





Editing File

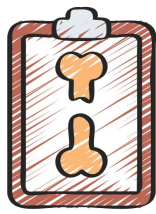


# Common Pediatric Fractures

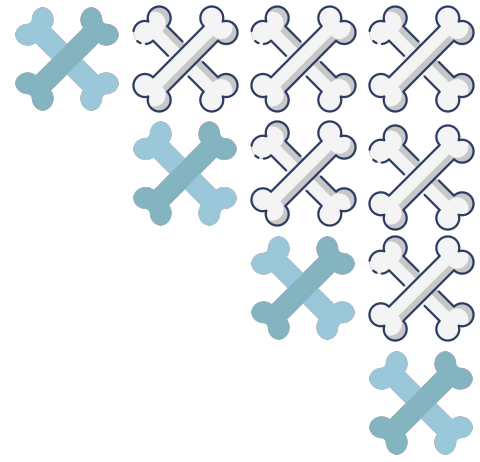
*Dr. Khalid Bakarman*

## Color Index:

-  Main Text
-  Important
-  441 Notes
-  Old Notes
-  Extra
-  



# Objectives



Difference between Pediatric & adult



Physis fracture → Salter-Harris classification



Indications of operative treatment



Methods of treatment of Pediatric fracture & trauma



Common Pediatric fractures:

- U. L → clavicle, humeral supracondylar, distal radius
- L. L → femur shaft



# Resources



# Introduction:

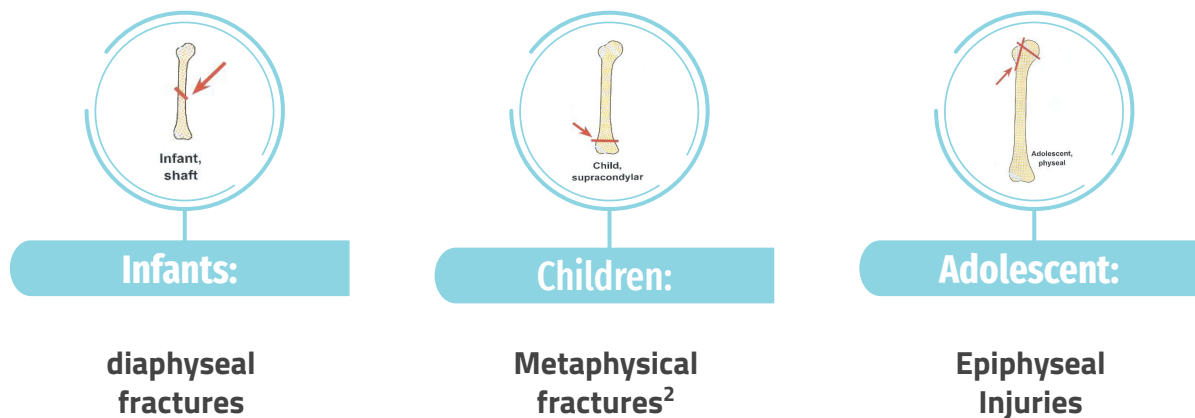
- Different from adult fractures
- Fractures account for ~15% of all injuries in children.
- **Boys > girls**
- Types of fractures vary in various age groups (infants, children and adolescents).
- Rate increases with age till adolescent.
- Pediatric fractures have **great remodeling potentials. Growth plates** and periosteum are important in remodeling

A good number of cases can be treated conservatively, operative fixations aid in avoiding complications

- Adults are skeletally mature; pediatrics are skeletally immature. In Saudi Arabia, the pediatric age range is 14 "18 in the west" and below.

## Why are children's fractures different?

### Age-related fracture pattern<sup>1</sup>



### Examples of Remodeling in children:

This is more evident in younger children. Don't expect this in a child aged 13-14 years old. We only realign the bone then apply casting. Fractures near to a joint that moves everywhere (multiaxial ball-and-socket synovial joint like the shoulder) and near to epiphysis → Better for remodeling.

1- Age in pedia MCQs is very important, in 2 Qs they had the same case but different ages which will make the answer for each Q totally different. In real life situation though age related fracture patterns is indicative on the incidence and not accuracy eg: (14 y/o child, most likely epiphyseal fracture but can happen in metaphysis or diaphysis)

2- Starts with walking age



This radiograph shows diaphyseal humeral fracture

- Note the tremendous amount of callus at day
- 6 months → almost normal



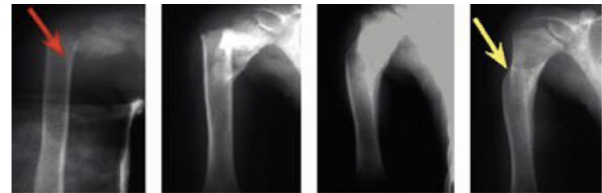
Femur fracture: Big callus forms remodeling 3 segments fracture. You can see the Plaster of Paris (POP) cast in the first picture



100% translation of femur bone fracture Union happened at 15 weeks.



Fracture in the humerus surgical neck with remodeling



## Children have different physiology and anatomy:

### Growth Plate:

- Provides perfect remodeling power.
- Injury of growth plate causes deformity. It's a two edged sword, can aid in healing the deformity by itself or can cause the deformity depends on the mechanism of the fracture.

May cause angular deformity or "Leg Length Inequality" (L.L.I)

- A fracture might lead to overgrowth.

