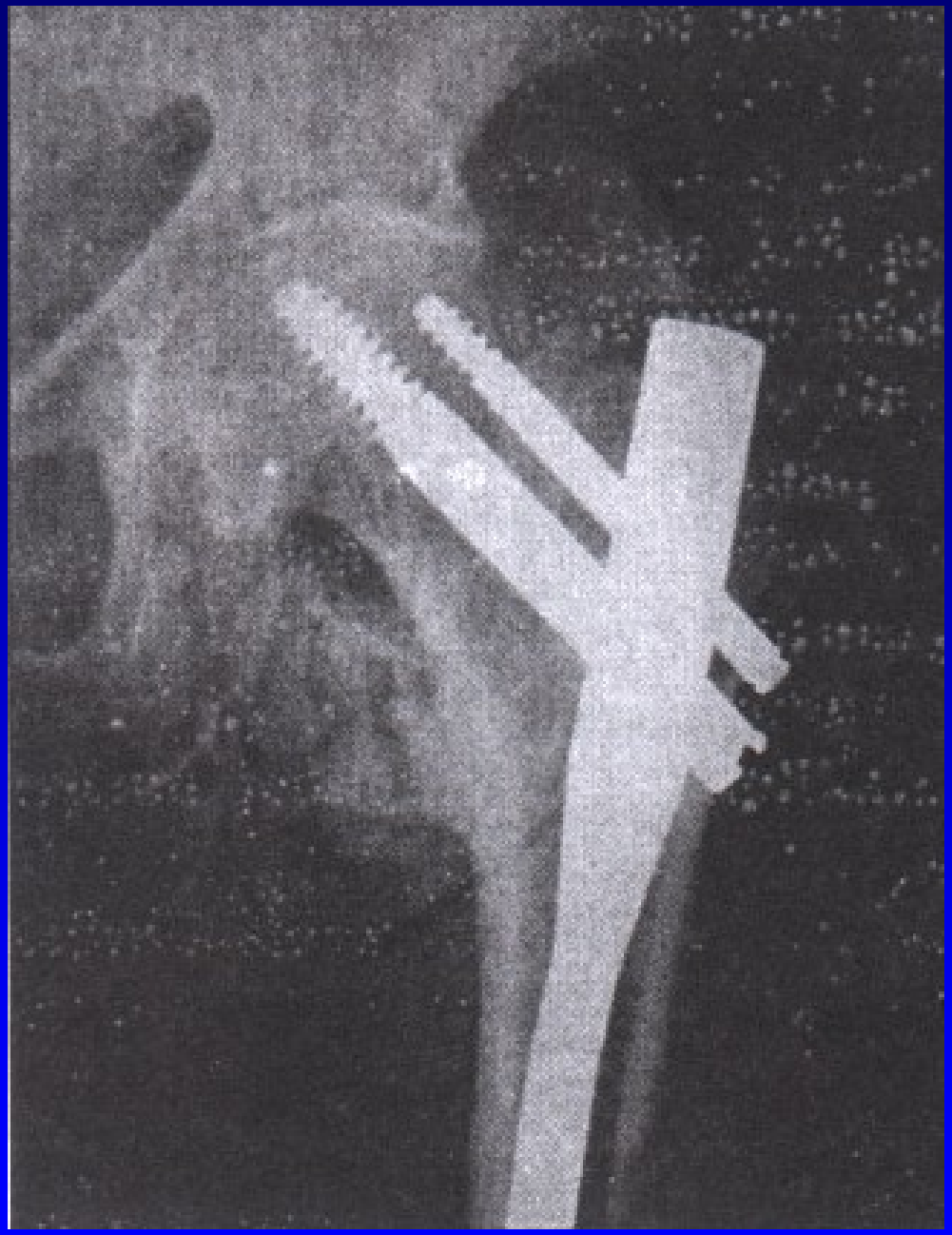
Nail PFNA

Rotation and angle stability

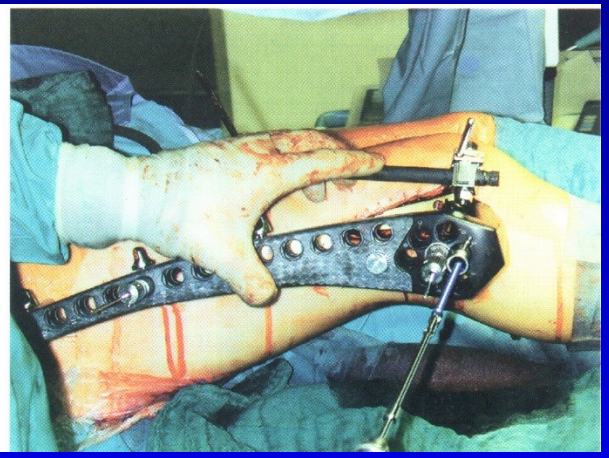
Static and dynamic locking mechanism

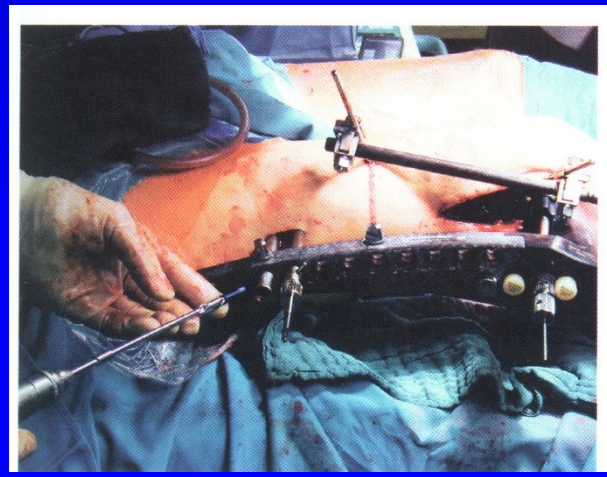


PFNA Synthes

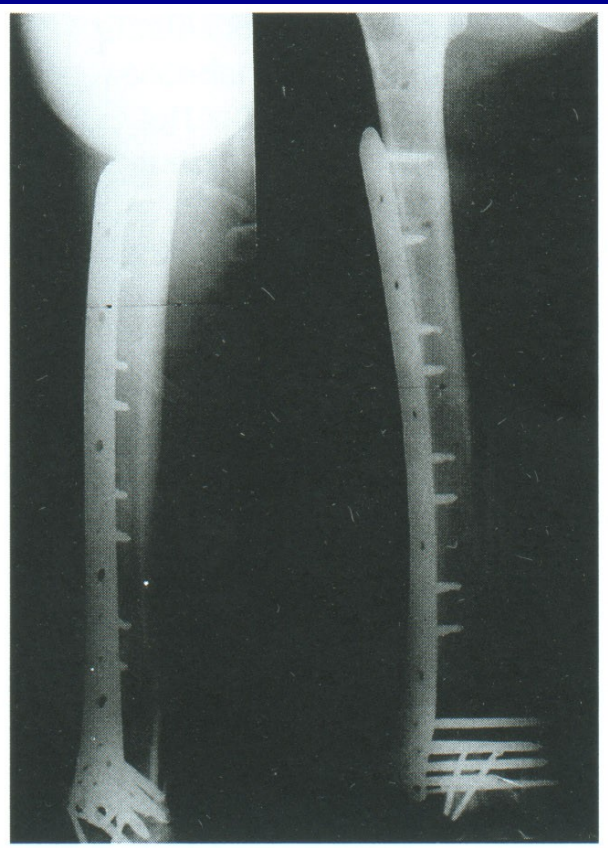


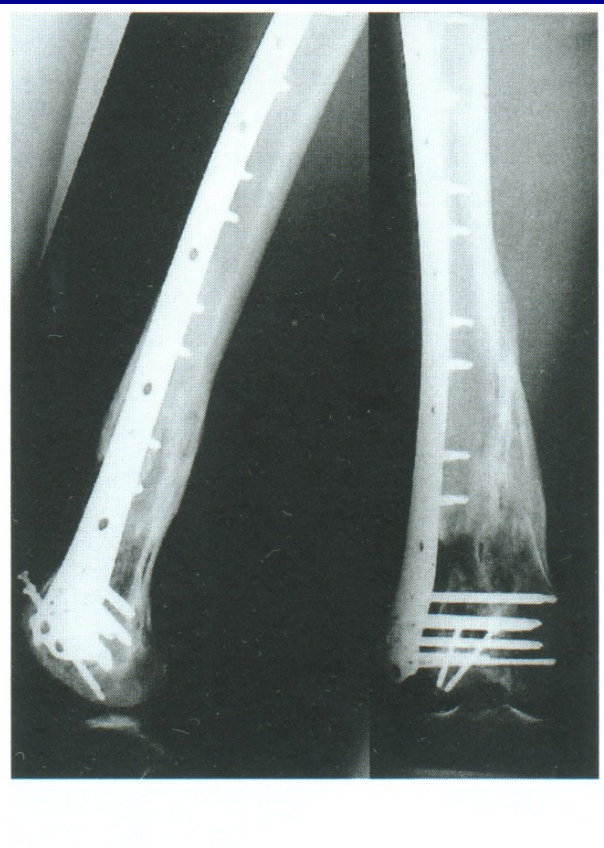
LISS – less invasive stabilisation system





