# Common Pediatric Fractures and Trauma

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# Introduction

- Different from adult fractures
- Boys > girls
- Vary in various age groups

  ( Infants, children, adolescents )
- Rate increases with age

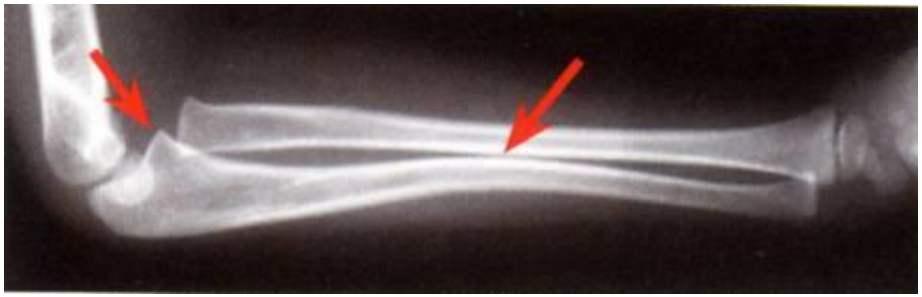
# Why are children's fractures different?

Children have different physiology and anatomy

- Growth plate:
  - Provides perfect remodeling power
  - Injury of growth plate causes deformity
  - A fracture might lead to overgrowth

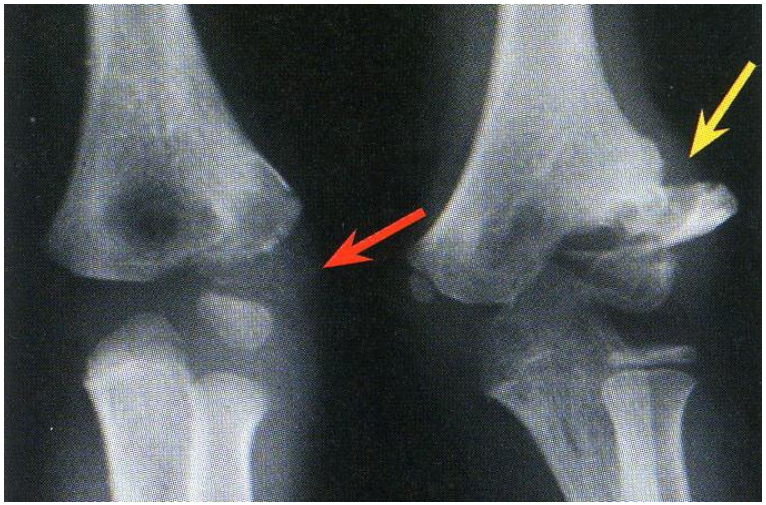
# Why are children's fractures different?

- Bone:
  - Increased collagen/bone ratio makes the bone
    - Less brittle
    - deformation



# Why are children's fractures different?

- Cartilage:
  - Difficult x-ray evaluation
  - Size of articular fragment often under-estimated



# Why are children's fractures different?

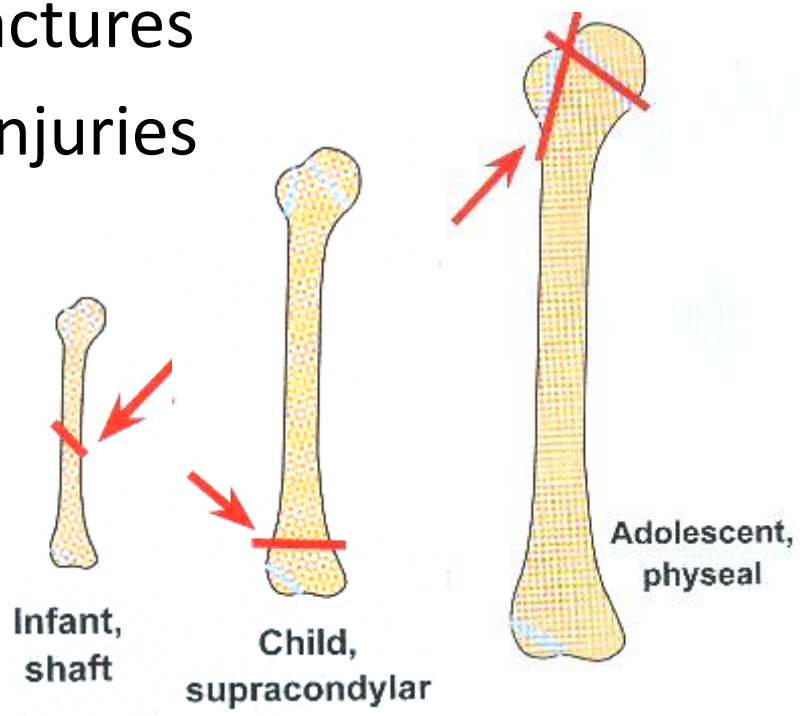
- Periosteum:
  - Metabolically active
    - more callus, rapid union, increased remodeling
  - Thickness and strength
    - Intact periosteal hinge affects fracture pattern

# Why are children's fractures different?

- Ligaments:
  - ligaments in children are functionally stronger than bone. Therefore, a higher proportion of injuries that produce sprains in adults result in fractures in children.

# Why are children's fractures different?

- Age related fracture pattern:
  - Infants: diaphyseal fractures
  - Children: metaphyseal fractures
  - Adolescents: epiphyseal injuries