The growth plate gives the length in long bones, while the periosteum increase the width of a bone. In the picture the lateral side growth is arrested while the medial side continues to grow "genu valgus deformity"

- If there is an injury to the medial growth plate while the lateral side is normal and the bone continues to grow, we will have **Varus deformity**.
- If the injury is in the lateral growth plate we will end up having **valgus deformity**.
- If there is destruction of both sides the whole bone will shorten
- (leg length discrepancy).

**Procurvatum/recurvatum:** This refers to the movement of a single bone; where a procurvatum deformity describes forward bending of the bone and recurvatum deformity is the backward bending of the bone.



Genu valgus deformity

### Bone:

Increased collagen/bone ratio makes the bone:

- Less brittle
- Becomes deformed

The bone itself has more collagen than actual bone → do not fracture easily and it can bend sometimes, this is what we call plastic deformation.

(Bowing deformity):

Picture shows the cortex and periosteum are intact, it's not a fracture it's called plastic deformation this is not the normal bowing of ulna.

The younger the patient the more you will see this.

1-

2



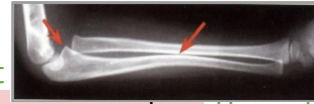
3

**Cartilage:**

- Difficult X-ray evaluation. Radio translucent.
- Size of articular fragment often underestimated.

We always operate if it involves the lateral condyle because the size of fracture is underestimated. Children and adolescents have more cartilage that's why in an X-ray we see spaces.

Collateral condyle must be treated surgically



- **(red arrow):** Left elbow joint. You might think that without displacement (**less than 2mm**) so we can go conservative. The red arrow is pointing to the ossification center (this is not the radial head). This child is so young that the ossific nucleus of radius did not appear yet. This is the ossific nucleus of the capitulum and it should be higher up. - Right picture (yellow arrow): This is an elbow of an older child, the whole epicondyle is fractured and rotated, we call it fracture of necessity 2 (always going intra-articular) we don't go with conservative it should be anatomical reduction to prevent the risk of premature osteoarthritis.

4

**Periosteum:** (which is an actual layer)

Metabolically active

- more callus, rapid union, increased remodeling

Thickness and strength

- Intact periosteal hinge affects fracture pattern. May aid reduction if it's intact

In adults it becomes thinner, but it's very strong in pediatrics, where we need a scalpel to cut it. We can't restore it, but we can bring back the two ends close to each other. If the bone breaks, we don't feel the pain in the cortex + medulla, we only feel the pain from the nerve endings which are in the periosteum. So, fracture movement is what causes pain that's why the first line of analgesia for any fracture is immobilization.

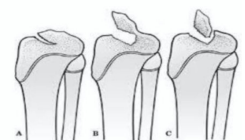
5

**Ligaments:**

Functionally stronger than bone, unlike in adults. Therefore, Higher proportion of injuries that produce sprains in adults result in fractures in children. You'll never hear a child with ACL tear.



ACL is attached to the tibial eminence; tibial spine fracture is not normally seen in adults. It causes avulsion of the tibial spine. X-ray shows abnormal knee (tibial plateau should be smooth), we use a headless screw to stabilize it (arthrotomy or arthroscopy). ACL is intact, the injury happened in the epiphysis.



The only exception not to do surgery for intra articular fracture is if it's <2mm, will heal with its articular cartilage

6

**Physiology:**

Better blood supply. AKA periosteum. So, the remodeling potential is 6-high. Rare incidence of delayed union and non-union (mainly the problem with children is malunion not non-union. Non-union mainly a problem found in adults)

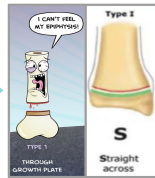
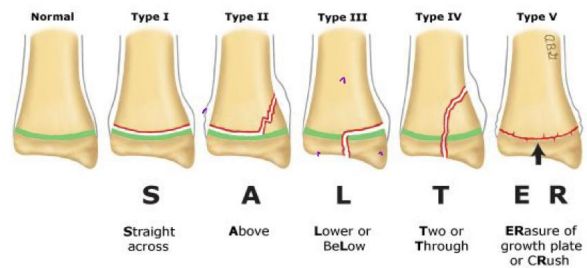
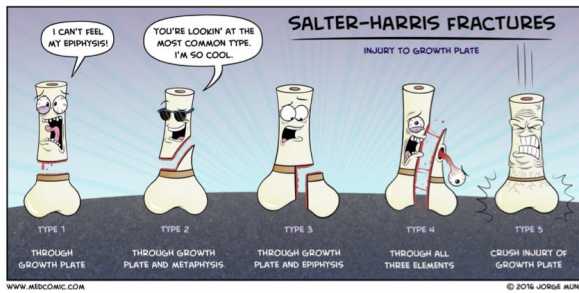


# Physis Fracture:

The growth plate, or physis, is the translucent, cartilaginous disc separating the epiphysis from the metaphysis and is responsible for longitudinal growth of long bones. As we said before the growth plate is a two edged sword it helps in remodelling and union but if it gets injured itself there will be a deformity.

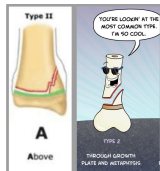
- Account for ~25% of all children’s fractures.
- More in boys.
- More in upper limb **more in the dominant hand.**
- **Most** heal well rapidly with good remodeling, but growth may be affected.

## ★ Salter-Harris Classification



Through the growth plate.