Unicortical plates





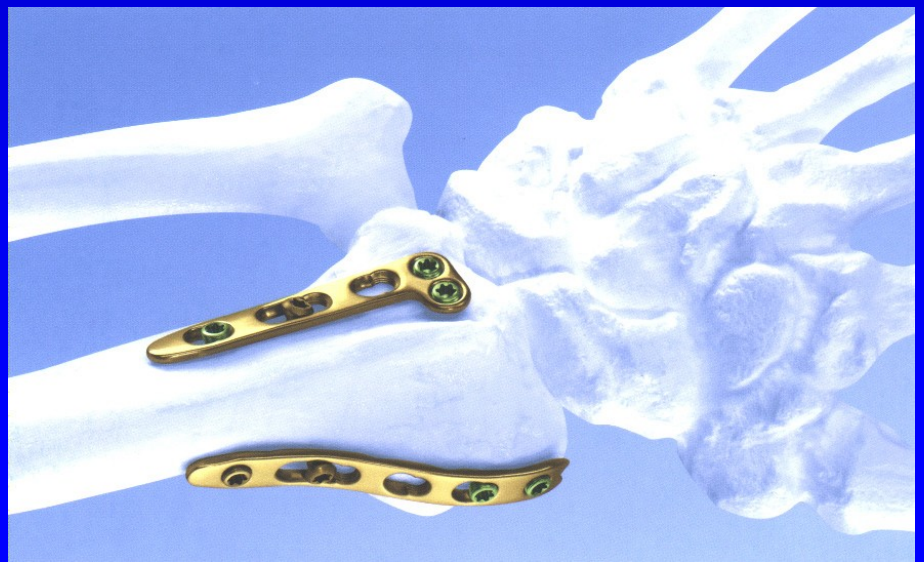
Locking compression plate - LCP

Unicortical fixation – in diaphysis
Bicortical fixation - in epiphysis

Compression screws – oblique direction
Limited contact

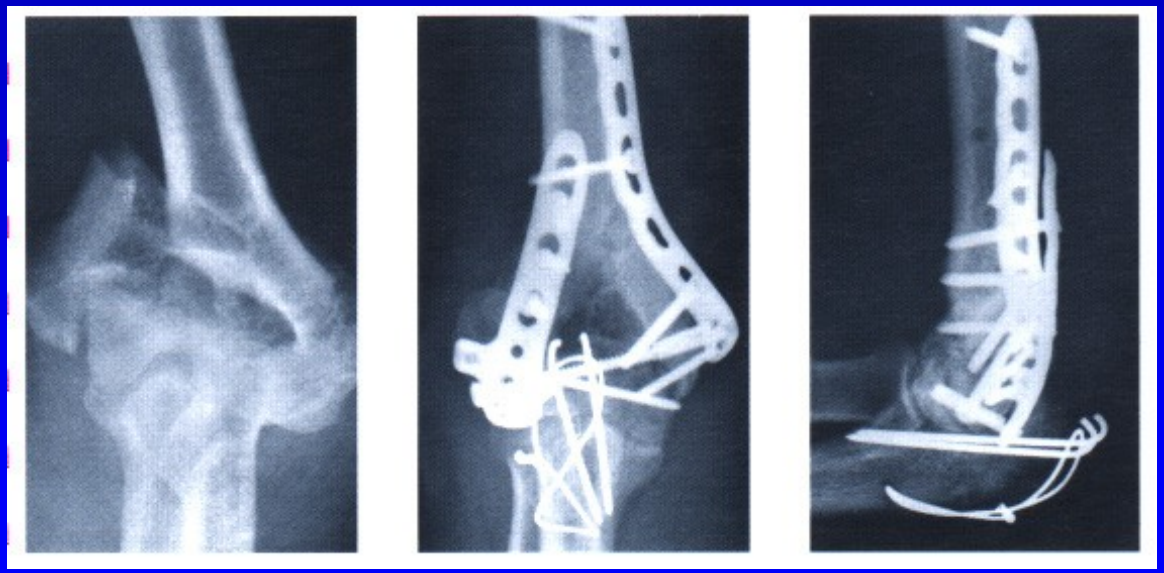
Adjusted to every anatomical region

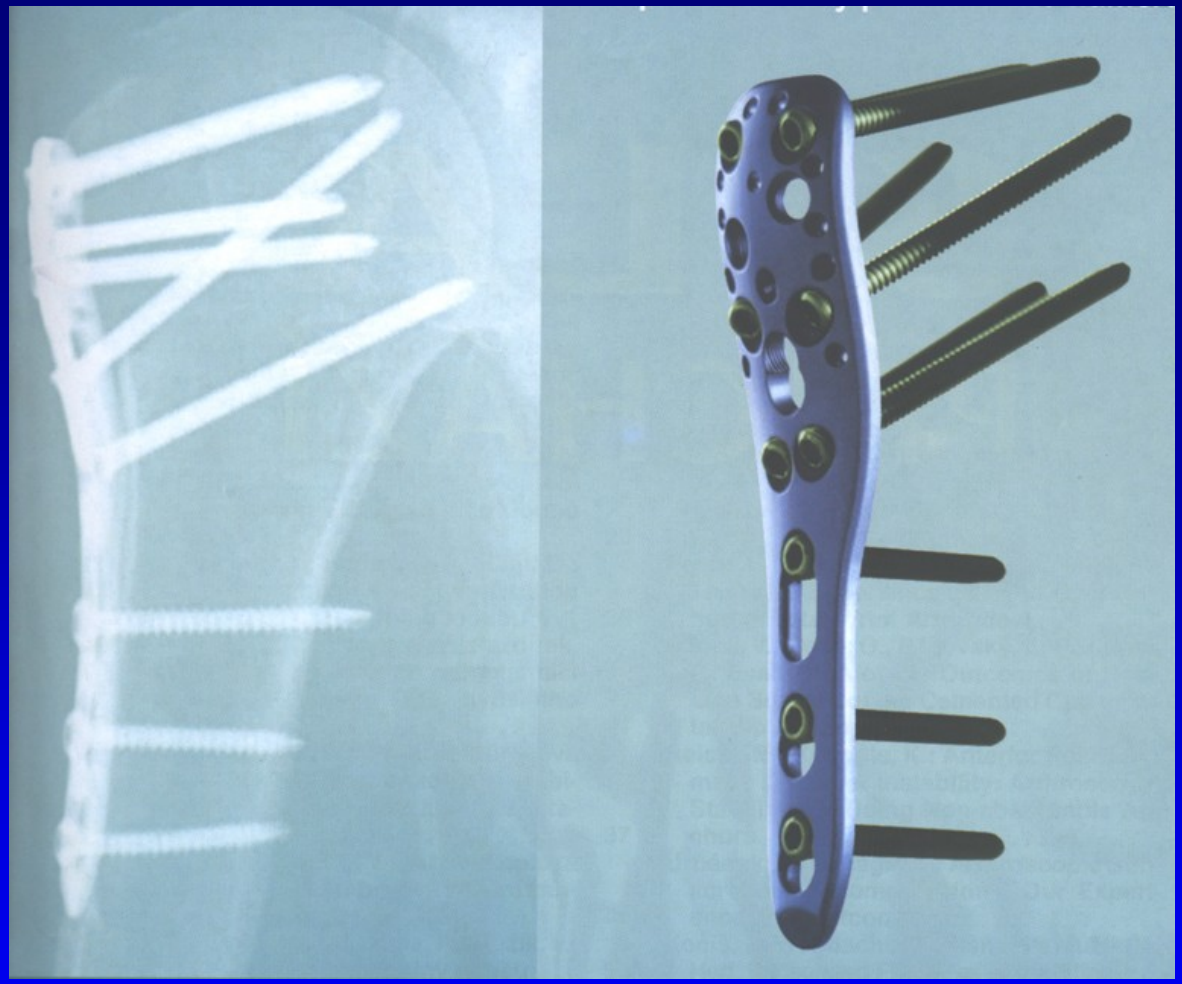
Titanium



Locking compression plate - LCP

In epiphysis bicortical fixation
In diaphysis unicortical fixation



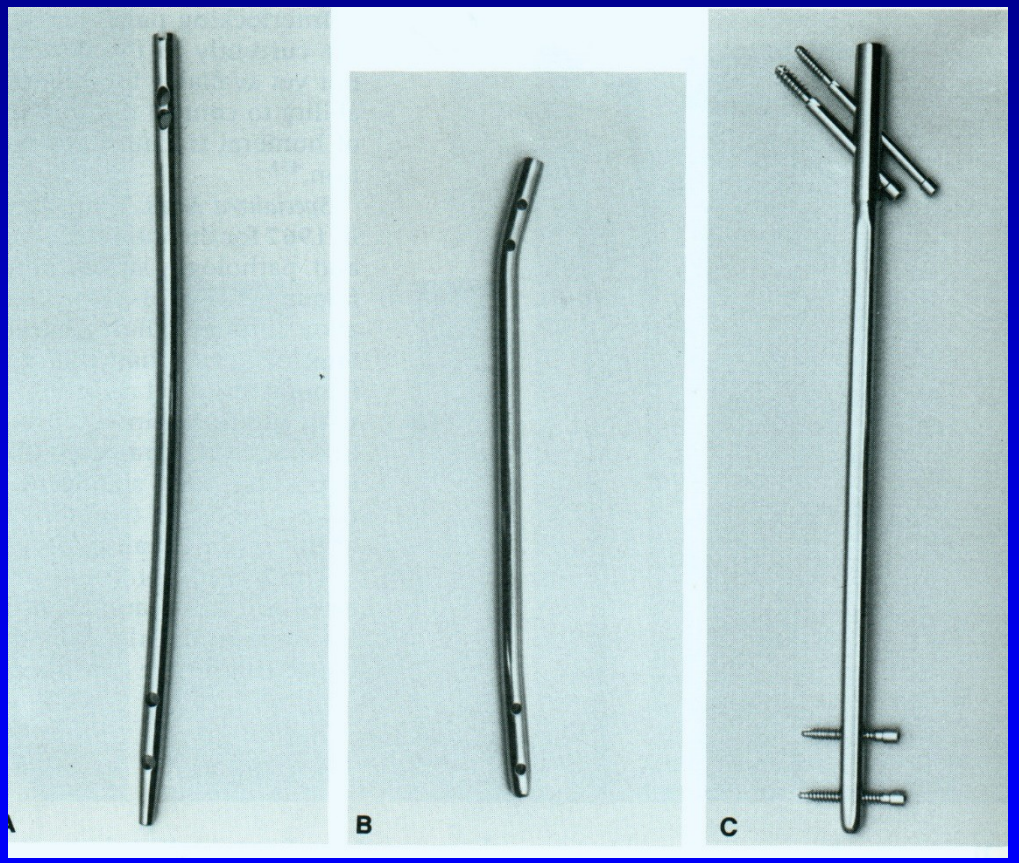


LCP - Philos
Anatomical shape

Locking intramedullary nails

Reamed

Unreamed



Locking intramedullar nails

Reamed:

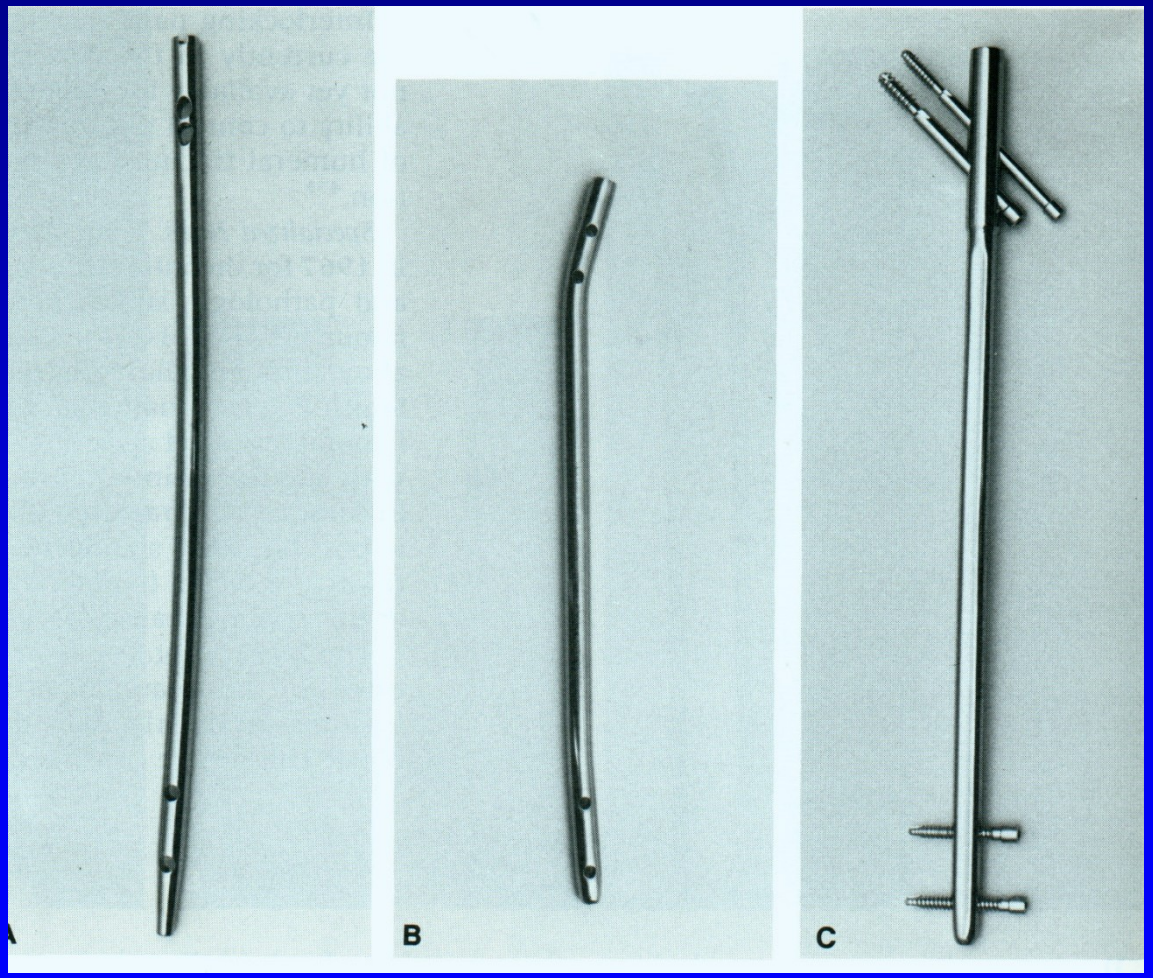
Stronger

Flexible reamers

Hollow

Good stability

Risk of fat embolism
In type fx. A,B



Locking intramedullar nails

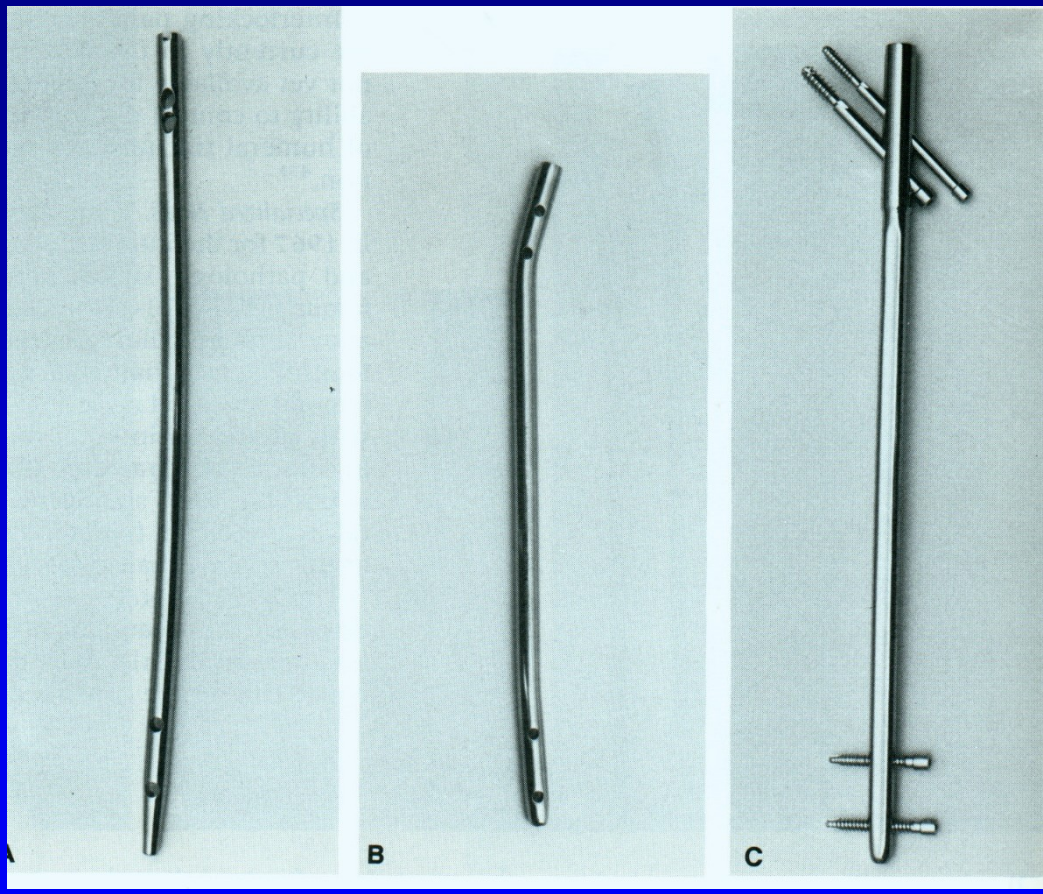
Unreamed:

Solid

Proximal and distal locking

Less stability

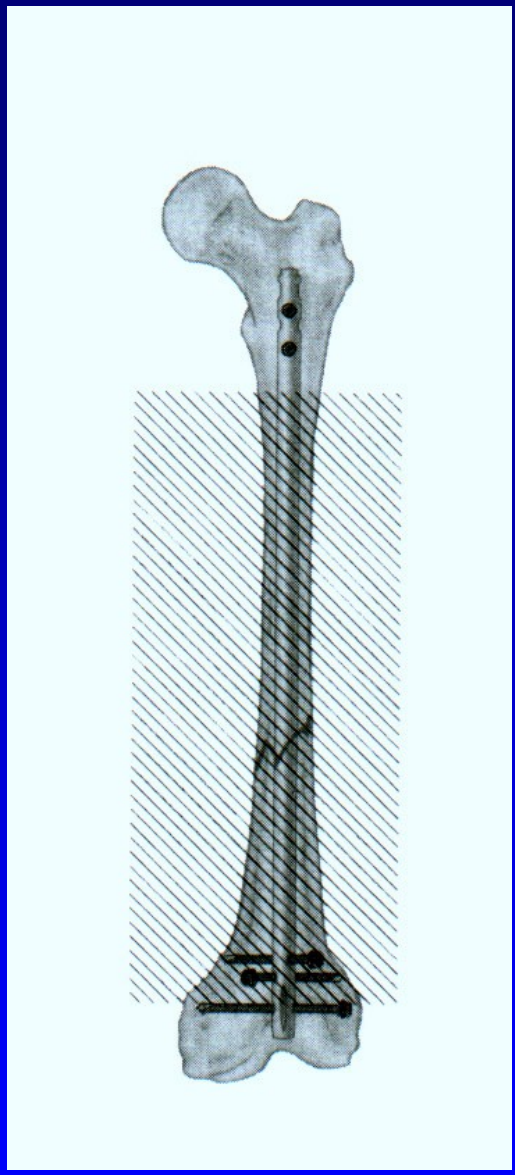
For fx. type C



Intramedullar nail of femur

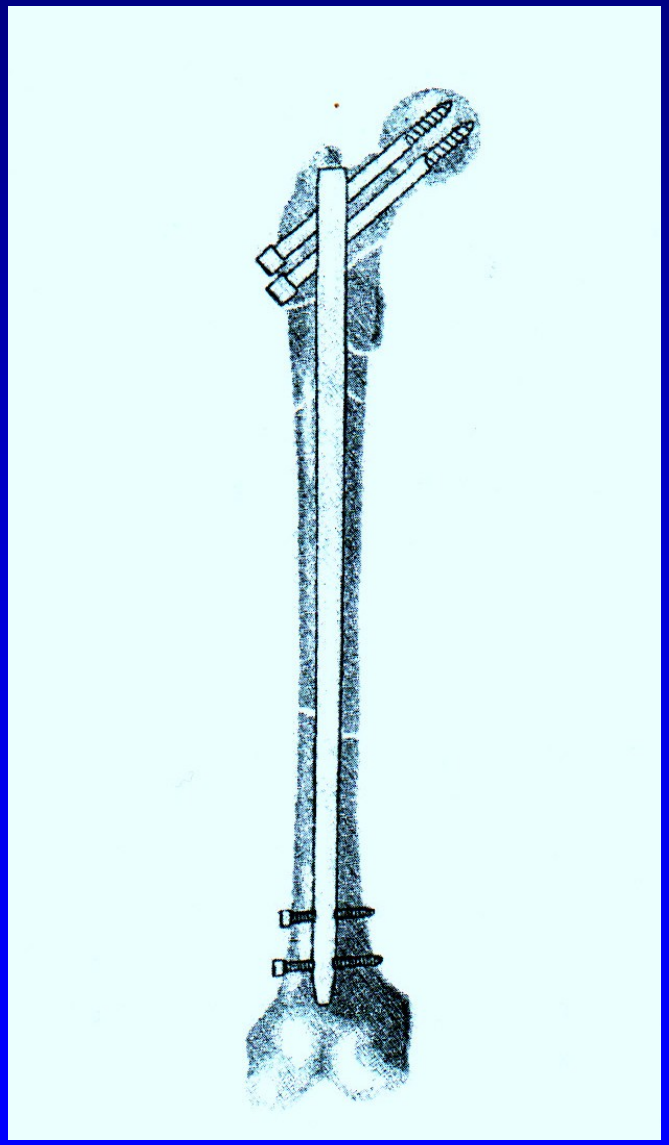
Rotation stability

Static - circle holes
Dynamic - oval holes
with compression of fragments

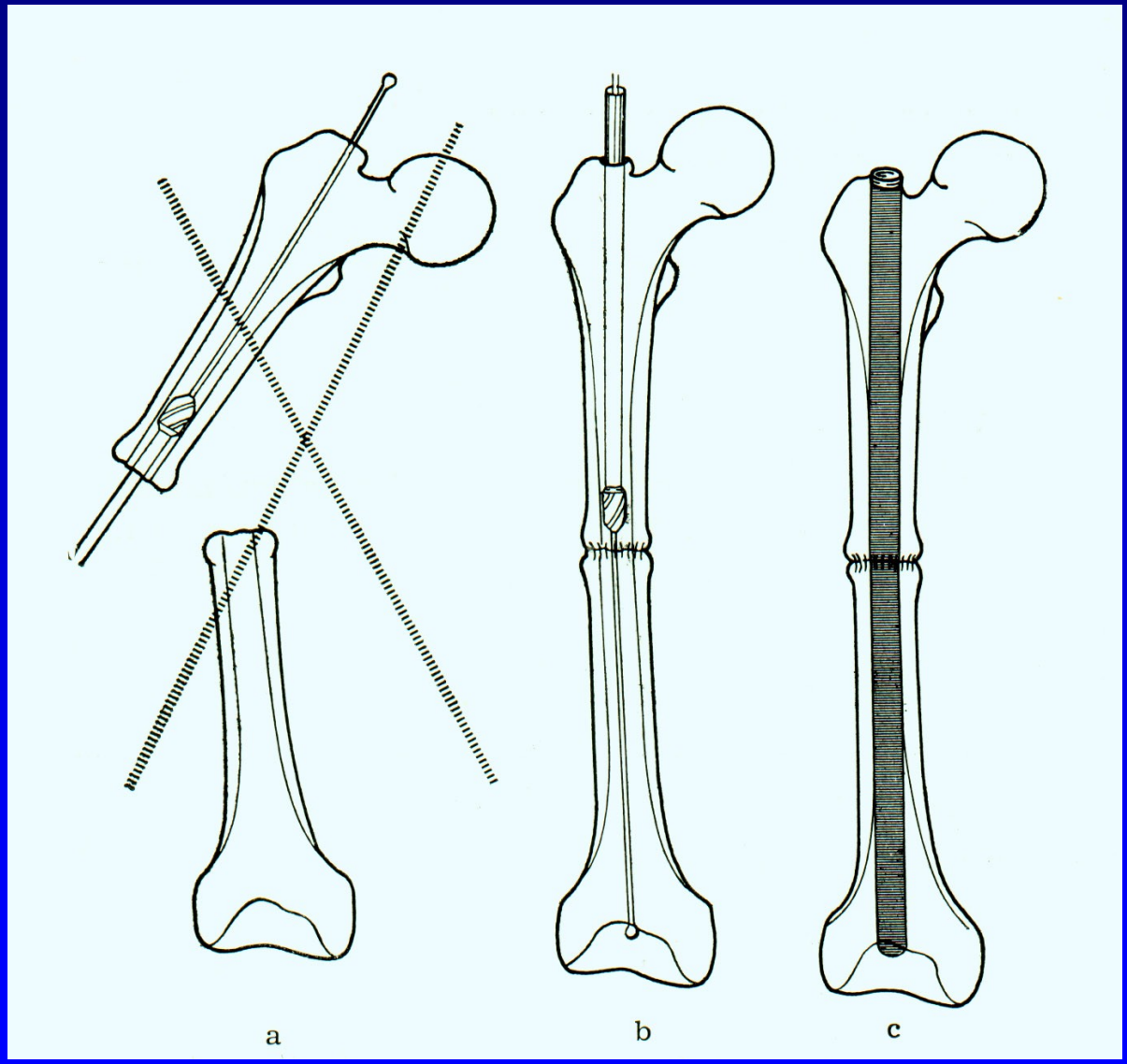


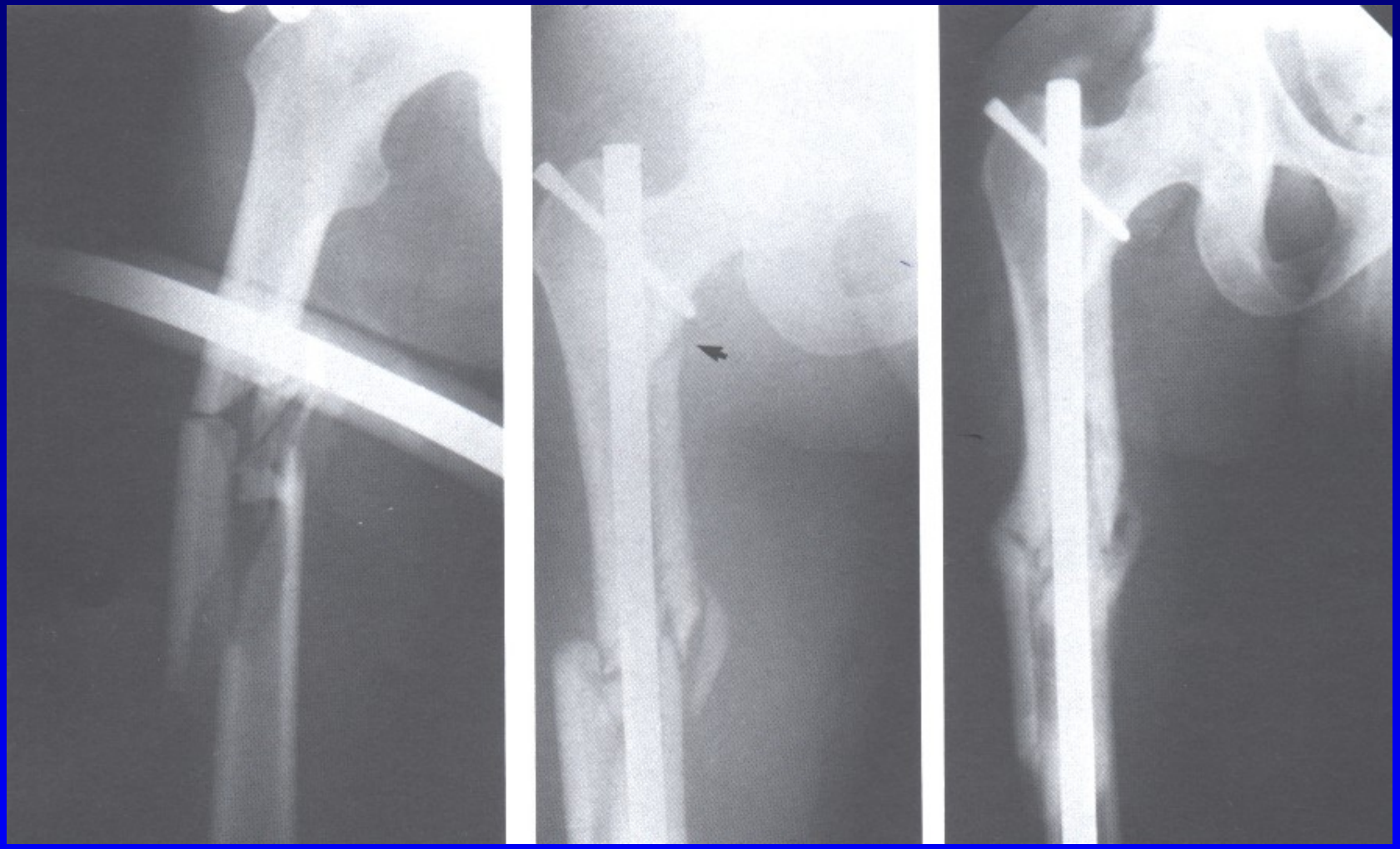
Middle 3/5 of diaphysis

PFN - proximal femoral nail
Reconstructive nails



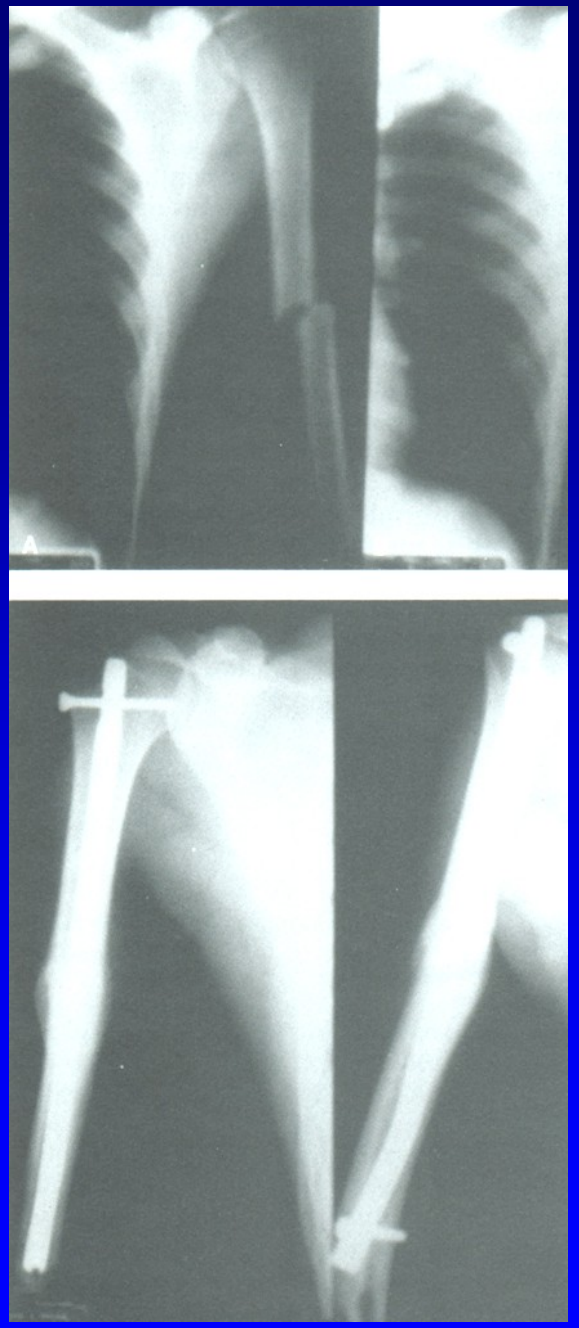
Kűntscher intramedullar nail





Intramedullar nailing of the femur

Locked nail in humerus

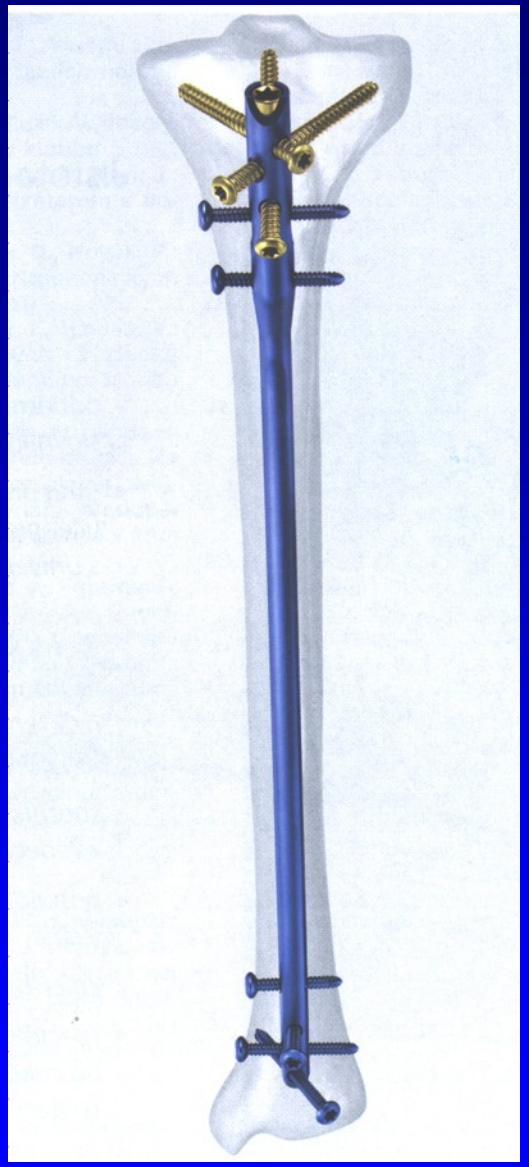