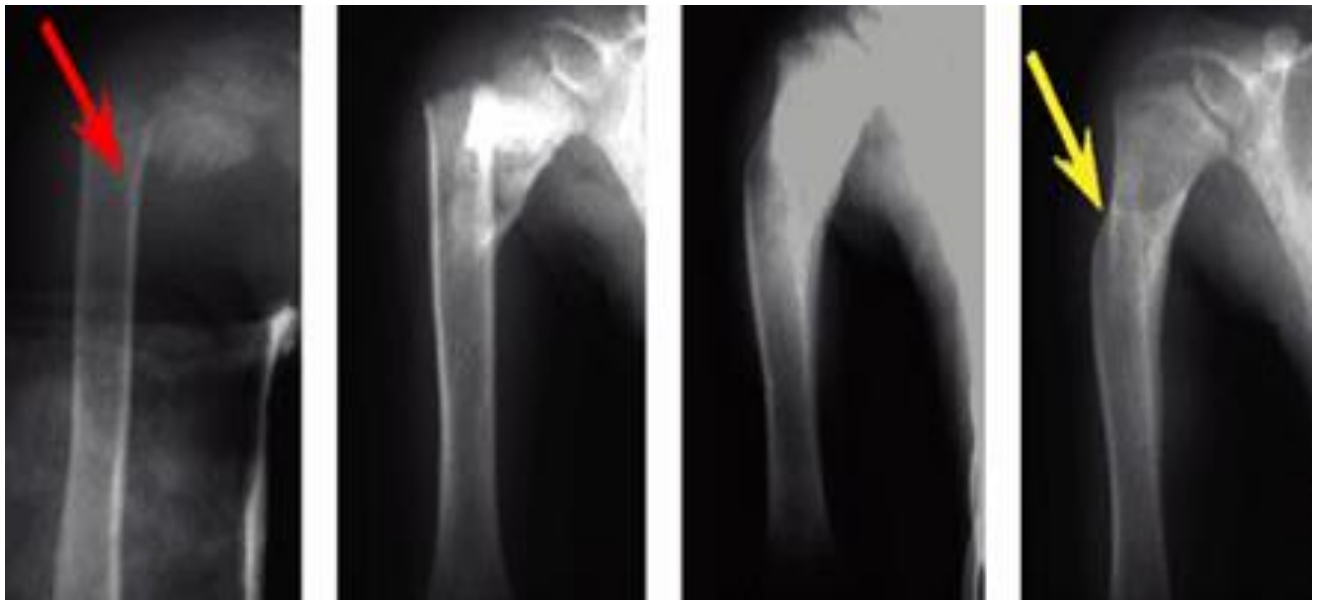


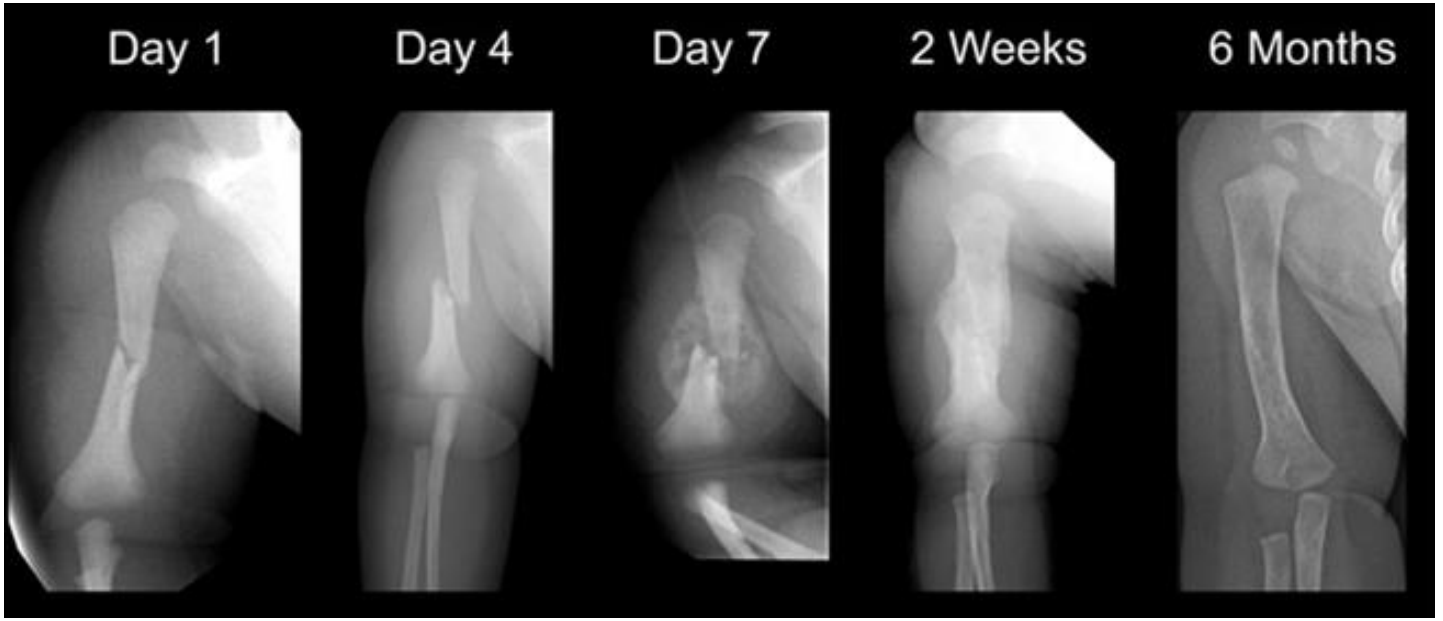
# Why are children's fractures different?

- Physiology
  - Better blood supply

    rare incidence of delayed and non-union


1
2
15




Day 1
Day 4
Day 7
2 Weeks
6 Months

# Physeal injuries

- Account for ~25% of all children's fractures.
- More in boys.
- More in upper limb.
- Most heal well rapidly with good remodeling.
- Growth may be affected.

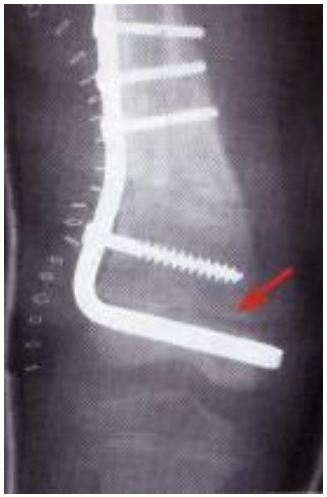
# Physeal injuries

Classification:


Salter-Harris

# Physeal injuries

- Small bridges (<10%) may lyse spontaneously.
- Central bridges more likely to lyse.
- Peripheral bridges more likely to cause deformity
- Avoid injury to physis during fixation.
- Monitor growth over a long period.
- Image suspected physeal bar (CT, MRI)



# General Management

**Indications for surgery**

- Head injury
- Multiple injuries
- Open fractures
- Displaced intra articular fractures
  ( Salter-Harris III-IV )
- Adolescence
- Failure of conservative means (irreducible or unstable fractures)
- Severe soft-tissue injury or fractures with vascular injury
- Neurological disorder
- Malunion and delayed union
- ?Compartment syndrome