It doesn't appear on the x-ray, so usually request an x-ray to the other side. In type 1, you go with history and examination mainly (A Child fell down and he is crying and holding his knee, he can't bear weight (femur) sometimes in X-ray you see a fracture that is slightly translucent, but don't forget your history and examination in which you can reach a diagnosis up to 70 % just by proper history. A transverse fracture through the hypertrophic or calcified zone of the plate. Even if the fracture is quite alarming displaced, the growing zone of the physis is usually not injured and growth disturbance is uncommon. Usually apply a cast and it'll be sufficient.

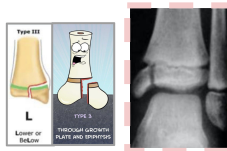


Growth plate with metaphysis.

This is similar to Type 1, but towards the edge the fracture deviates away from the physis and splits off a triangular piece of metaphyseal bone. Growth is usually not affected. This is the commonest type. Usually apply a cast and it'll be sufficient.



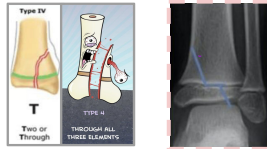
## Type III



Growth plate with epiphysis.

**"Intra-articular"**, needs anatomic reduction, usually it will go to surgery. This fracture runs partly along the physis and then veers off through all layers of the physis and the epiphysis into the joint. Inevitably the reproductive zone of the physis is damaged and this may result in growth disturbance. one of the complications is premature osteoarthritis.

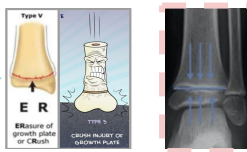
## Type IV



Growth plate with metaphysis and epiphysis.

needs anatomic reduction, usually it will go to surgery. As with Type 3, this fracture splits the epiphysis, but it continues through the physis into the metaphysis. The fracture is particularly liable to displacement and a consequent misfit between the separated parts of the physis, resulting in asymmetrical growth. (corrected with K-wires and screws).

## Type V:



A longitudinal compression injury of the physis, doesn't cause angle

deformity, it only causes leg-length discrepancy. Sometimes you have to do X-ray for both limbs to compare. There is no visible fracture, but the growth plate is crushed, and this may result in growth arrest.

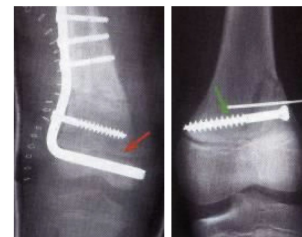
The worst Type.

## Complications of Physeal Injuries:

Physeal bridging<sup>1</sup> (AKA Physeal bar) **a < 1% (from 438)**, Cause as affecting growth (varus, valgus, or even L.L.I)

Keep in mind:

- Small bridges (<10%) may lyse spontaneously
- Central bridges more likely to lyse
- **Peripheral bridges more likely to cause deformity**



Be Careful:

1. Avoid injury to physis during fixation
2. Monitor growth over a long period (18-24 m). Varus or valgus will not appear immediately, they will take time to appear. Because in the period of 18-24 months, the body is still healing.
3. Image suspected physeal bar (CT/MRI) **Not CT only MRI.**

-When suspecting physeal bar **do MRI/CT** because you are looking for soft tissue (growth plate) **(MCQ)**

-A scenario where someone fell but got treatment and healed properly, he came after a few years suffering from a deformity or valgus and you check the most recent X-Ray, what's the next step to see the bar? **MRI**



Type 5 salter-harris fractures in the distal tibia sometimes can cause an incomplete crushing of the epiphyseal plate, which in turn will cause the continuation of the bone growth only on one side which lead to valgus or varus with time. The ankle in the picture is showing varus. We check in integrity of the epiphyseal plate using MRI.

1- Bony bridge crossing the growth plate that results in growth disturbance and/or deformity.