Locked nail in tibia

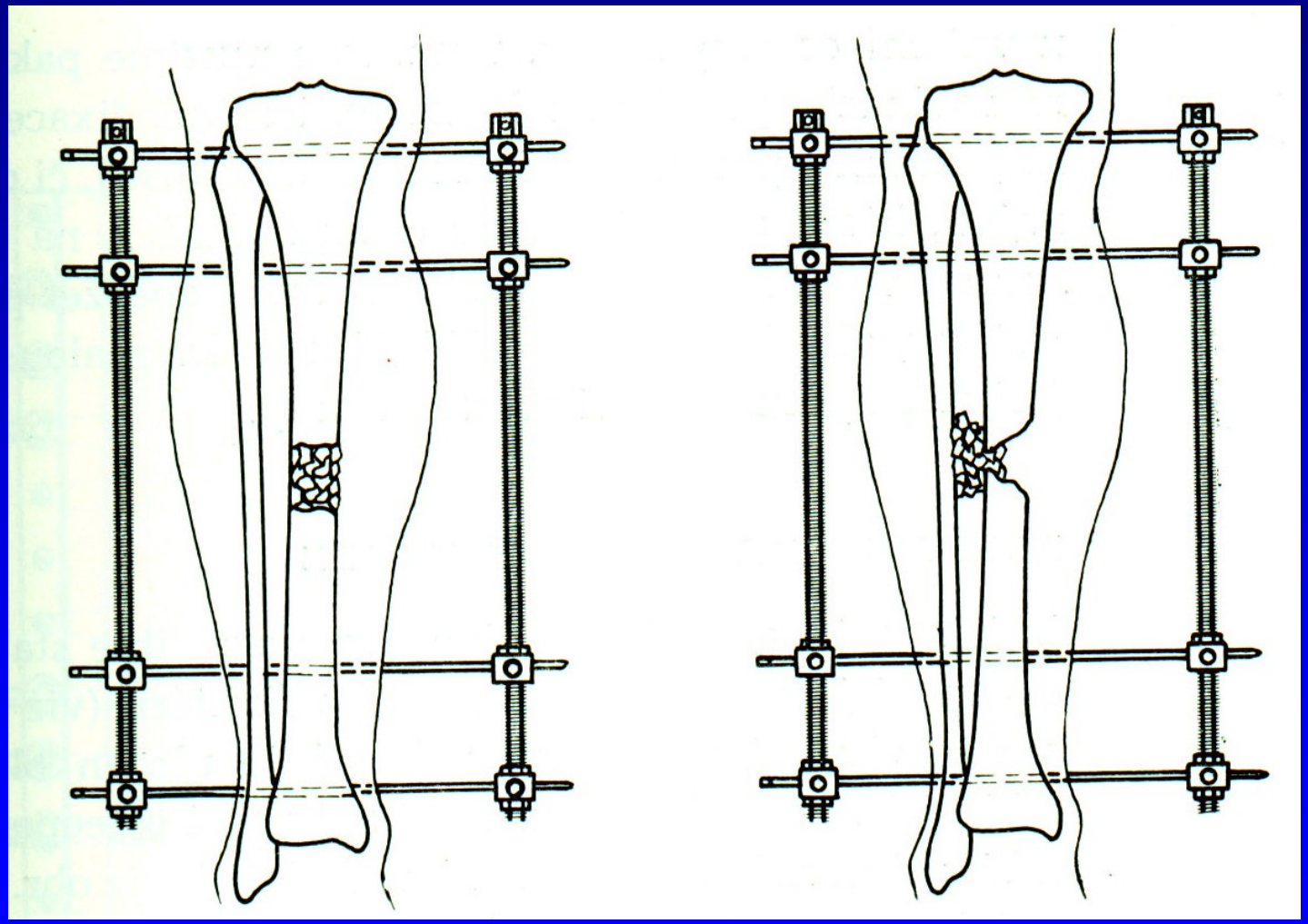
Tibial nail - Synthes

Steel
Titan

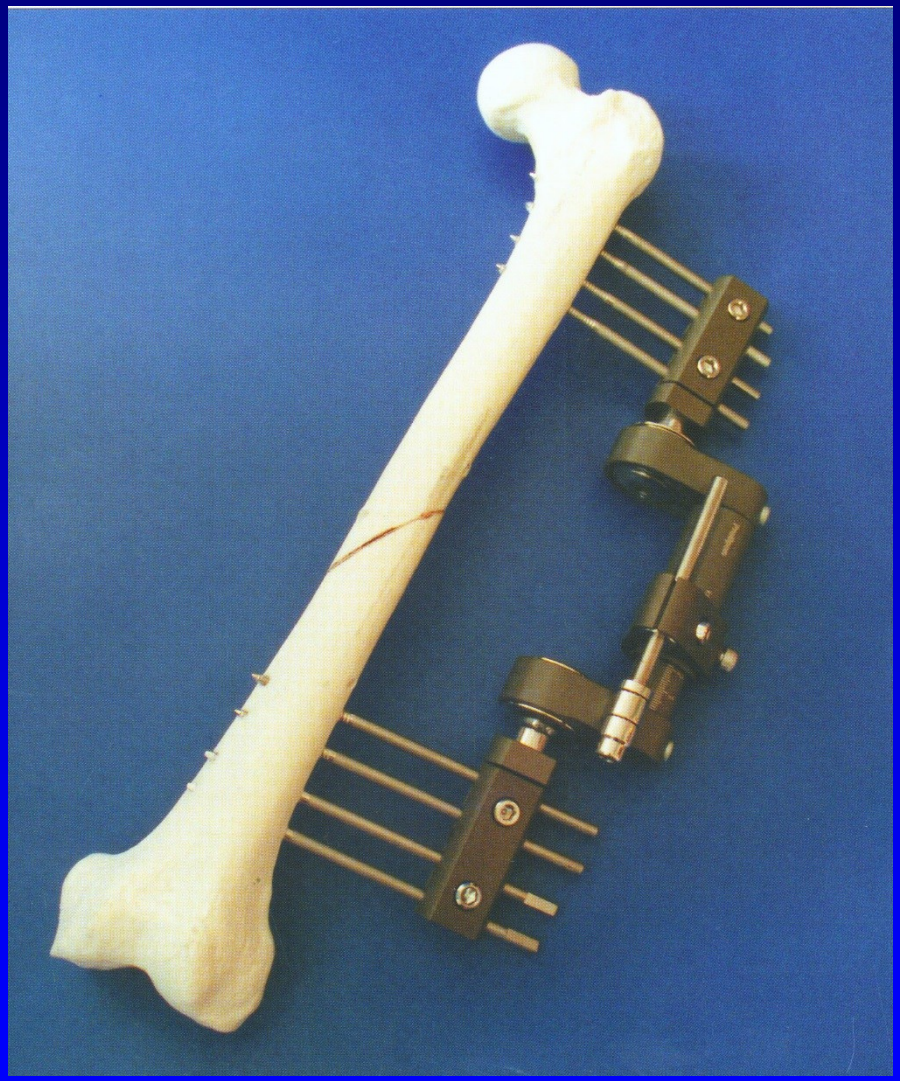
Anatomic curvature

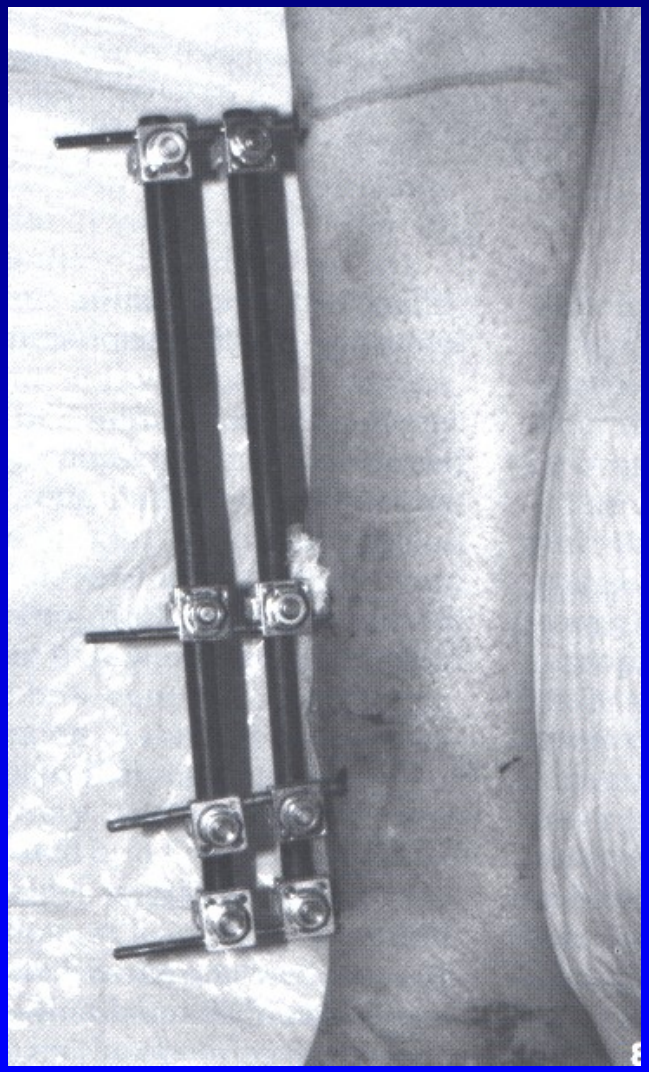


External fixator - frame

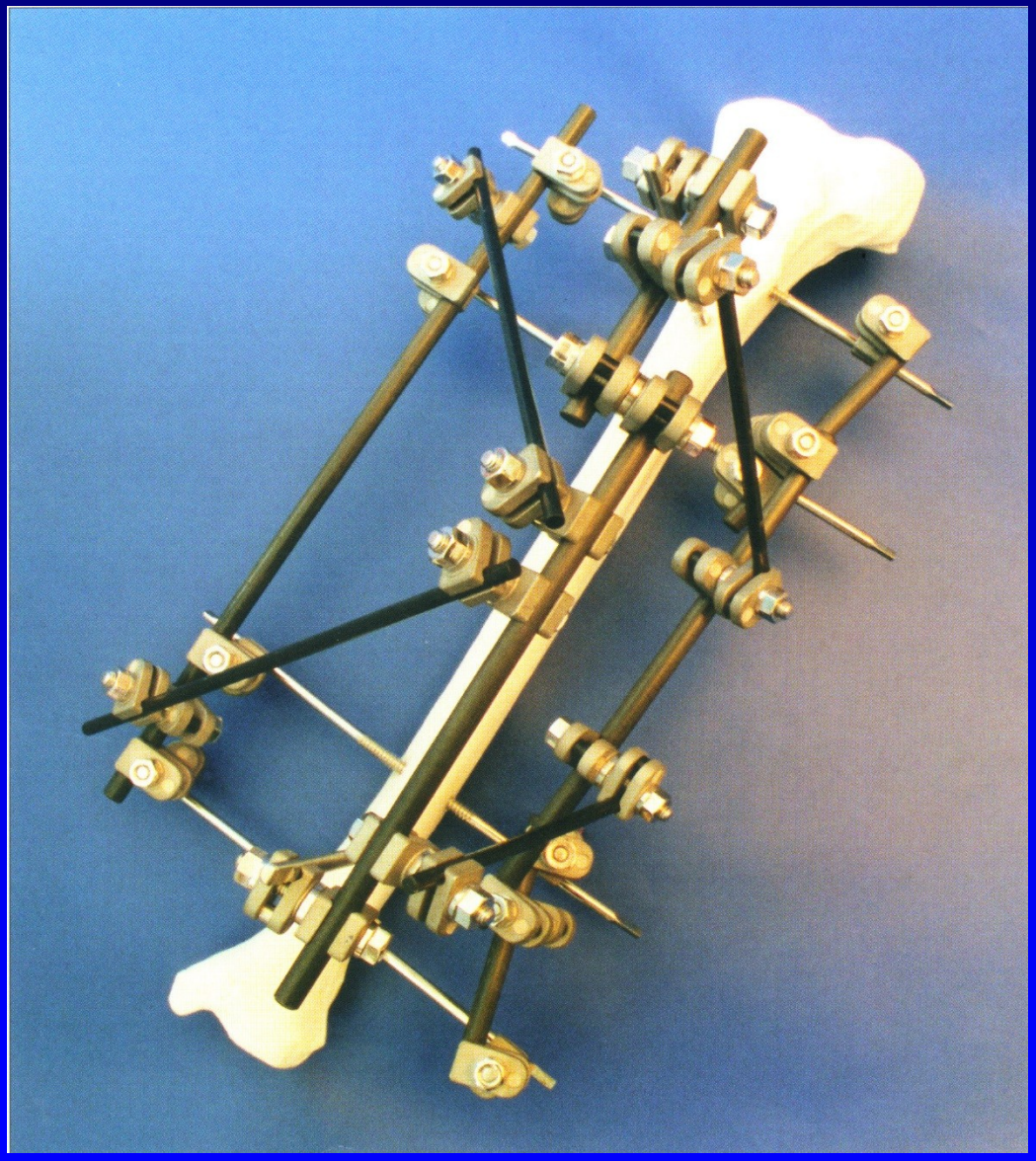


External fixator

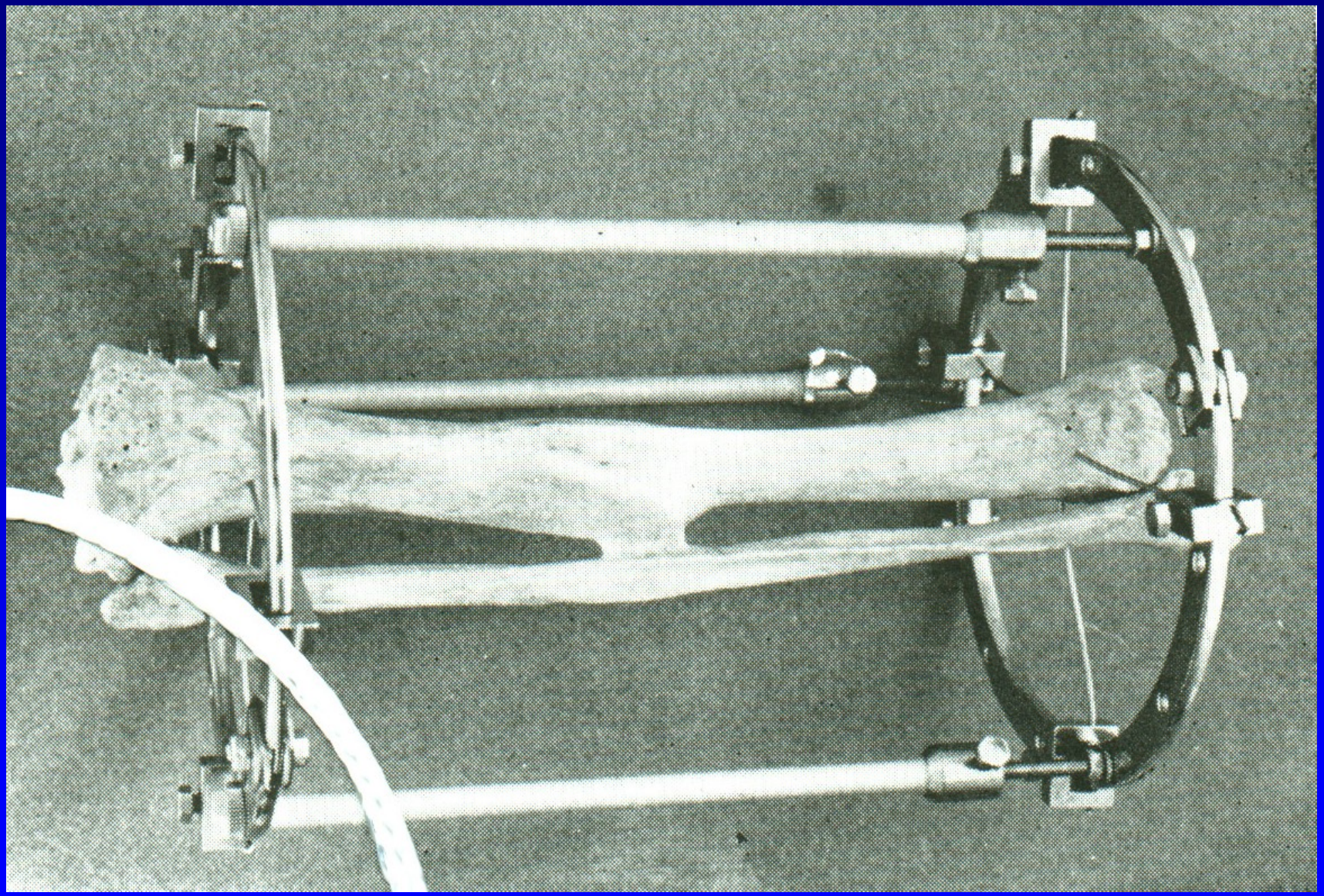




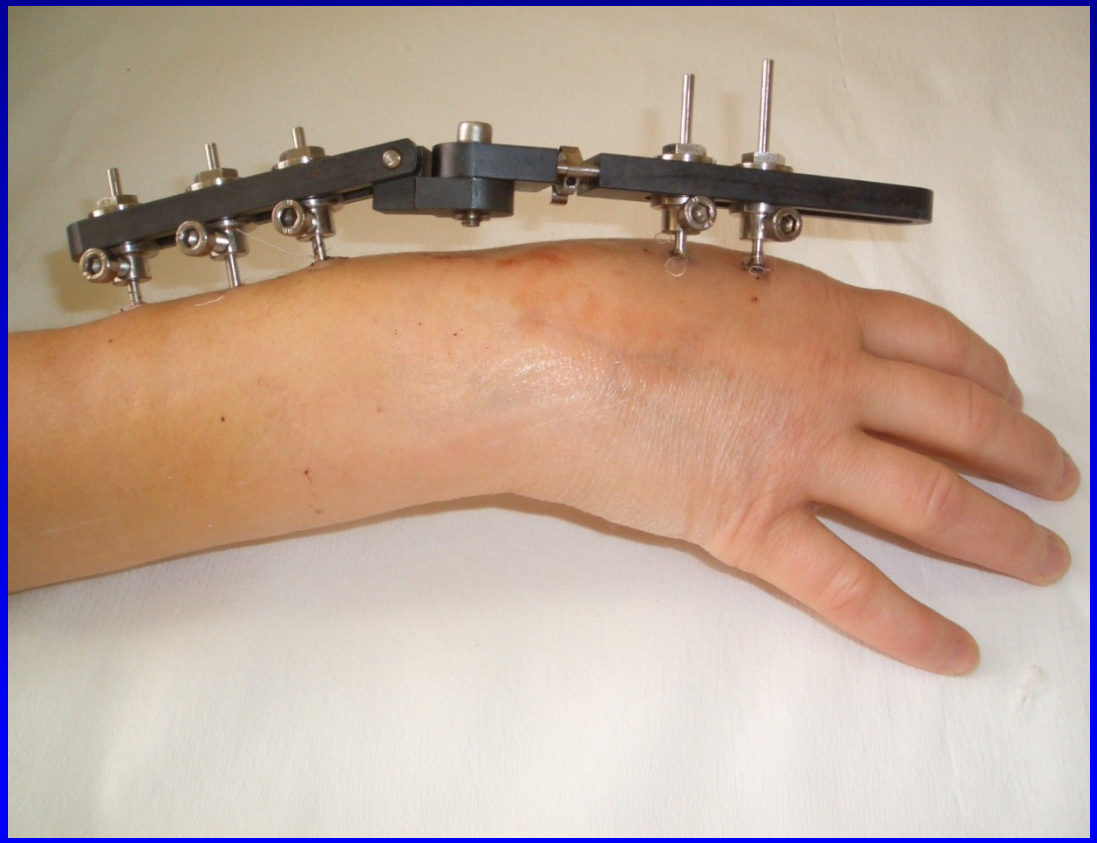
External fixator



External fixator - Ilizarev



External fixator of the wrist

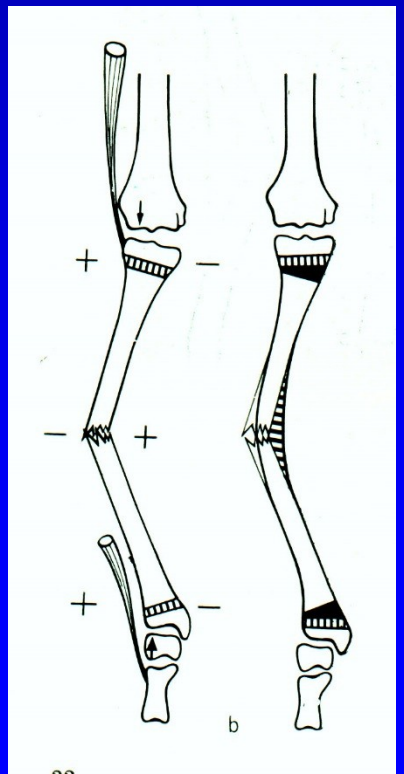


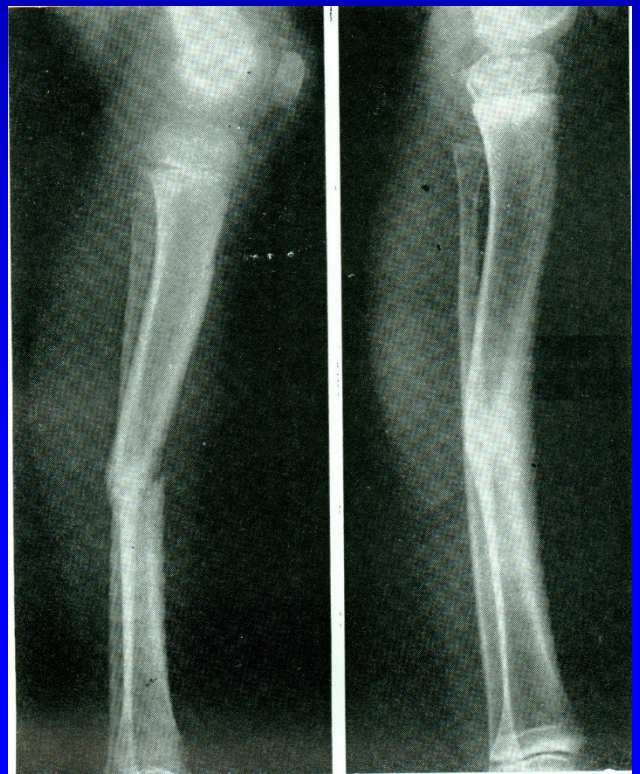
Fractures in children

- Fast healing
- Many fx. healed by conservative methods