# Methods of Fixation

- Casting

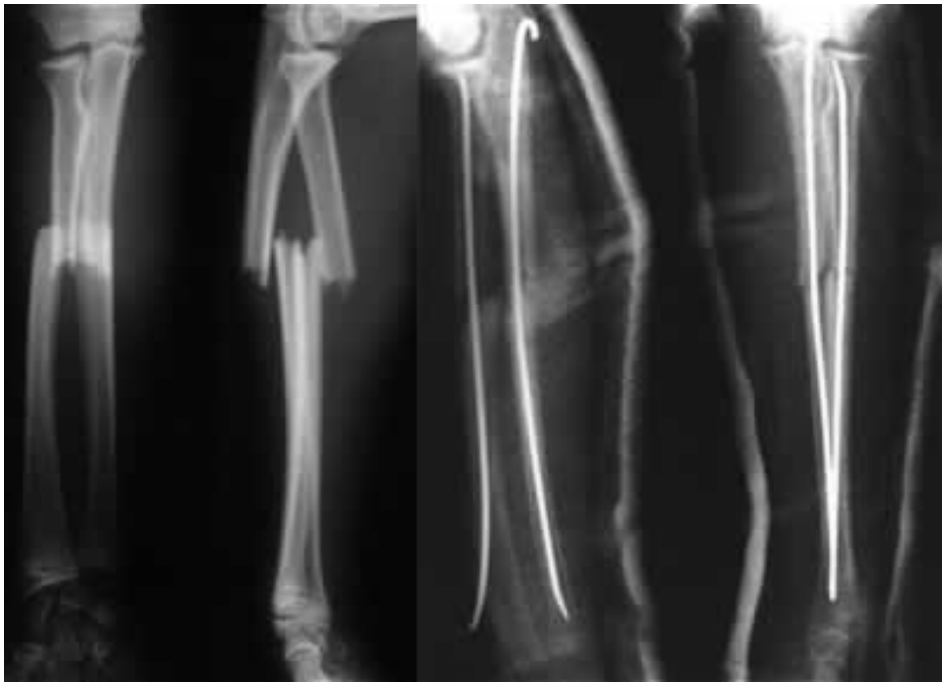
  Still the commonest

# Methods of Fixation

- K-wires
  - Most commonly used IF
  - Metaphyseal fractures

# Methods of Fixation

- Intramedullary wires, elastic nails



# Methods of Fixation

- Screws

# Methods of Fixation

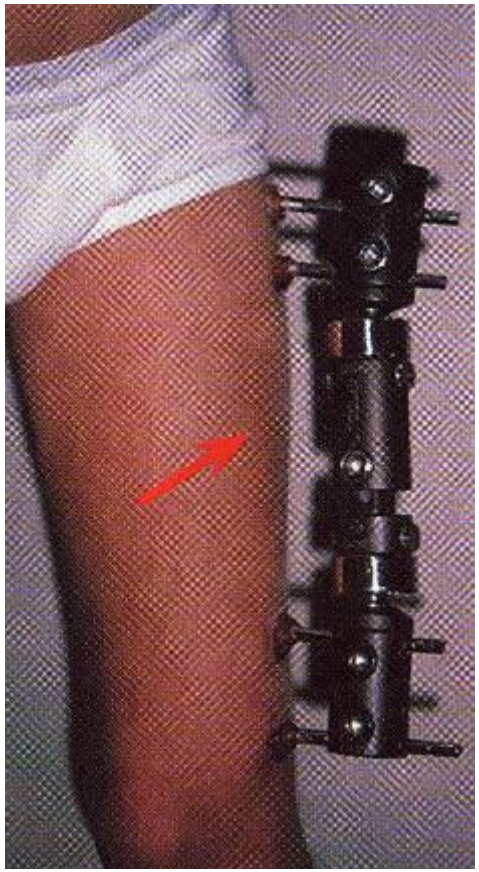
- Plates – multiple trauma


# Methods of Fixation

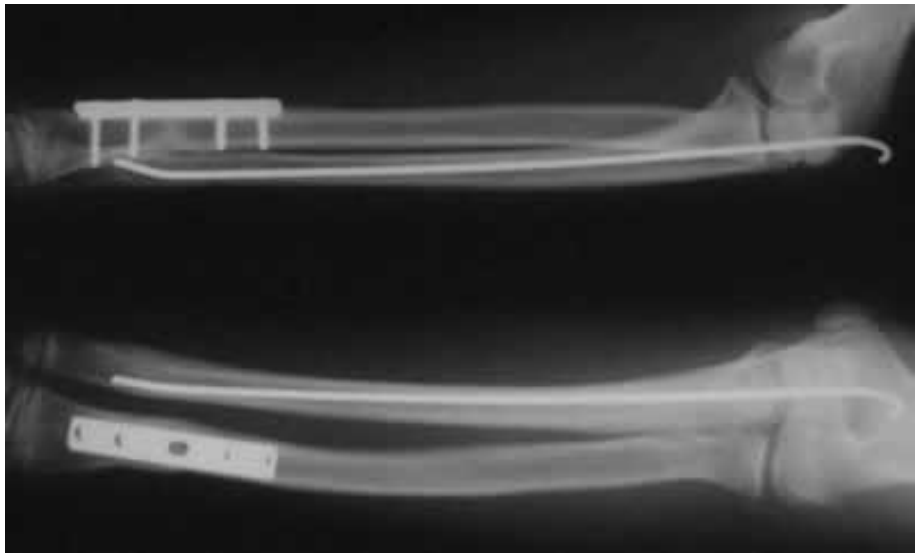
- IMN - adolescents

# Methods of Fixation

- Ex-fix – usually in open fractures



# Methods of fixation

# Common Pediatric Fractures

- Upper limb
  a. Clavicle .
  b. Supracondylar Fracture.
  c. Distal Radius .

- Lower Limbs
  a. Femur fractures

# Fracture Clavicle

- 80% of clavicle fractures occur in the shaft
- The periosteal sleeve always remains in the anatomic position. Therefore, remodeling is ensured.

# Fracture Clavicle

Mechanism of Injury:

- Indirect: Fall onto an outstretched hand
- Direct: it carries the highest incidence of injury to the underlying neurovascular and pulmonary structures
- Birth injury

# Fracture Clavicle

Clinical Evaluation:

- Painful palpable mass along the clavicle
- Tenderness, crepitus, and ecchymosis
- May be associated with neurovascular injury
- Pulmonary status must be assessed.

# Fracture Clavicle

Radiographic Evaluation:

- AP view

# Fracture Clavicle

Classification:

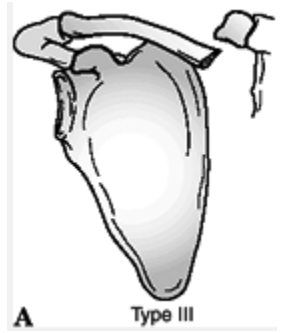
- Location
- Open or closed
- Displacement
- Fracture type

  segmental, comminuted, greenstick

# Fracture Clavicle

<u>Allman classification:</u>

- Type I:
  Medial third
- Type II:
  Middle third (most common)
- Type III:
  Lateral third





# Fracture Clavicle

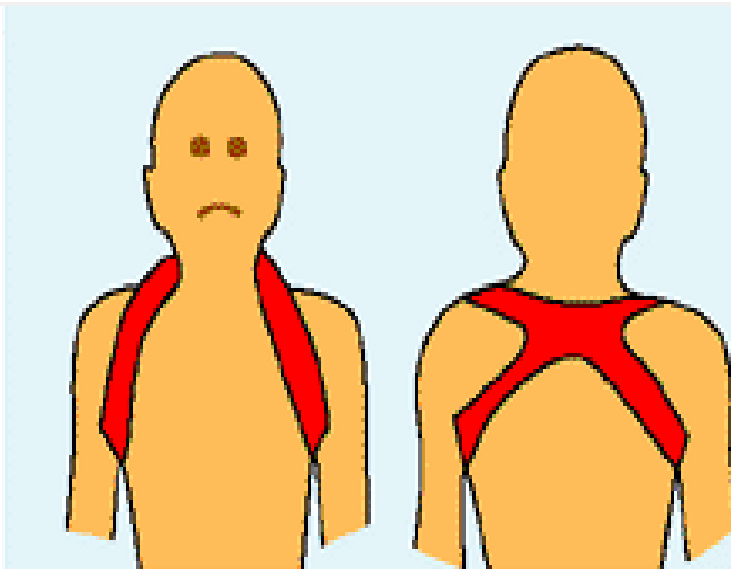
<u>Treatment:</u>

- Newborn:

unite in 1 week

- Up to 2 years:

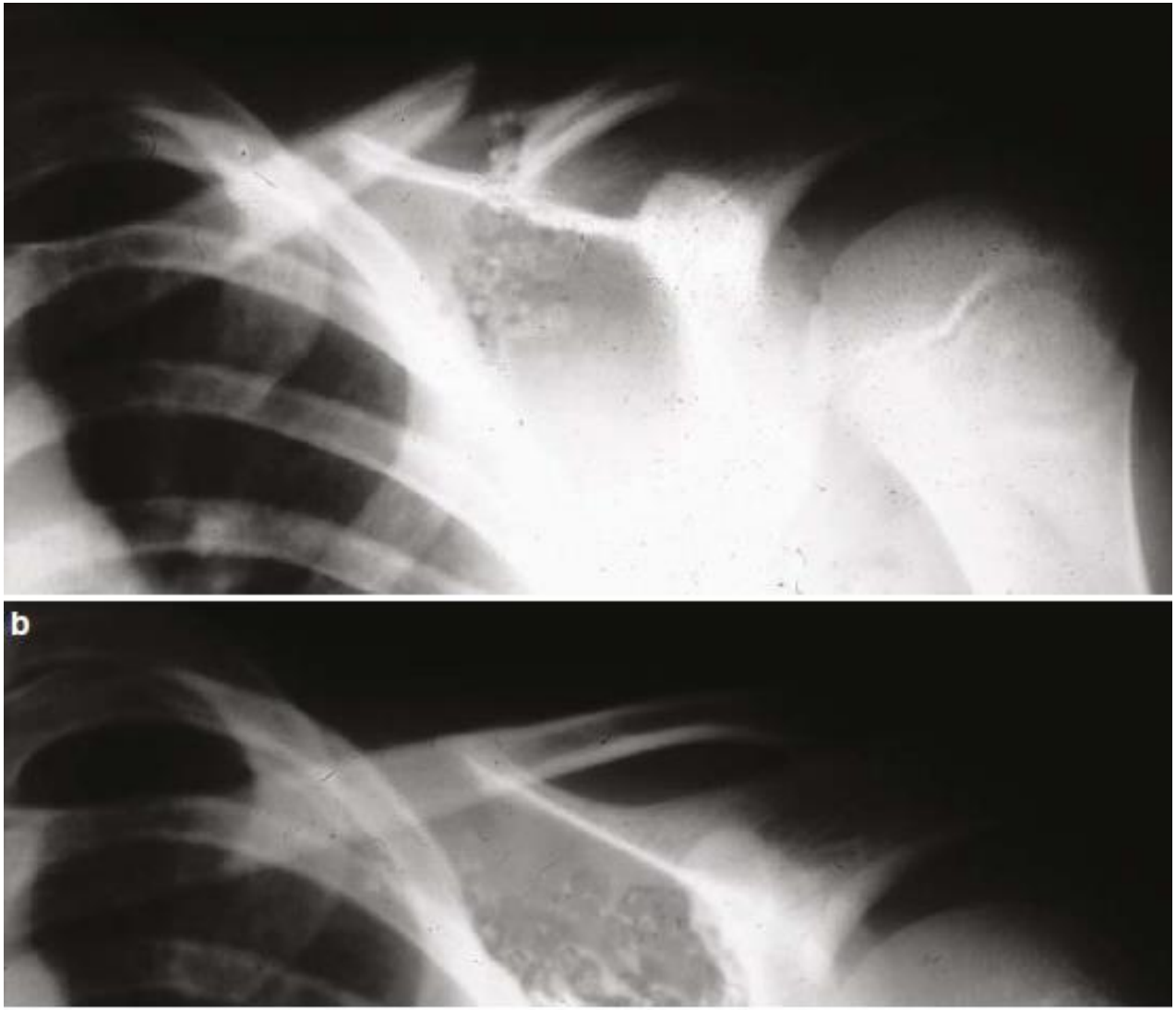
figure-of-eight for 2 weeks



- Age 2-12 Years:

A figure-of-eight or sling for 2-4 weeks

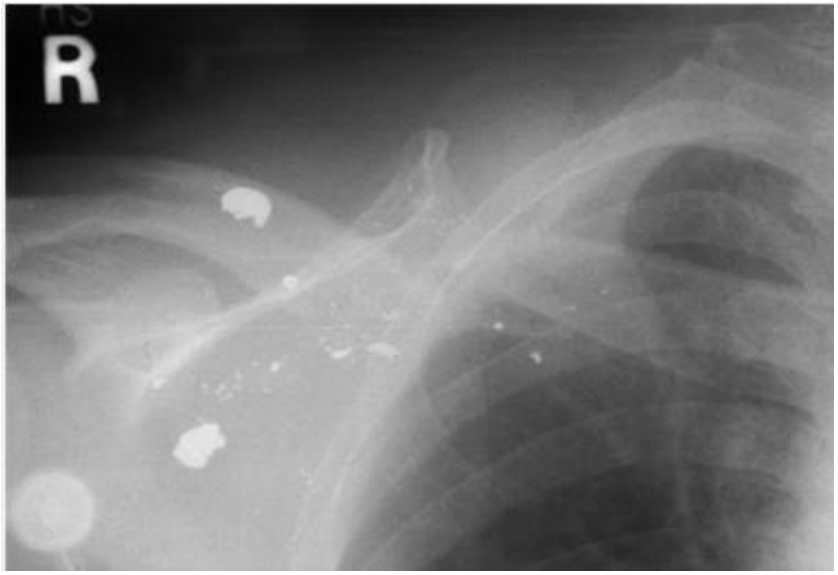
# Fracture Clavicle



# Fracture Clavicle

<u>Indications of operative treatment:</u>

- Open fractures
- Neurovascular compromise




# Fracture Clavicle

<u>Complications:</u>

Rare

- Neurovascular compromise
- Malunion
- Nonunion
- Pulmonary injury

# Supracondylar Humeral Fracture

- 55-75% of all elbow fractures
- The male-to-female ratio is 3:2
- 5 to 8 years
- The left, or nondominant side, is most frequently injured

# Supracondylar Humeral Fracture

Mechanism of Injury:

- Indirect

  Extension type >95%

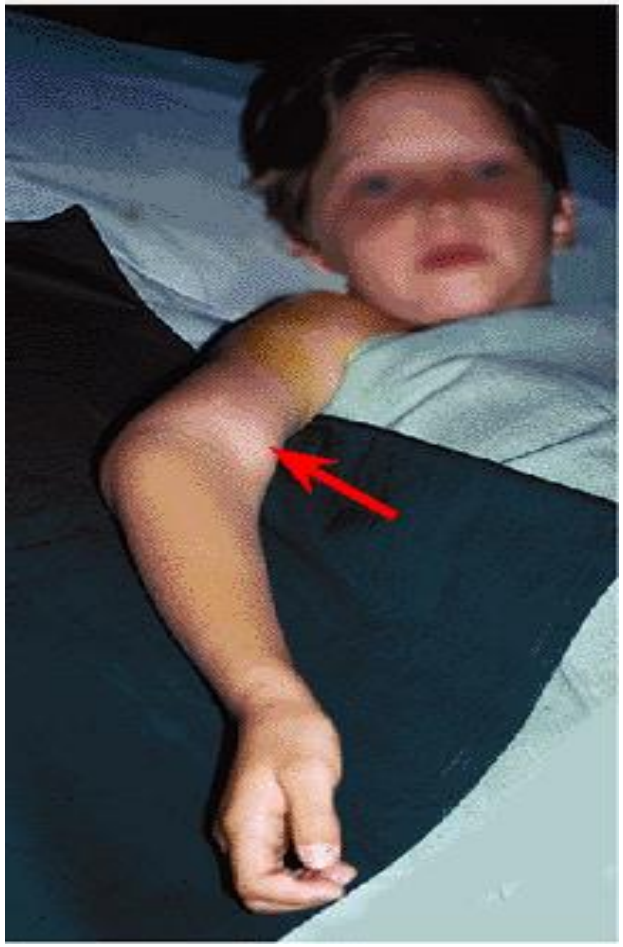
- Direct

  Flexion type  < 3%

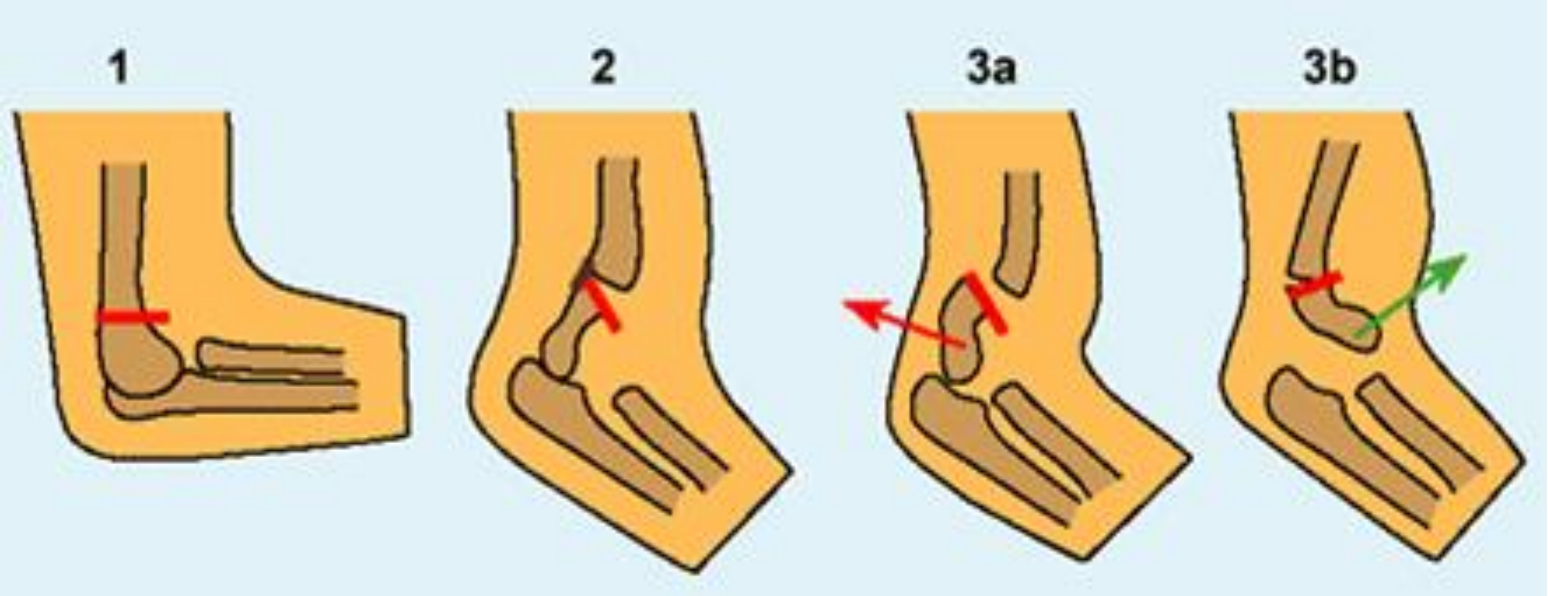
# Supracondylar Humeral Fracture

Clinical Evaluation:

- Swollen, tender elbow with painful ROM
- S-shaped angulation
- Pucker sign (dimpling of the skin anteriorly )
- Neurovascular examination



# Supracondylar Humeral Fracture
## Classification (Gartland)




Complete displacement (extension type) may be posteromedial (75%) or posterolateral (25%)

# Type 1

# Type 2


# Type 3

Flexion type

Extension type

# Supracondylar Humeral Fracture Treatment

- Type I:

  Immobilization in a long arm cast or splint at 60 to 90 degrees of flexion for 2 to 3 weeks

- Type II:

  Closed reduction followed by casting or pinning if unstable or sever swelling

# Supracondylar Humeral Fracture Treatment

- Type III:
  - Attempt closed reduction and pinning
  - Open reduction and internal fixation may be necessary for unstable fractures, open fractures, or those with neurovascular injury

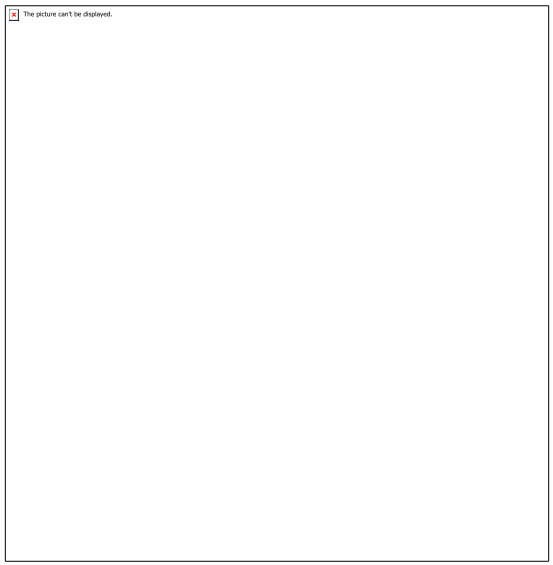



# Supracondylar Humeral Fracture Complications

- Neurologic injury (7% to 10%)
  - Most are neurapraxias requiring no treatment
  - Median and anterior interosseous nerves (most common)
  - Ulnar nerve (Iatrogenic)
- Vascular injury (0.5%)
  - Direct injury to the brachial artery or secondary to swelling

# Supracondylar Humeral Fracture Complications

- Loss of motion
- Myositis ossificans
- Angular deformity (cubitus varus)
- Compartment syndrome