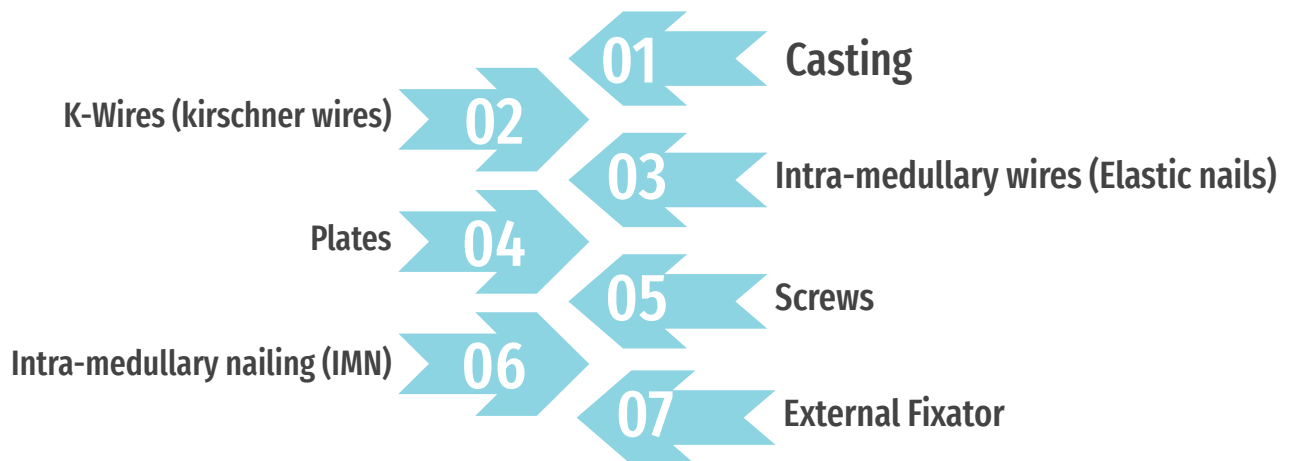


## General management:






### Indications for surgery: (MCQ) Golden slide

- Open fractures
- Severe soft-tissue injury to do debridement
- Fractures with vascular injury actual cut of the vessels
- Compartment syndrome "it depends when patient came to hospital"
- Multiple injuries.(like both femur fractures)
- **Displaced intra articular fractures (Salter-Harris III-IV).**
- Failure of conservative means (irreducible or unstable fractures).
- Malunion and delayed union very rare because of rich blood supply "when you see nonunion in MCQs don't choose it. We know that a child healing is much faster". One of the causes of nonunion is exposure to smoking.
- **Adolescence** we tend to treat them as adults, because the remodeling potentials are really low
- **Head injury (MCQ) in RTA. If asked look for operative ones.** When the patient loses consciousness, the body starts healing. At the beginning catabolic stage caused by the injury → they'll develop a lot of callus" what happens in week 4 can happen in week 2 that's why we should fix it as soon as possible before it malunite. Except if the fracture is nondisplaced and immobilizes properly → we don't need surgery.
- Neurological disorder cerebral palsy, myelomeningocele pts. (they're not normal
- and sometimes their bones don't heal in a normal way)
- Uncooperative patient like pts with ADHD

## Methods of Treatment (Fixation) of Pediatric Fractures & Trauma





| Method   | Indication   |
|--|--|
| <p><b>Casting</b></p>  | <p>Acute fractures or sprains, or for initial stabilization of reduced, displaced, or unstable fractures <b>before orthopedic intervention</b>. Used to correct deformities especially in pediatrics.</p> <p><b>IMP Notes: Still the commonest.</b></p>   <p><b>Casting is the first option of treatment.</b> In infants we don't use cast, instead we use tongue depressor.</p>  |
| <p><b>K-wires</b><br/>(Kirschner wires) (relative fixation)</p>                | <ul style="list-style-type: none"> <li>● <b>Fractures in epi- /metaphyseal areas.</b> Fractures of small bones (e.g. hand and foot).</li> <li>● Small bony fragments.</li> <li>● For fragment reposition in multifragmentary fractures in addition to stable fixation.</li> </ul> <p><b>IMP Notes:</b></p> <ul style="list-style-type: none"> <li>● Most commonly used for internal fixation (I.F).</li> <li>● Usually used in metaphyseal fractures &amp; supracondylar fractures.</li> <li>● Inserted percutaneously in OP under GA.</li> <li>● You can go through growth plate, but it is done by seniors.</li> <li>● Not good for bone fixation in adults.</li> </ul>   |
| <p><b>Intramedullary wires</b><br/>(Elastic Nails)<br/>(relative fixation)</p> | <p>When you bend a K wire it will bend but elastic wire will recoil. The elastic wire uses the technique of 3-points fixation (2C shaped wires, they come straight, and we bend them to give a push in the center. Usually used in mid-shaft diaphysis <b>"Only in long bones"</b> → stabilizes the fracture (3 points: upper crossing/lower crossing/central push). In the radius and ulna we don't have enough space in the medulla to put 2 wires so we put 1 wire. Used mainly in pediatrics but can be used in adults.</p>   |

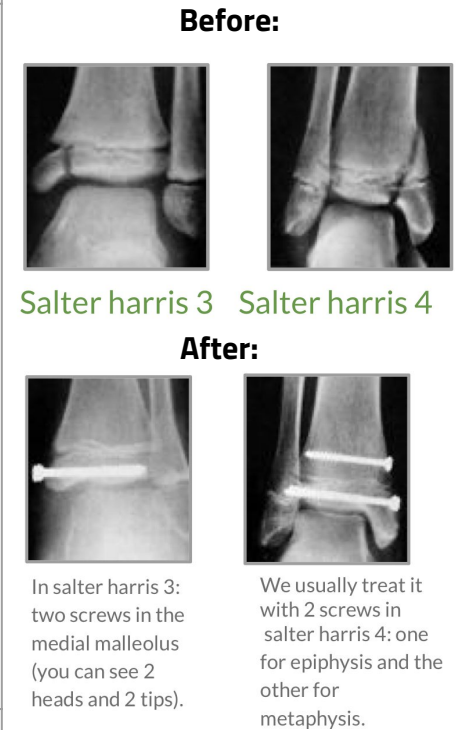
**Plates**  
(absolute fixation)

Especially **in multiple trauma**  
IMP Notes: Comminuted fracture and we use bridging plate. In comminution we don't search for each single piece to fix but what is important is to keep length to prevent LLD.



**Screws**  
(relative fixation)

**IMP Notes:**  
**We NEVER cross a physis with a screw because it will destroy the growth plate, with a k-wire yes because it's smooth.**  
Remember in SCFE (salter harris 1) we put a screw for in situ fixation, but we won't fuse it into the growth plate.