- Few complications

Remodelation

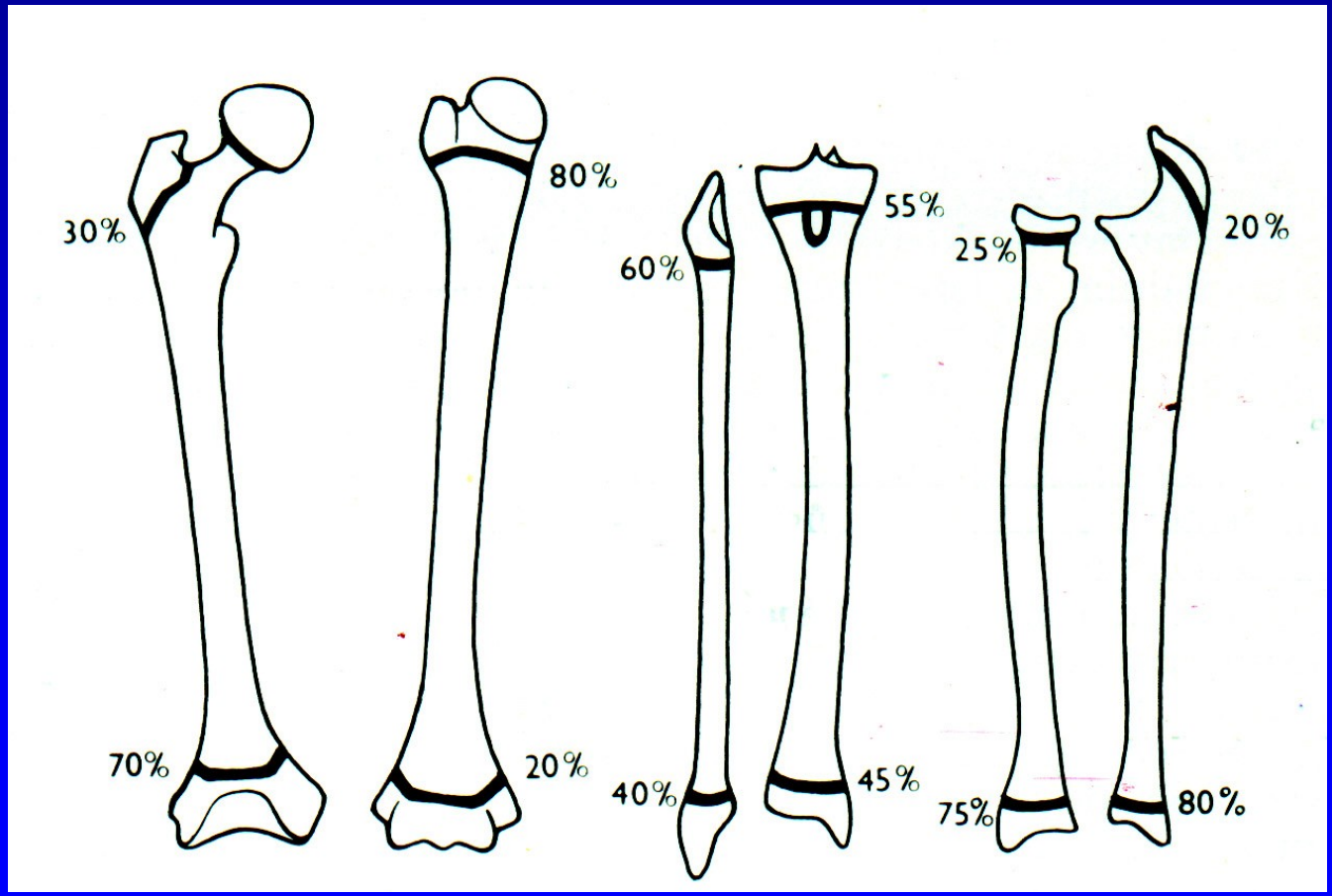
Remodelation (dislocation ad latus, ad axim, in antecurvation or recurvation) can heal properly.
Depends on age and site to growth plate.
Dislocations ad peripheriam should be reduced.





Fractures in children

- growth plate – lengthening of long bones
- damage of growth plate – disturbance of growth



Fractures in children

- Strong periosteum, elasticity of bone (green stick fractures)
- Subperiosteal haematoma.
  Ossifications of haematoma
- Ligaments are elastic
  - epiphyseolysis is common
  - fracture is less common