# Distal Radius Fractures

## Distal Radius Physeal Injuries

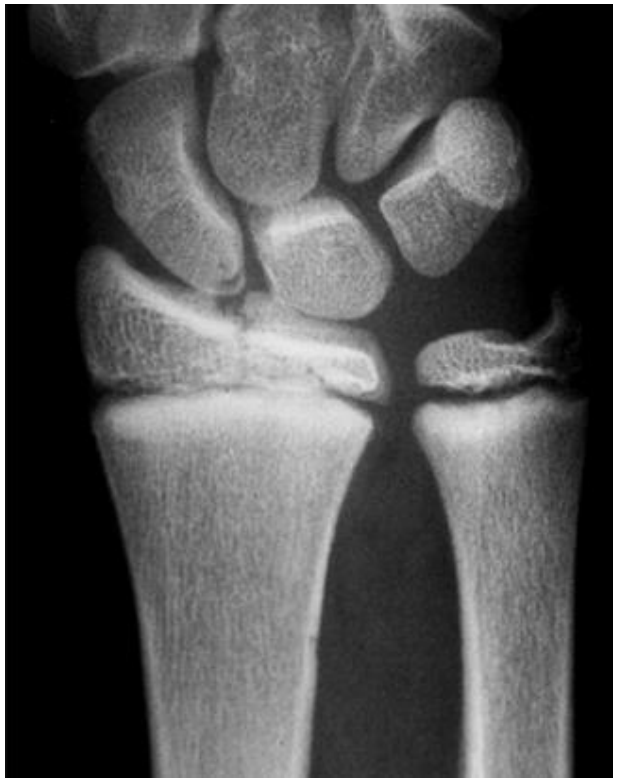
### Type 1

# Distal Radius Fractures

## Distal Radius Physeal Injuries

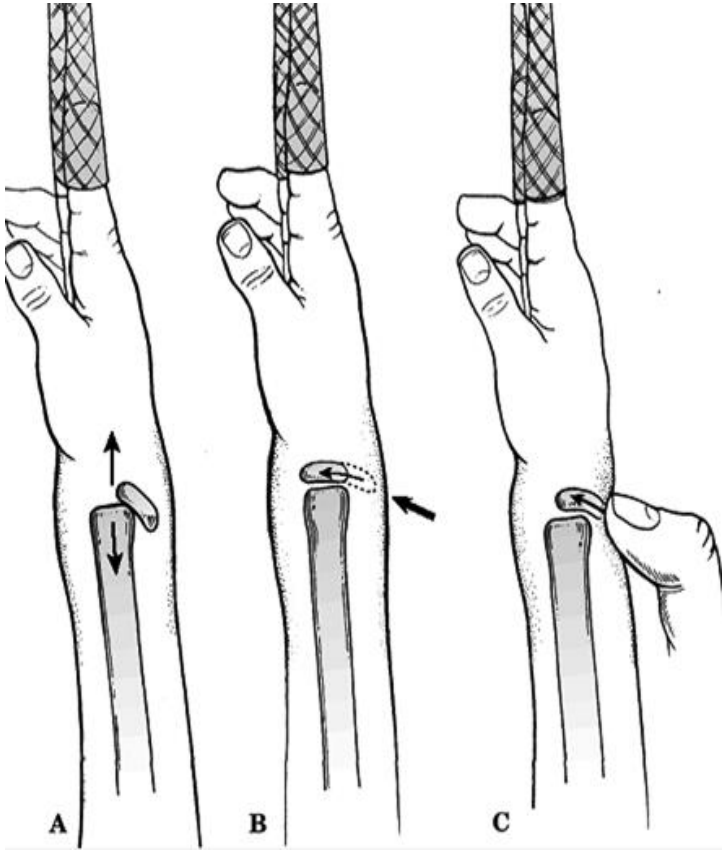
Type 2

Type 3

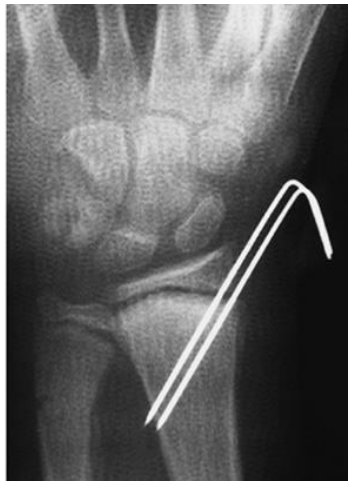


# Distal Radius Physeal Injuries Treatment

- Salter-Harris Types I and II
  - Closed reduction followed by long arm cast with the forearm pronated
  - 50% apposition with no angular or rotational deformity is acceptable
  - Growth arrest can occur in 25% with repeated manipulations
  - Open reduction is indicated
    - Irreducible fracture
    - Open fracture



# Distal Radius Physeal Injuries
## Treatment



# Distal Radius Physeal Injuries Treatment

- Salter-Harris Type III
  - Anatomic reduction is necessary
  - ORIF with smooth pins or screws
- Salter-Harris Types IV and V
  - Rare injuries
  - Need ORIF

# Distal Radius Physeal Injuries Complications

- Physeal arrest
  - Shortening
  - Angular deformity
- Ulnar styloid nonunion
- Carpal tunnel syndrome

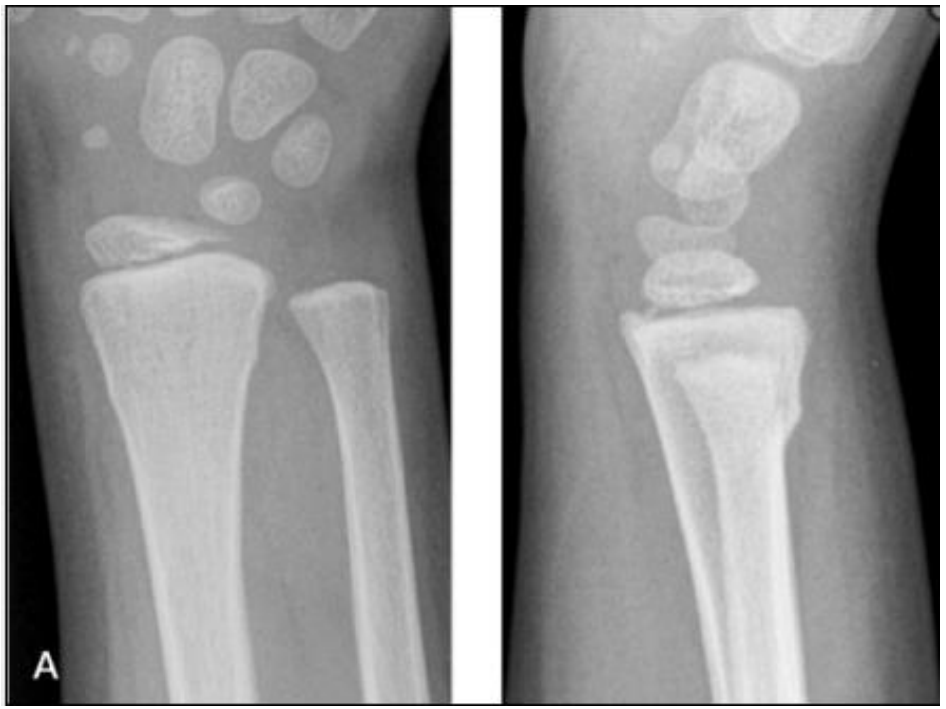
# Distal Radius Metaphyseal Injuries Classification

- Direction of displacement
- Involvement of the ulna
- Biomechanical pattern
  - Torus (only one cortex is involved)
  - Incomplete (greenstick)
  - Complete

# Distal Radius Metaphyseal Injuries

## Torus fracture

- Stable
- Immobilized for pain relief




# Distal Radius Metaphyseal Injuries

## Incomplete (greenstick)

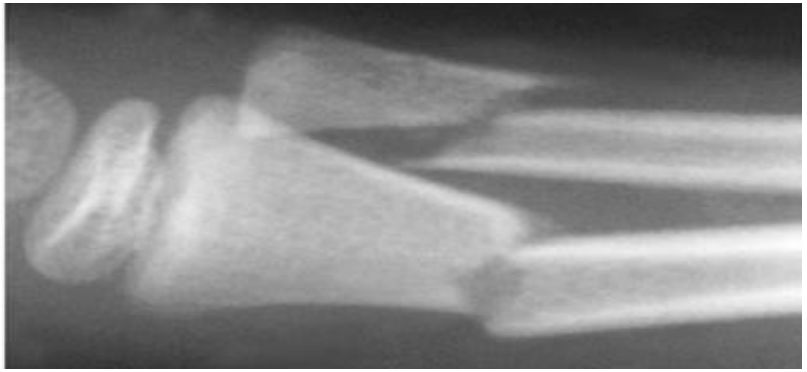
- Greater ability to remodel in the sagittal plane
- Closed reduction and above elbow cast with supinated forearm to relax the brachioradialis muscle