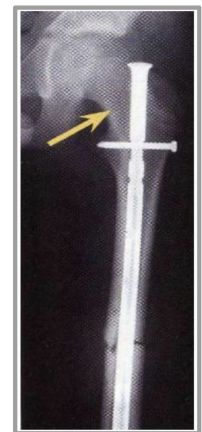


**Intramedullary Nailing [I.M.N]**  
(relative fixation)

Only in **adolescents (>12y) (MCQ)**

There are many blood vessels come for head of femur and other for greater trochanter. The area between the greater trochanter and the neck is called piriformis fossa (blood supply of the growth plate of the greater trochanter) if I go there with an IM nail I will interfere with the blood supply "AVN" of the greater trochanter, it will affect the growth plate and it will grow into valgus and if it goes into too much valgus it will dislocate.

**IF I give you MCQ and the options are IM nail, K wire, Elastic nail, traction please look at the age: If it's 14 year old patient choose IM nail / If it's 4 year old patient choose elastic nail.**



**External fixator**

Usually in **open fractures**.  
Valid in pts who have skin conditions. "crush injury" Used as a temporary treatment for Fractures. Because they are easily applied, external fixators are often put on when a patient has multiple injuries and is not yet ready for a longer surgery to fix the fracture.



**Combination**





## Side notes

- Usually in pediatrics we remove the screws
- We always remove Plate and screws in pediatrics once it heals bc later on it will grow on top of it through which I will have to cut the cortex for removal
- potential area for pathological fracture. That's why we use wires which can be removed very easily. Plates and screws has limited use.
- In adults: upper limb we don't remove the screws cause there is a lot of nerves and blood vessels.
- In the lower limb we have to remove, cause after it heals, we will have something called shear force (breaks in the sites of the screws)
- Fellow level info: if the pt have some sort of handicap and walks on the upper limb then we have to remove it

## Common Pediatric Fractures:

### Clavicle Fractures:

#### Incidence:

- 80% occur in the shaft
  - The periosteal sleeve always remains in the anatomic position.
  - Therefore, remodeling is ensured. It's thicker in the pediatric group.
- 8-15% of all pediatric fractures
  - 0.5% of normal SVD
  - 1.6% of breech deliveries Dr didn't mention it
  - 90% of obstetric fractures

#### Mechanism of injury:

- Indirect (fall onto an outstretched hand)
- Direct
  - Has highest incidence of injury to the underlying:
  - **Neurovascular** (e.g Subclavian artery)
  - **Pulmonary structures** (Apex of the lung)
- Birth injury<sup>1</sup> may present with or without Erb's palsy

#### MECHANISM OF INJURY

a) Fall with arm out, onto hand



b) Fall onto shoulder



c) Direct blow to shoulder



Going into 4th year like:



<sup>1</sup>-Shoulder dystocia: Shoulder dystocia is a birth injury (also called birth trauma) that happens when one or both of a baby's shoulders get stuck inside the mother's pelvis during labor and birth. In most cases of shoulder dystocia, babies are born safely, but in other cases it causes fractured clavicle and brachial plexus injury



## Clinical evaluation:

- **Look:** Ecchymosis, swelling, bruises, tenting of the skin.
- **Feel:**
  - Extreme tenderness at fracture site
  - As a palpable mass along the clavicle (as in displaced fracture) when presented late you can feel the callus.
  - You feel crepitus of the fracture (when lung is compromised) emphysema.
- **Special tests:** Must assess for any.
  - Neurovascular (N.V) injury examine the brachial plexus, subclavian vessels they run behind clavicle
  - Pulmonary injury If the fracture went downward.

## Reading X-ray: AP view (438):

- Location: (medial, middle, lateral) 1/3, commonest middle 1/3 fracture site: Junction of middle & lateral 1/3
- Fracture type: transverse, segmental, comminuted, greenstick.
- Displacement in percentage %
- Open or closed: see air on XR it's skin on bone, you have to exclude open fracture.
- If pneumothorax you will see air in the x- ray.
- If subclavian and moved down it will cause vessel injury

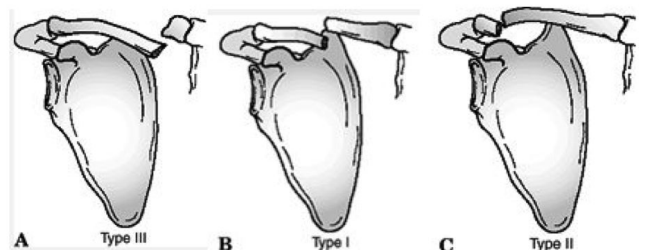
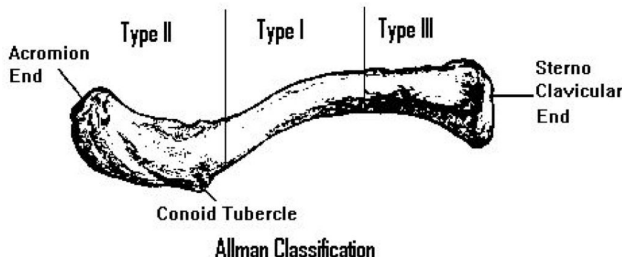
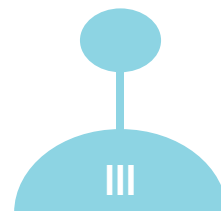
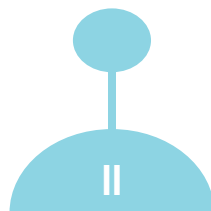
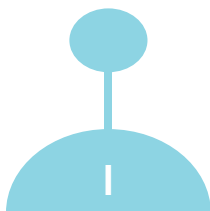


## Allman Classification<sup>1</sup>:

Type I: medial 1/3

Type II: middle 1/3  
(most common)

Type III: lateral 1/3



<sup>1</sup>- the pictures and context contradict each other, the Dr said most importantly is to know if it's (proximal, middle or distal) moreover the number of the type isn't important but if you want to know the right numbering it's the picture not the context.