Epiphyseal injuries - Salter- Harris

- in 15 % of cases

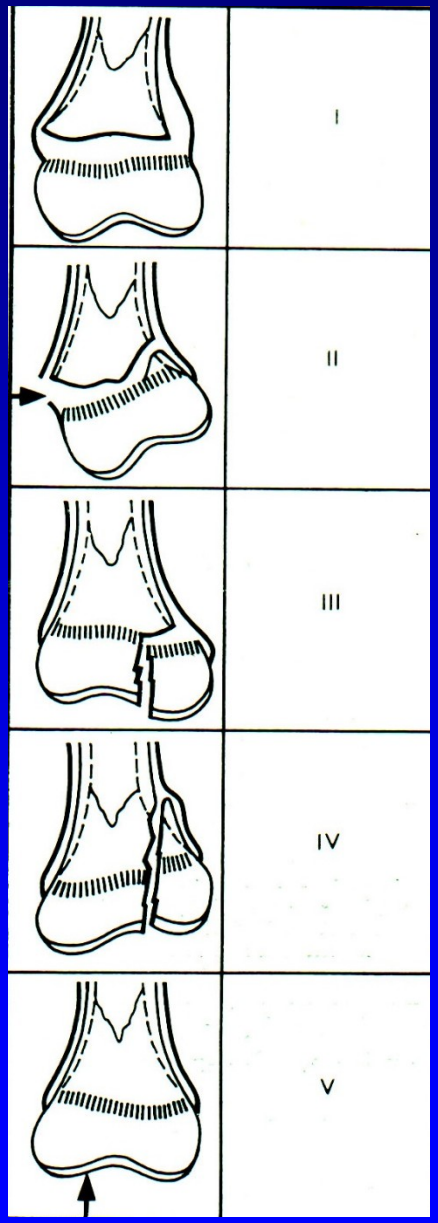
1. Epifyseolysis

2. Fx. of epiphysis- Holland triangle

3. Fx. of epiphysis

4. Fx. epiphyseometaphyseal

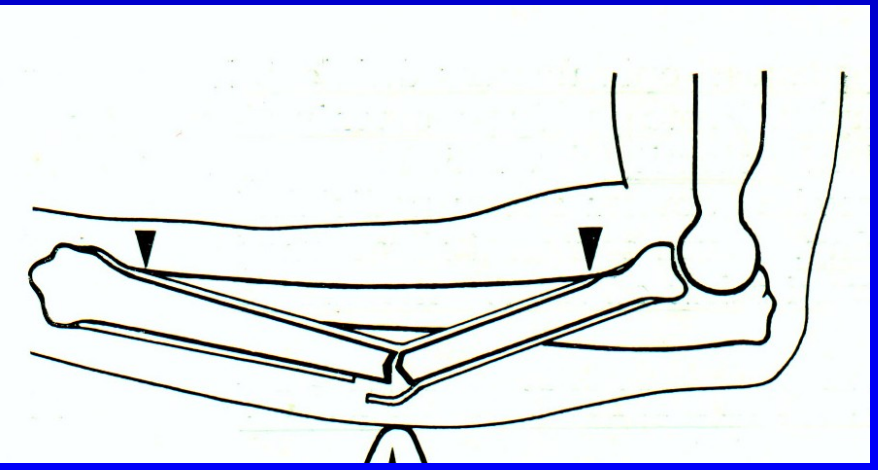
5. Contusion of epiphysis

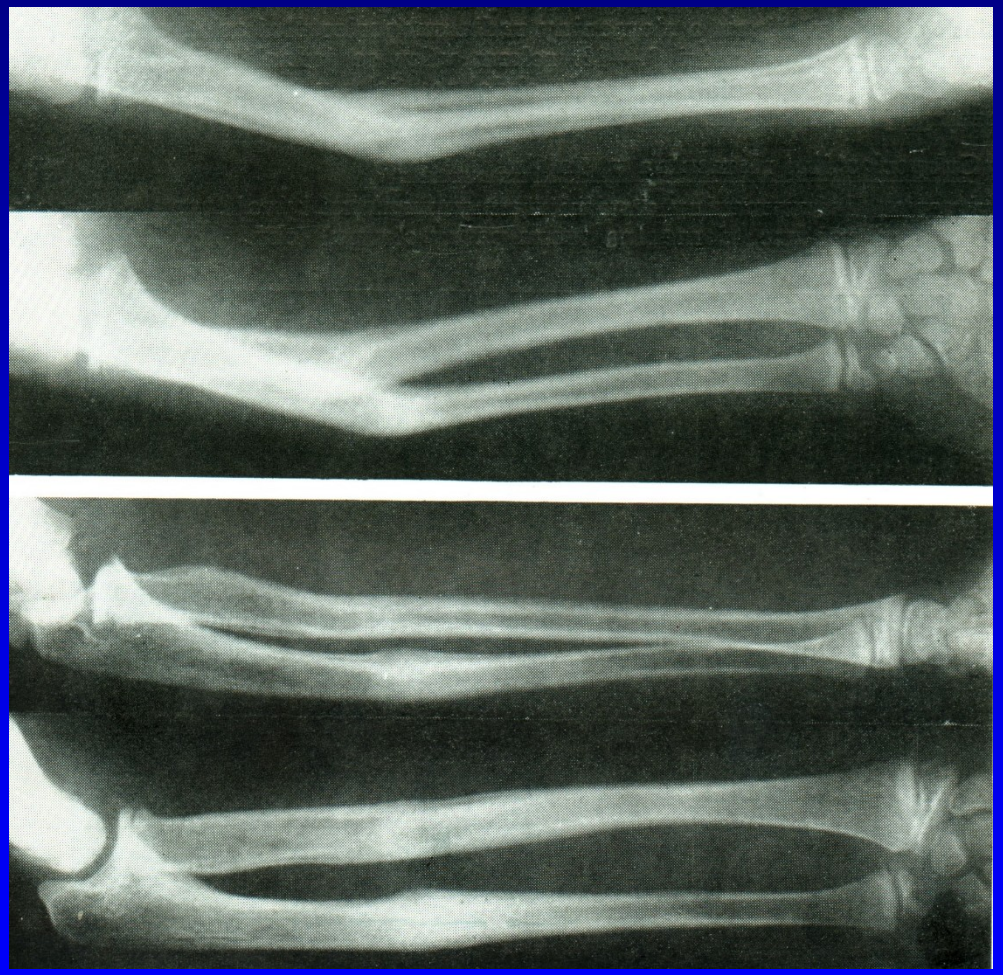


Green stick fractures

Bone is broken
in a periosteal sleeve

Periosteum is not disrupted





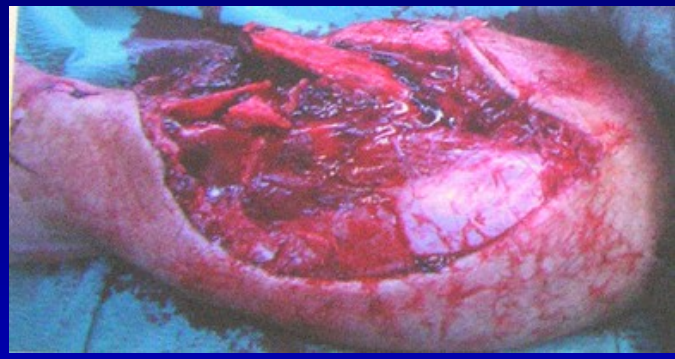
Physiotherapy

- Physiotherapy in chidren is easier than in adults

Componed (open) fractures

Damage of skin
Damage of soft tissues
Bacterial contamination

Classification of Gustilo and Anderson



1 stage – puncture of skin from bone fragment
low energy trauma

2 stage – open fracture without defect of skin and
soft tissue

3 stage – wound with defect of skin and soft
tissue, high energy trauma

Tscherne clasification

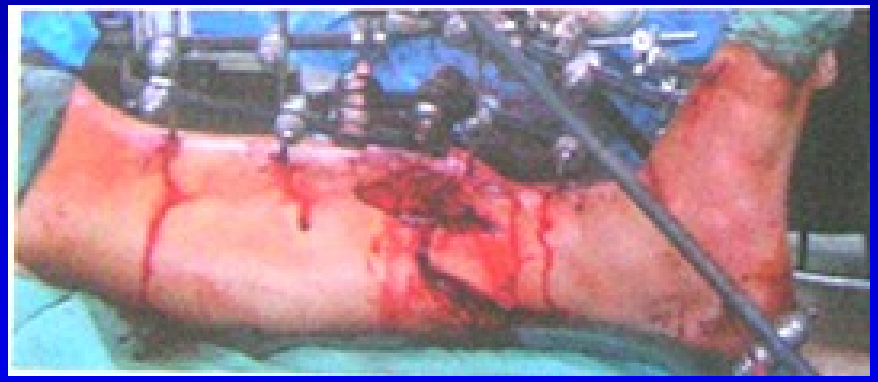
Closed fr.
G0 no damage to soft tissues
GI superficial excoriations
GII deep excoriations
GIII contusion of the skin, decollement, damage of muscles

Open fr.
OI puncture wound from bone fragment, small wound
OII wound without loss of skin
OIII large wound with loss of skin
OIV subtotal amputation

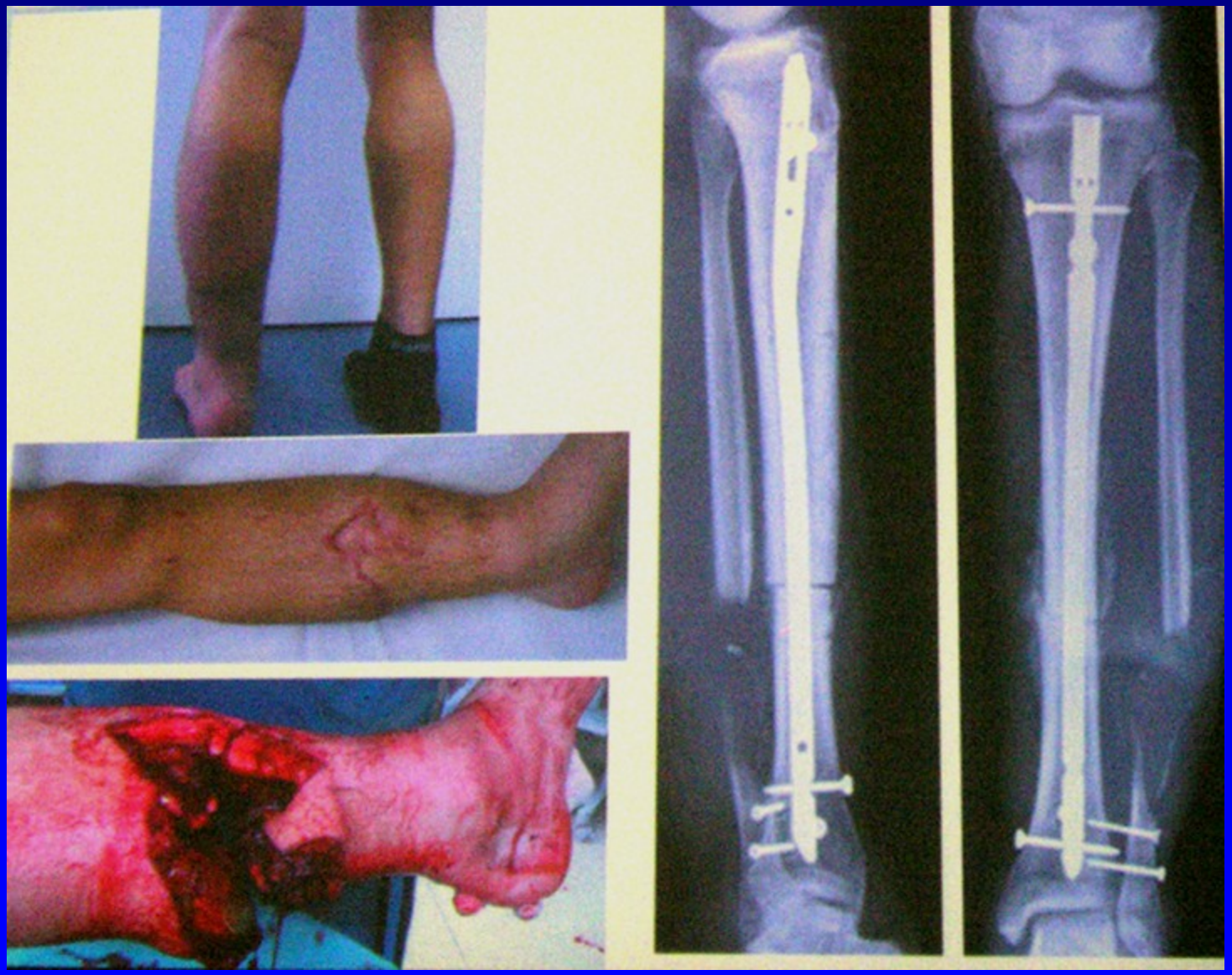
Management

- Surgery as soon as possible
- 1. Cleaning of skin
- 2. Debridement of wound (removal of foreign bodies, excision od dead parts, lavage
- 3. Open reduction, stabilisation with external fixator, suction drainage, suture of skin without tension

Management



Conversion to the intramedullary nail



Management

- Musculocutaneous flap
- Antibiotics
- Tetanus prevention
- Antigangrenous serum
- Prevention of phlebotrombosis

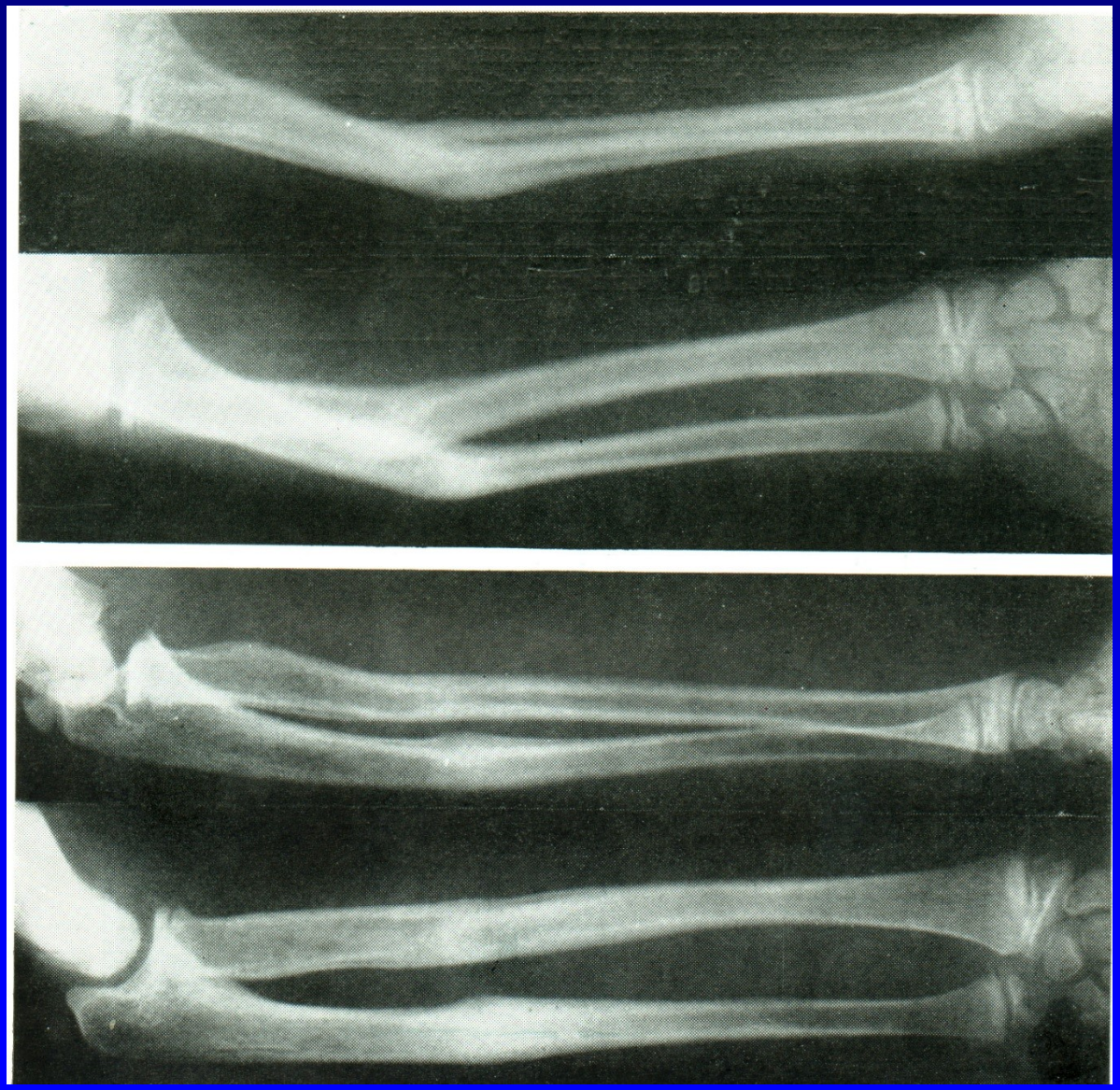
Disturbance of fracture healing

- Malunion- fractura male sanata
- Hypertrophic callus
- Delayed union
- Avascular necrosis of epiphysis
- Nonunion: aseptic, septic
  vital, nonvital
- Refracture