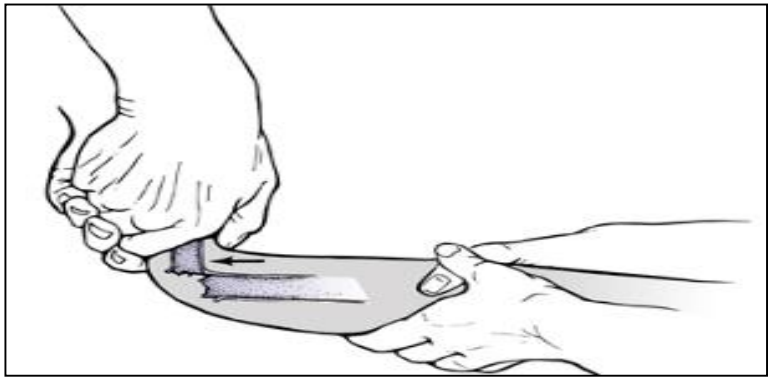


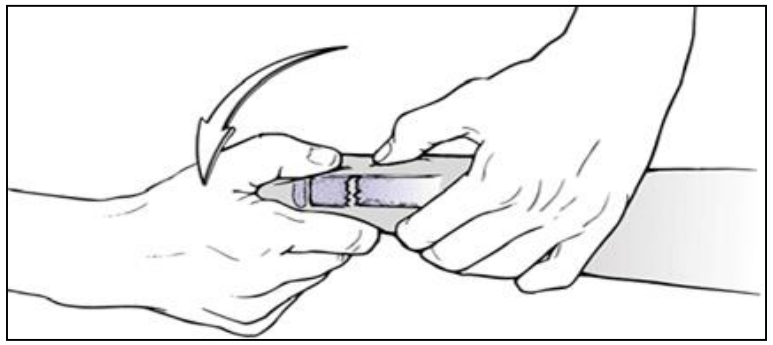
# Distal Radius Metaphyseal Injuries

## Complete fracture

- Closed reduction
- Well molded long arm cast for 3 to 4 weeks





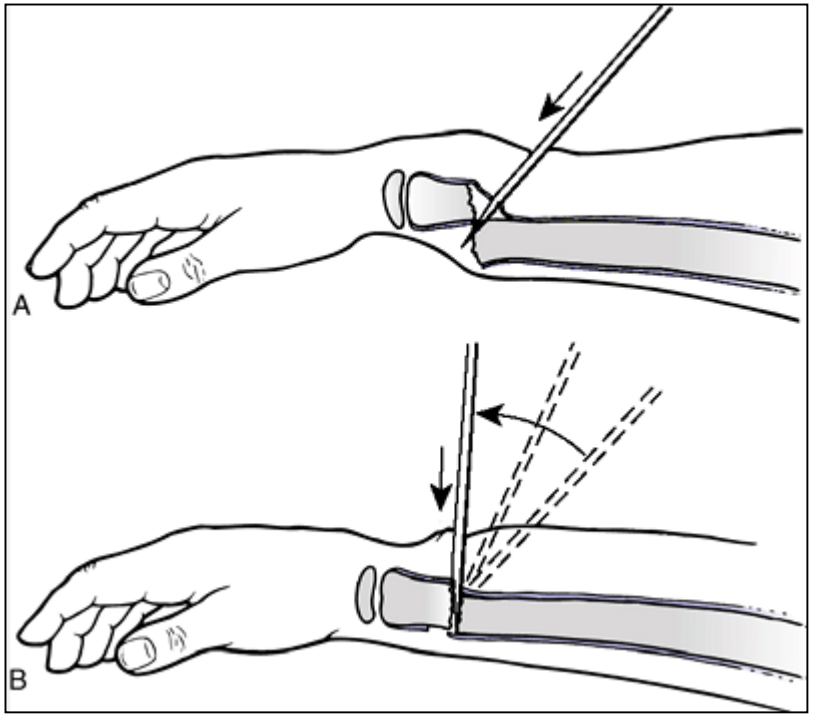


# Distal Radius Metaphyseal Injuries

<u>Complete fracture</u>

Indications for percutaneous pinning without open reduction

- loss of reduction
- Excessive swelling
- Floating elbow
- Multiple manipulations

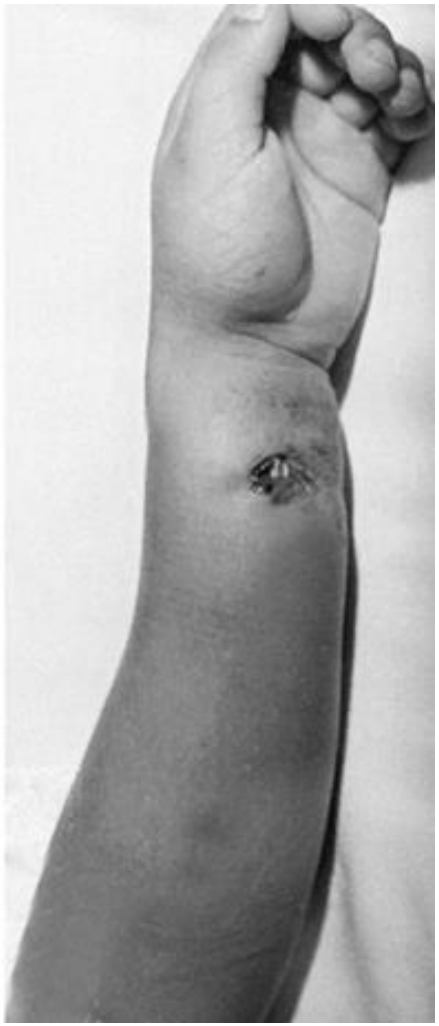


# Distal Radius Metaphyseal Injuries

<u>Complete fracture</u>

Indications for ORIF

- Irreducible fracture
- Open fracture
- Compartment syndrome



# Distal Radius Metaphyseal Injuries Complications

- Malunion
  Residual angulation may result in loss of forearm rotation
- Nonunion
  Rare
- Refracture
  With early return to activity (before 6 weeks)
- Growth disturbance
  Overgrowth or undergrowth
- Neurovascular injuries
  With extreme positions of immobilization

# Femoral Shaft Fractures

- Boys > girls
- 2 to 4 years of age, mid-adolescence
- In children younger than walking age, 80% of these injuries are caused by child abuse
- In adolescence, >90%  due to RTA

# Femoral Shaft Fractures

## Mechanism of Injury

- Direct trauma

  RTA, fall, or child abuse

- Indirect trauma

  Rotational injury

- Pathologic fractures

  Osteogenesis imperfecta, nonossifying fibroma, bone cysts, and tumors

# Femoral Shaft Fractures

## Clinical Evaluation

- Pain, swelling, inability to ambulate, and variable gross deformity
- Careful neurovascular examination is essential
- Careful examination of the overlying soft tissues to rule out the possibility of an open fracture

# Femoral Shaft Fractures

<u>Radiographic Evaluation</u>

- AP and lateral views
- Must include hip, knee joints

# Femoral Shaft Fractures
## Classification

### Descriptive

- Open or closed
- Fracture pattern:

  transverse, spiral, oblique, butterfly fragment
- Comminution
- Displacement

### Anatomic

- Subtrochanteric
- Shaft
- Supracondylar

# Femoral Shaft Fractures
## Treatment

<u>Less than 6 Months</u>

- Pavlik harness
- Traction and spica casting

# Femoral Shaft Fractures
## Treatment

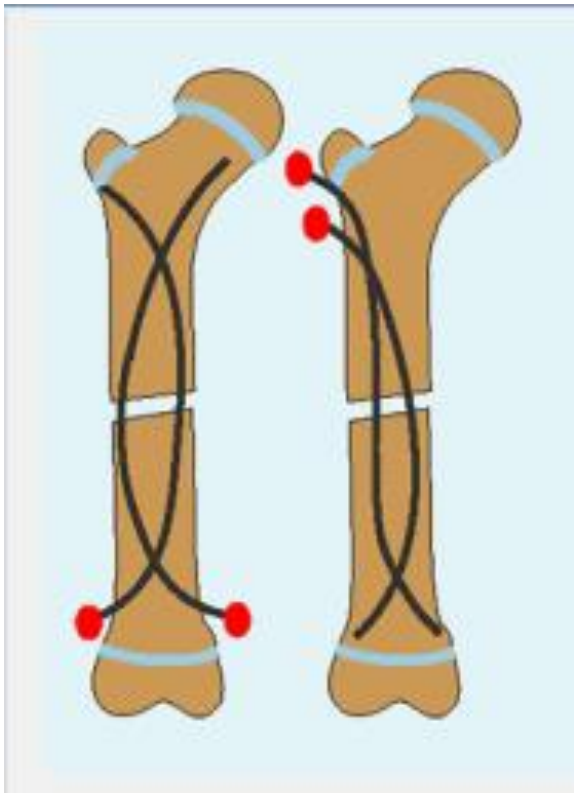
### 6 Months to 4 Years

- CR and immediate casting (>95%)
- Traction followed by spica casting if there is difficulty to maintain length and acceptable alignment

# Femoral Shaft Fractures
## Treatment

<u>4 to 12 Years</u>

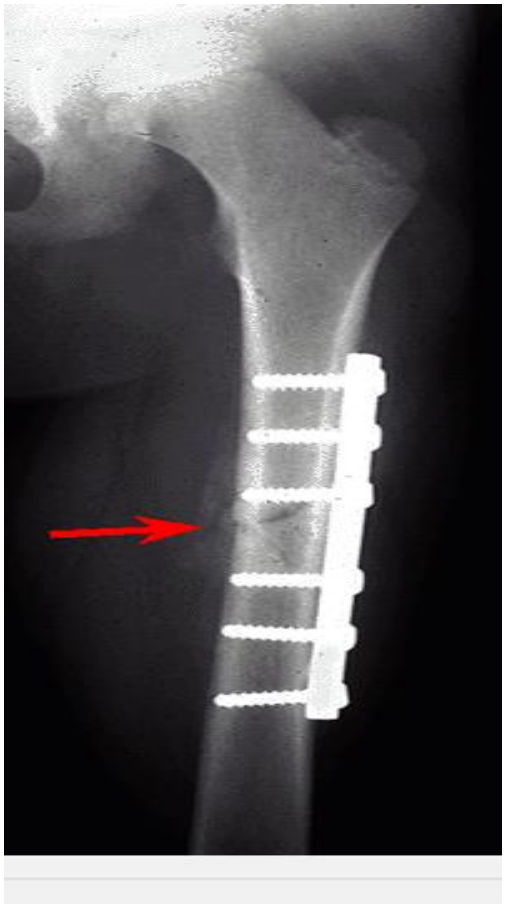
- Flexible IMN
- Bridge Plating
- External Fixation

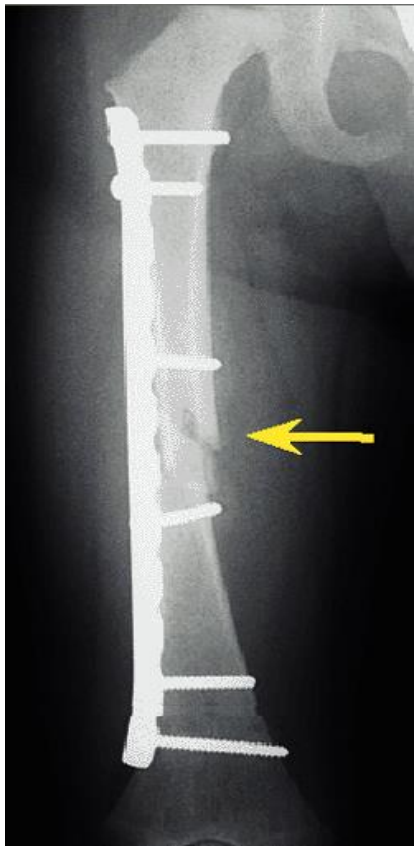


# Femoral Shaft Fractures
## Treatment

<u>6 to 12 Years</u>

- Flexible IMN
- Bridge Plating
- External Fixation

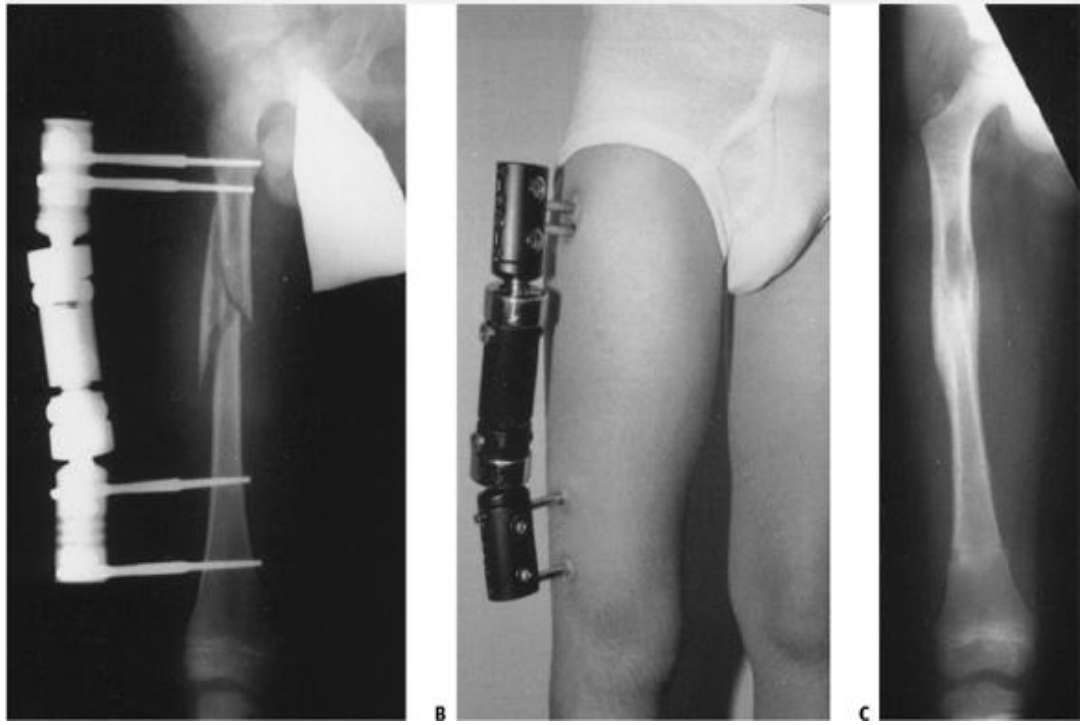




# Femoral Shaft Fractures
## Treatment

<u>6 to 12 Years</u>

- Flexible IMN
- Bridge Plating
- External Fixation
  - Multiple injuries
  - Open fracture
  - Comminuted #
  - Unstable patient



# Femoral Shaft Fractures
## Treatment

<u>12 Years to Maturity</u>

- Intramedullary fixation with either flexible or interlocked nails


# Femoral Shaft Fractures
## Complications

- Malunion
  Remodeling will not correct rotational deformities
- Nonunion (Rare)
- Muscle weakness
- Leg length discrepancy
  Secondary to shortening or overgrowth
  Overgrowth of 1.5 to 2.0 cm is common in 2-10 year of age
- Osteonecrosis with antegrade IMN <16 year