## Allman Classification<sup>1</sup> :

- **Newborn (< 28 days):** Figure-of-eight, untie in 1 week; because the sensory nervous system is not fully developed, Figure of eight we just tell the mother handle, Just leave it.
- **1m – 2y:** Figure-of-eight it just helps in realignment for 2 weeks
- **2 – 12y:** Figure-of-eight or sling for 2-4 weeks.



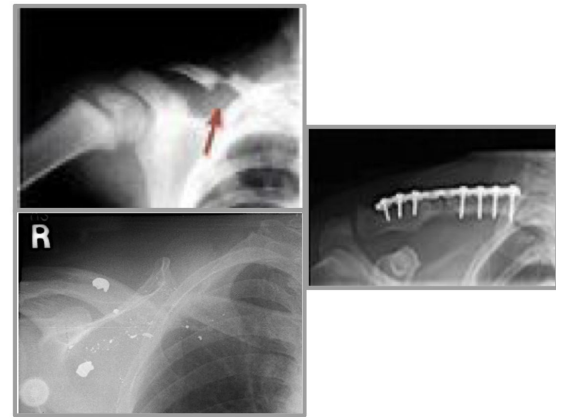
Figure of eight



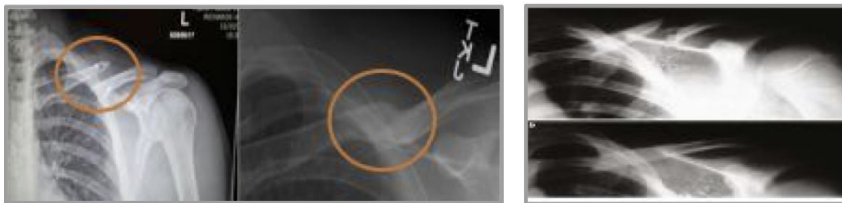
sling

## Indication of Operative Treatment:

1. **Open fractures** (tinting<sup>1</sup> of the skin)
2. **Neurovascular, pulmonary.** compromise
3. **Non-Union**
4. **Mal-Union**



## Clavicle Fracture Remodelling:



## Complications:

| From the Fracturerare   | Iatrogenic (438)  |
|---|---|
| <ul style="list-style-type: none"> <li>-Malunion</li> <li>-Nonunion</li> <li>-Secondary from healing</li> <li>1)Neurovascular compromise</li> <li>2)Pulmonary injury</li> </ul> | <ul style="list-style-type: none"> <li>-Bad healed scar major indication not to do surgery, keloid in this area is very bad because we are <b>crossing</b> the fibers → heals very bad.</li> <li>-Dehiscence</li> <li>-Infection</li> </ul> |

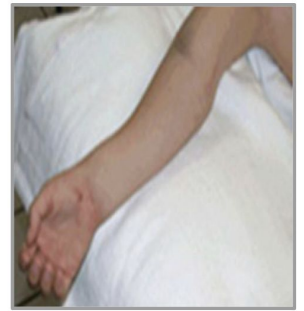
1- Grayish or blue skin, also called pallor, is a result of a lack of oxygenated blood to the area that is discolored.



# Supracondylar Humeral Fractures

## Incidence:

- 55-75% of all elbow fractures
- M:F ratio is 3:2
- Most commonly between 5-8 years, but can occur at any age
- The non-dominant side is most frequently injured (438)<sup>1</sup>



## Clinical evaluation:

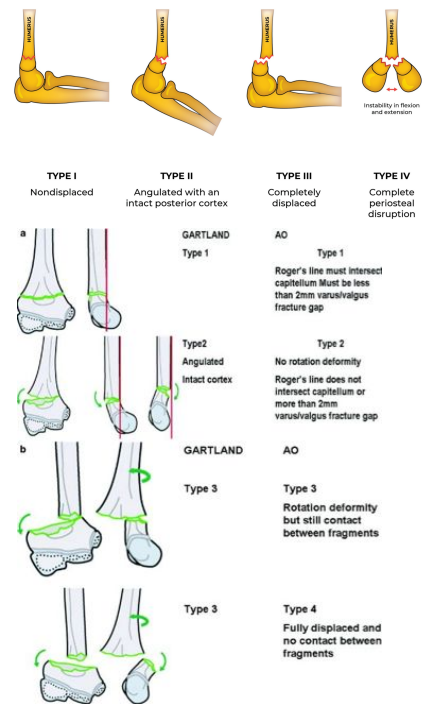
- Swollen, tender elbow with painful range of motion
- S-shaped angulation causing deformity
- Pucker sign (dimpling of skin anteriorly)<sup>2</sup>
- Neurovascular examination: asses brachial artery,
- median/AIN (most common), and radial nerve.