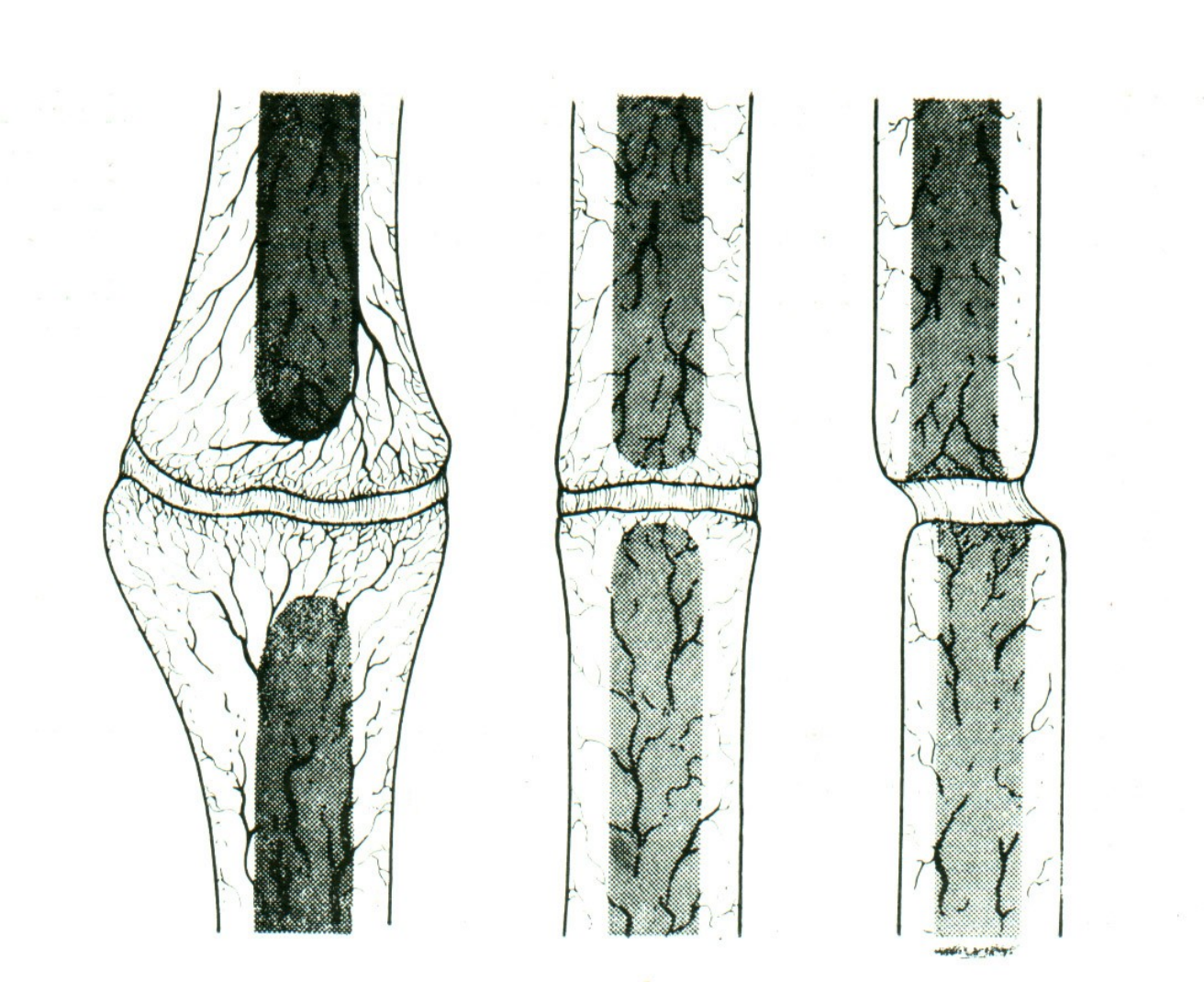
Consequences of fractures

Growth arrest
Shortening of bone
Paraarticular ossifications
Osteoarthrosis
Limites movements in joint

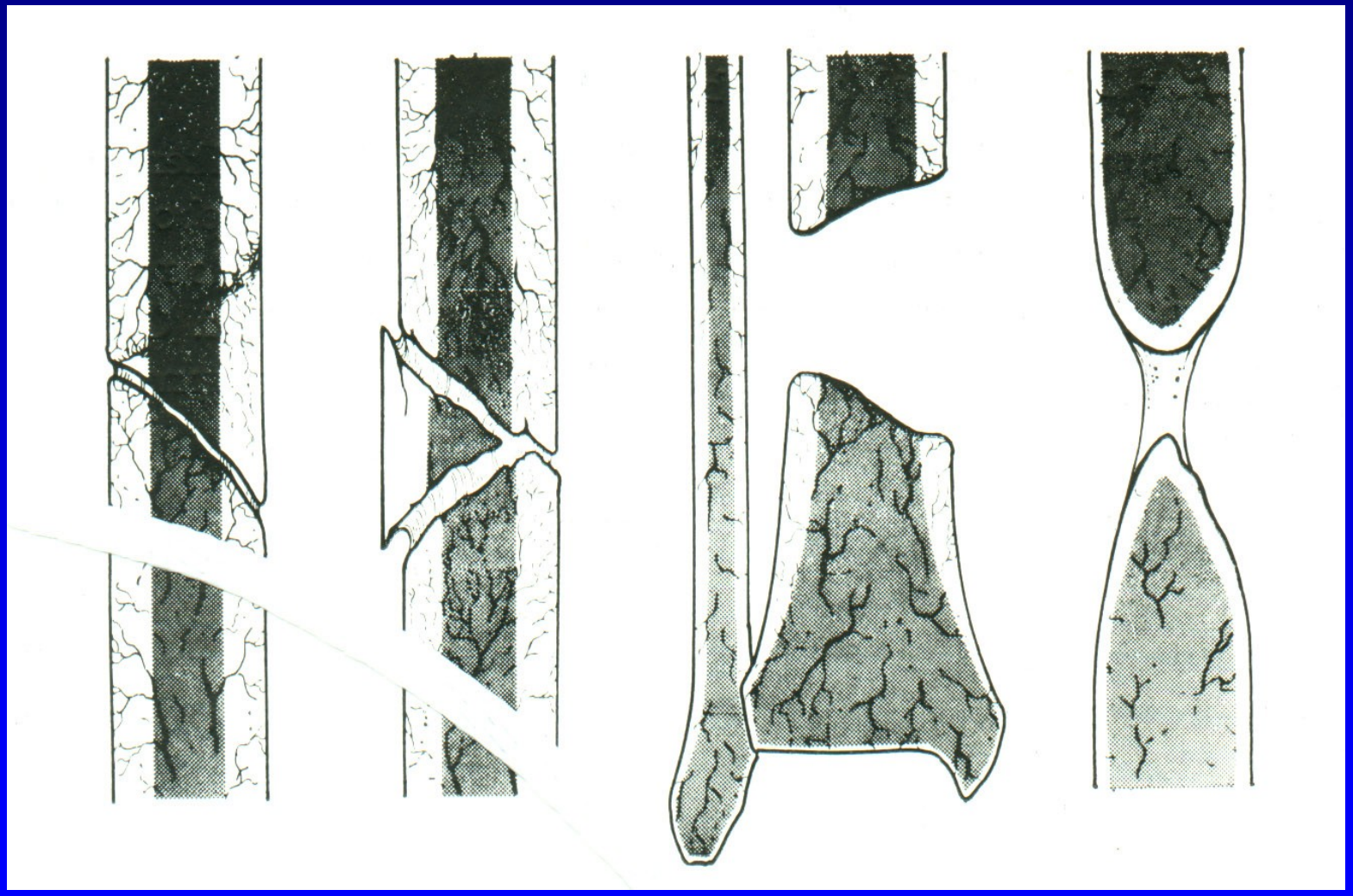
Malunion



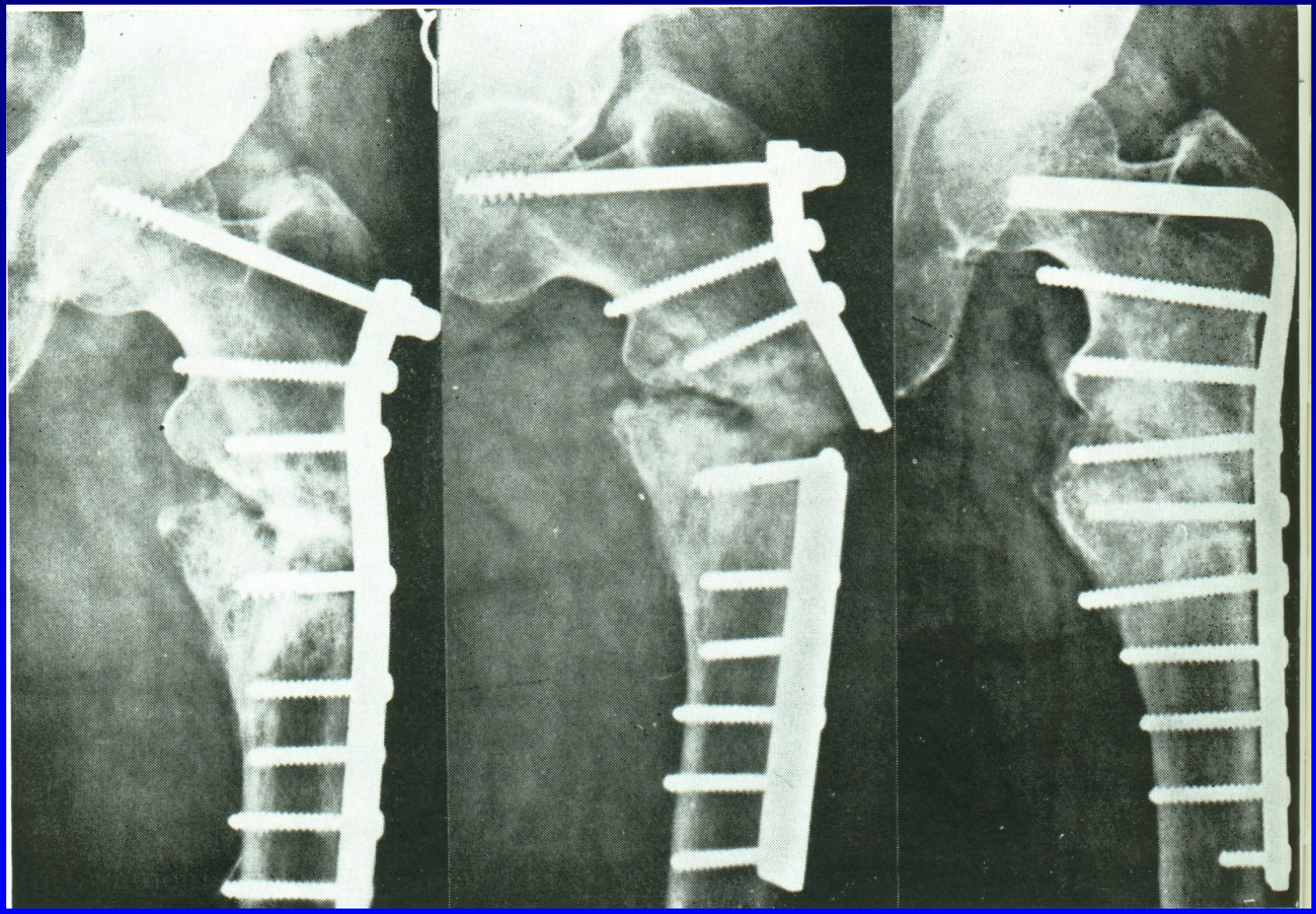
Vital nonunion



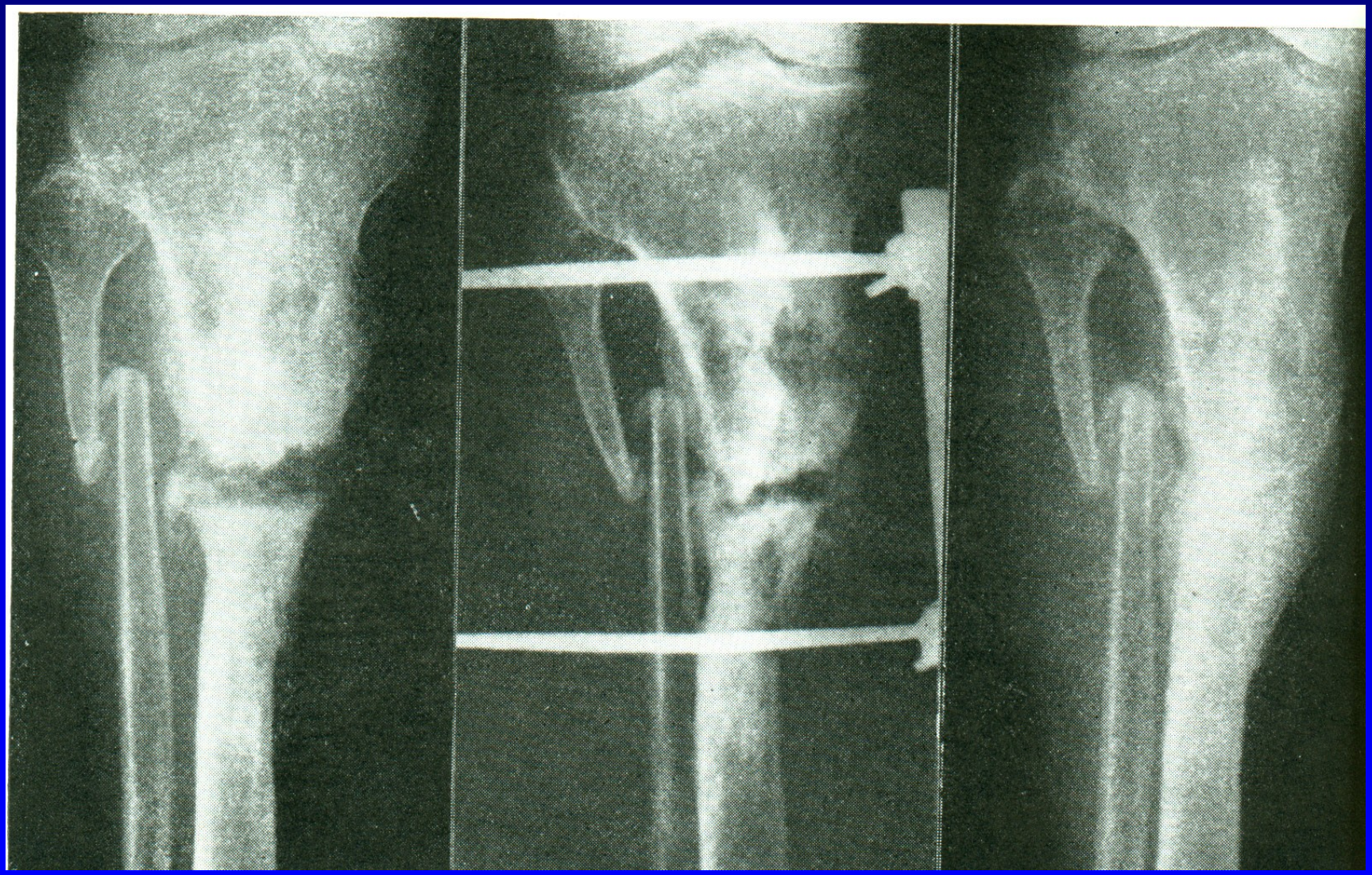
Avascular nonunions



Pseudoarthrosis of the femur



Pseudoarthrosis of the tibia



Complications of fractures - local

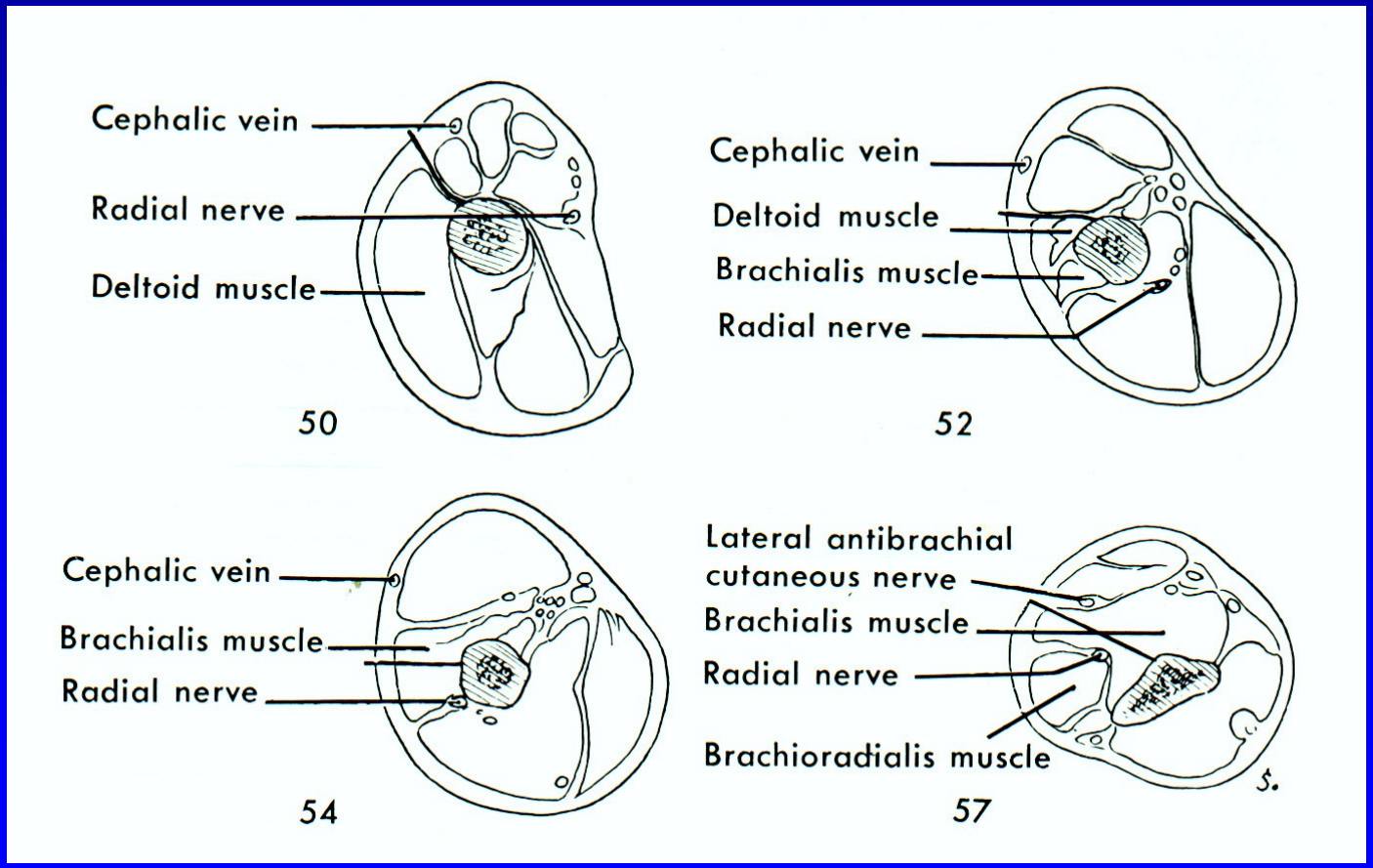
- Soft tissue damage:

  vessels, peripheral nerves, muscles, surrounding tissues
- Infection
- Compartment syndrom
- Algoneurodystrophy

Compartment syndrom- CS

Physiogical pressure in tissue: 0 - 6 mm Hg

Patholocal pressure in CS -tissue : 30- 40 mm Hg



Compartment syndrom

Hematoma
Swelling
Tight bandage ,tight plaster of Paris
Severe contusion
Tight suture of fascia

Compartment syndrom

Pain
Pallor
Paresthesia
Paralysis
pulselessness

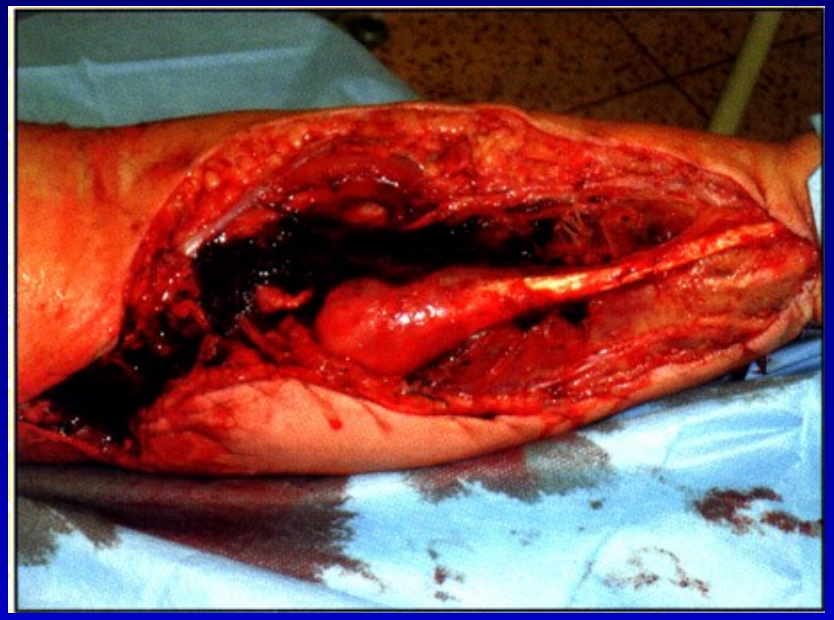
Normal preasure 3-10 mm Hg
Above 30 mm slow doen od circulatio
Piesoelectric sensor
Indication for fasciotomy mpre than 30-45 mm Hg

Symptoms

- Pain – intensive and growing
- Swelling- increasing
- Cold periphery, cyanosis
- Parestesia, hyperestesi, numbness of toes
- Diminished motor function (from ischemia)
- Diminished puls in periphery

Management of CS

Urgent fasciotomy



Obr. 5

Obr. 9

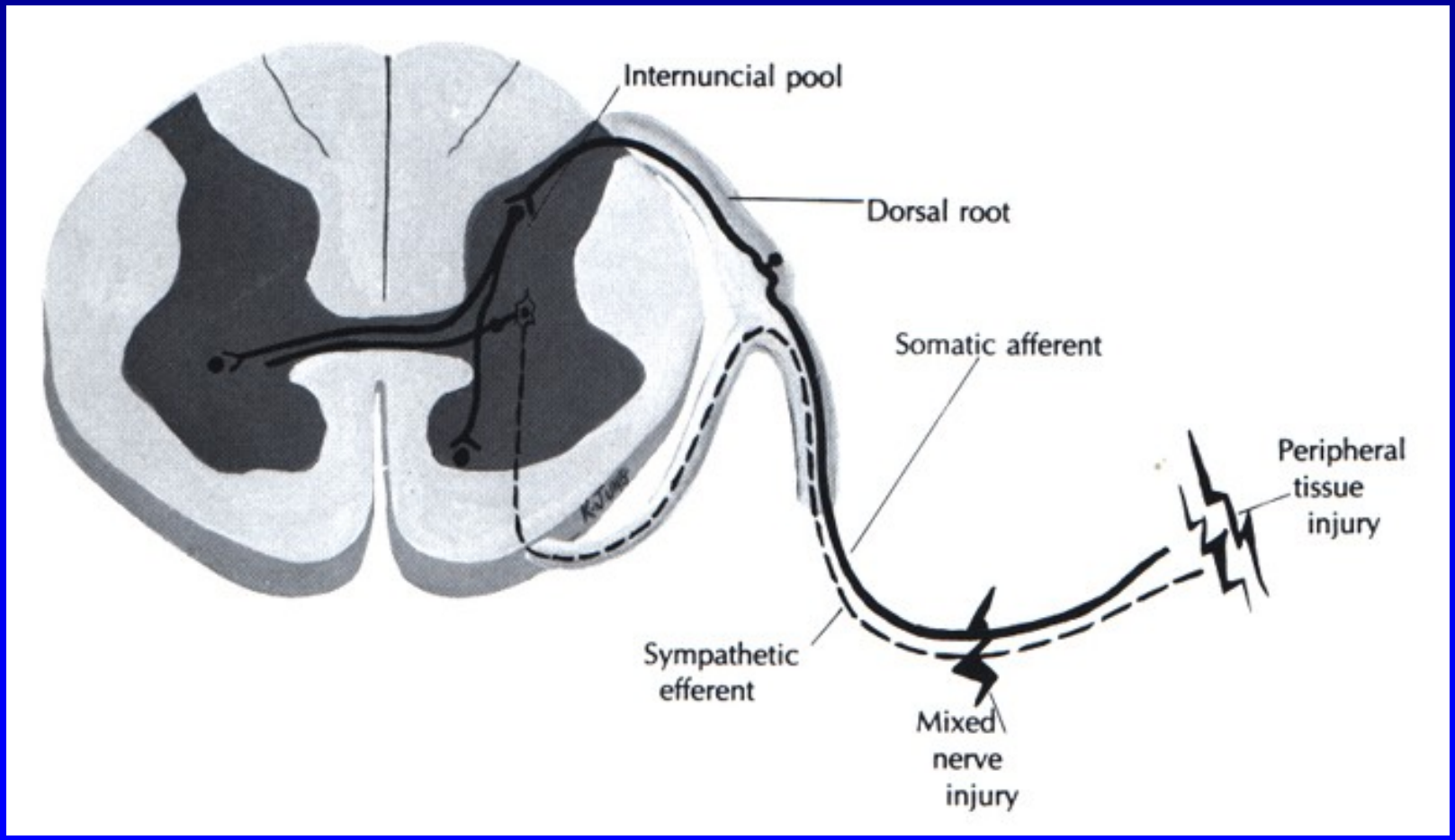
Compartment syndrom - consequences

After 6 hours – irreversible damage to muscles
- Change to fibrous filaments
- contracture of muscles

After 12 hours
- Irreversible damage to nerves

Algoneurodystrophy

Reaction of sympathetic nerves to the injury



Algoneurodystrophy

1. Stage - hyperemia, 0- 3 months
   pain, swelling, hyperestesia

2. Stage - dystrophy
   plastic oedema, cold periphery, thin skin, limited movements, X-ray - osteoporosis

3. Stage - atrophic
   atrofic skin, muscles, limited movements

Algoneurodystrophy -management

Short immobilisation
Drugs against swelling
Analgetics, sedative drugs
physiotherapy
Sympaticolytics
Regional blocks
Corticoids
Calcitonin, alendronate
Physioterapy after removal of bandage

Complication of fractures - general

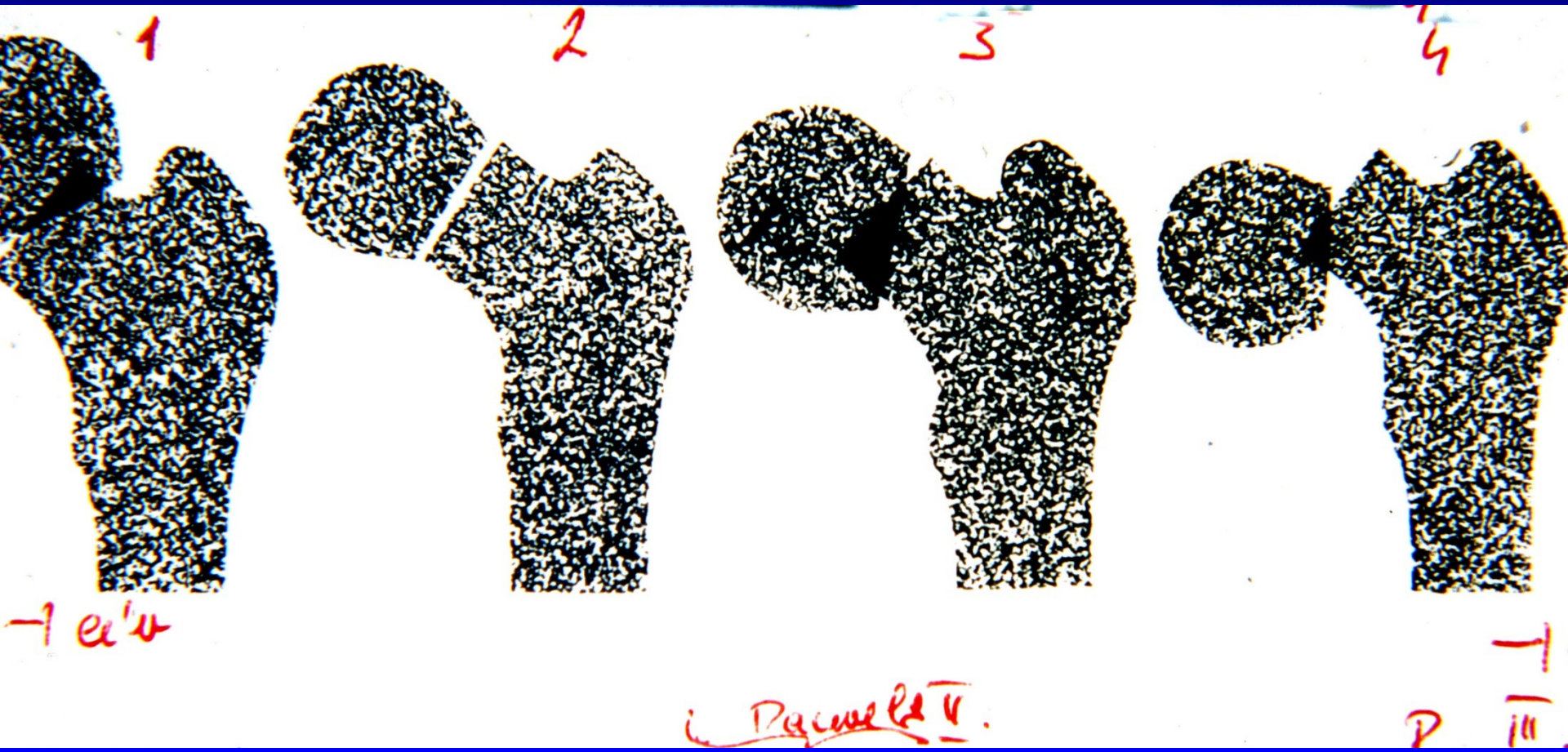
Hypovolemic shock
Cardiopulmonar arrest
Fat embolism
Haemoragic complications
Disseminated intravascular coagulopathy
Trombembolism

Complication of fractures - general

- Fracture disease:

- bronchopneumonia
- Phlebotrombosis, pulmonary embolism
- Preassure sores
- Urinary tract infection
- Weakness
- Muscle atrophy and contractures

Garden classification



Head prosthesis

Over 80 years

Minimal blood loss

Immidiate weightbearing

Disadvantage:
Erosion of the cartilage of the acetabulum



R