## Mechanism of injury:

- Indirect >95%
  - "Extension type" >95% when falling on stretched hand
- Direct
  - Flexion type" <3% when falling on the elbow itself

GARTLAND CLASSIFICATION SYSTEM



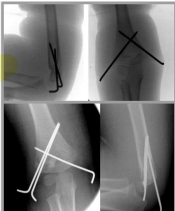
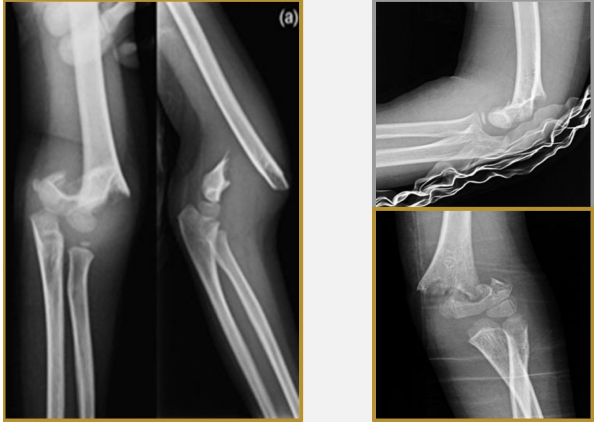


### Gartland's classification(important):

- **Type 1:** minimal or no displacement of the fracture. There is a normal anterior humeral line on the X-ray. Often only abnormality is abnormal fat pads.
- **Type 2:** with posterior displacement, the posterior cortex remains intact and with anterior displacement, the anterior cortex remains intact.
- **Type 3:** completely displaced with complete cortical disruption.
- **Type 4:** The periosteum is completely torn and is the most unstable type of fracture (can only be diagnosed intraoperatively).

### Modified Gartland's classification(important):

| Type | Description   | Treatment                 |
|------|---|---------------------------|
| I    | Undisplaced   | Casting                   |
| IIA  | Displaced with angulation, intact posterior cortex  | Casting or closed pinning |
| IIB  | Displaced with angulation and rotation, intact posterior cortex   | Closed pinning            |
| IIIA | Completely displaced with no contact over posterior cortex  | Closed or open pinning    |
|      | Medial periosteal hinge intact, distal fragment goes posteromedially  | Closed or open pinning    |
| IIIB | Completely displaced with no contact over posterior cortex Lateral periosteal hinge intact, distal fragment goes posterolaterally | Closed or open pinning    |
| IV   | Lack of periosteal hinge, presence of multidirectional instability  | Closed or open pinning    |

| Gartland        | Treatment  | Radiographs Class  |
|-----------------|--|--|
| <b>Typel</b>    | <ul style="list-style-type: none"> <li>• Immobilization in a long arm cast (above elbow) or splint Type 1</li> <li>• 60 to 90 degrees of flexion</li> <li>• 2 to 3 weeks</li> </ul>  |    |
| <b>Typell</b>   | <ul style="list-style-type: none"> <li>• Closed reduction, followed by casting or pinning if unstable or Type 2 severe swelling (with lateral wires to Slight avoid injuring the ulnar nerve)</li> </ul>   |    |
| <b>Type III</b> | <ul style="list-style-type: none"> <li>• Attempt closed reduction and pinning (crossed wires)</li> <li>• ORIF for unstable or open fractures, or those with neurovascular injury</li> </ul> <p style="text-align: center; color: red;">What is a common nerve injury caused by the crossed wires treatment in the case of a distal humeral fracture?</p> <p style="text-align: center; color: red;">Ulnar nerve injury (MCQ)</p>  |  <p style="text-align: center;">Extension type(3a). (Pucker sign)</p> <p style="text-align: center;">Flexion type(3b)</p> |

## Complications:

- Neurologic injury (7% to 10%)
  - Most are neuropraxias requiring no treatment (438)
  - Median and anterior interosseous nerves (most common)
  - Ulnar nerve (iatrogenic)
- Vascular injury (0.5%)
  - Direct injury to the brachial artery or secondary to swelling
- Loss of motion (stiffness)
- Myositis ossificans
- Angular deformity (cubitus varus) caused by injured growth plate, reduction with rotation (malunion)
- Compartment syndrome






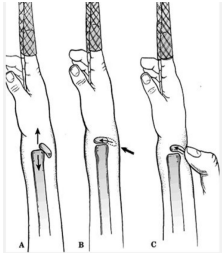
cubitus varus

1) not based on scientific evidence  
2) caused by bone displacement/angulation against the skin



# Distal Radius Physeal Fractures:

## Salter-Harris Classification:

| Salter-Harris | Type I  | Type II  | Type III   |
|---------------|---|--|--|
| x-rays        |    |  |   |
| treatment     | <ul style="list-style-type: none"><li>• Closed reduction followed by long arm cast with the forearm pronated</li><li>• 50% apposition with no angular or rotational deformity is treatment acceptable</li><li>• Growth arrest can occur in 25% with repeated manipulations</li><li>• Open reduction indication:<ul style="list-style-type: none"><li>○ Irreducible or open fractures</li></ul></li></ul>  |  | <ul style="list-style-type: none"><li>• Anatomic reduction is necessary</li><li>• ORIF (open reduction and internal fixation) with smooth pins or screws</li></ul> |



Use k-wires to hold the reduction if closed reduction is unstable



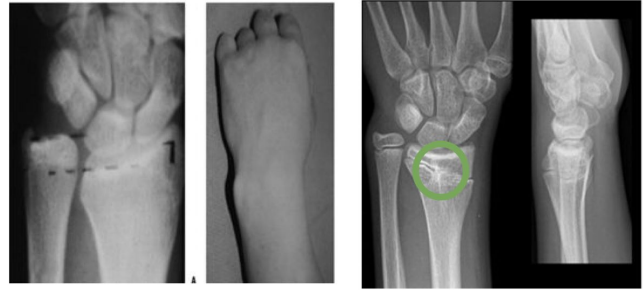
Salter-Harris Types IV and V are rare (in radius) and require ORIF





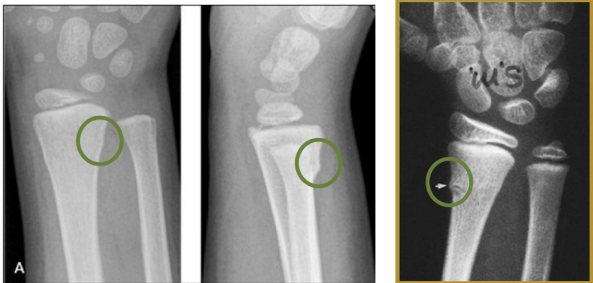
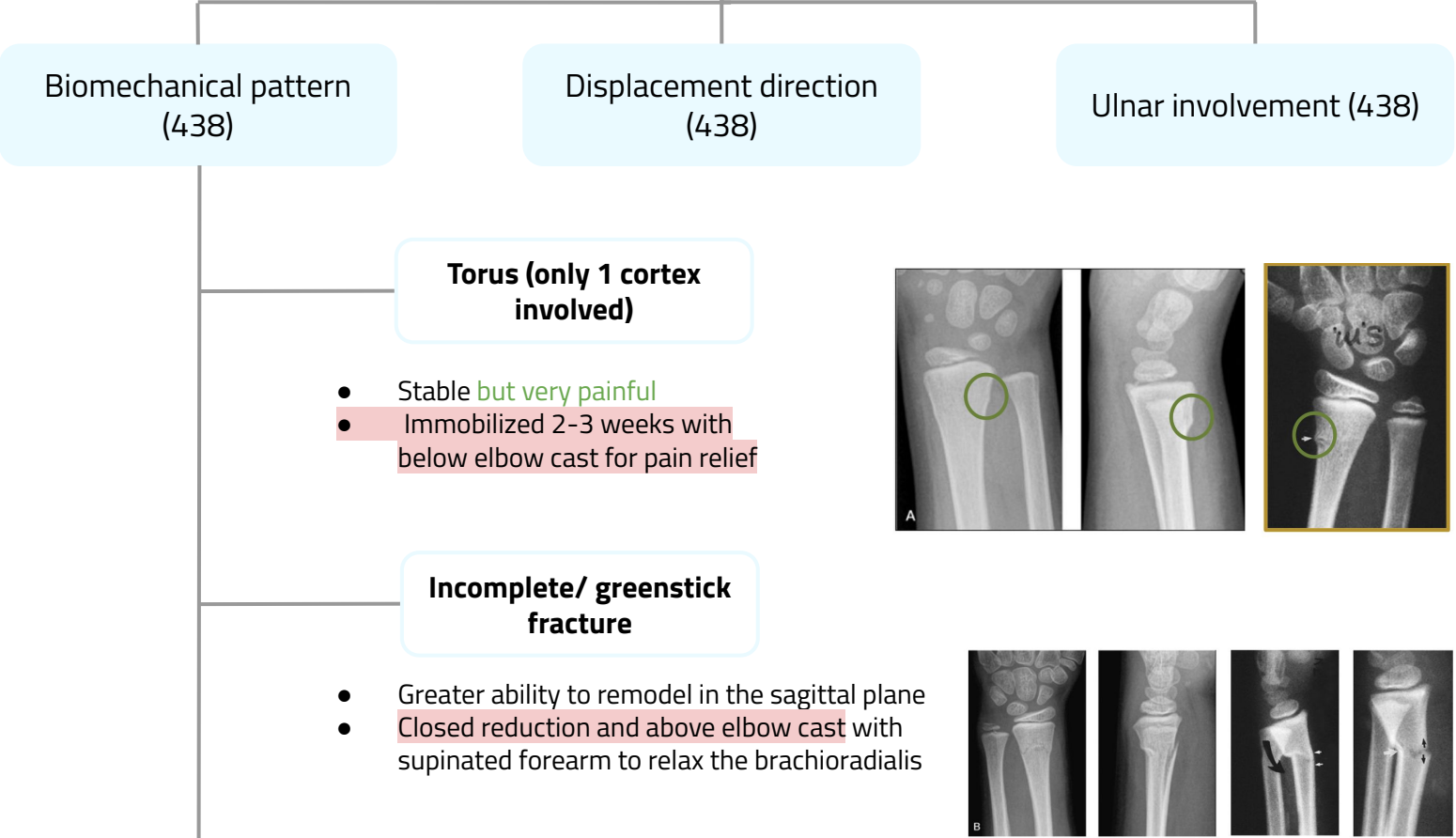
# Complications of SHF:

- Physeal arrest
  - Shortening due to physeal bridge
  - Angular deformity
- Ulnar styloid nonunion
- Carpal tunnel syndrome



## Distal Radius Metaphyseal Fractures:

### Classification



**Complete fracture**

- Closed reduction
- Well molded long arm cast for **6 weeks**

#### Indications for percutaneous pinning without open reductions

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

#### Indications for ORIF

- Irreducible fracture
  - Open fracture
  - Compartment syndrome
-



## Complications of DRMF:

- Malunion: residual angulation may result in loss of forearm rotation
- Nonunion: rare (since the metaphysis has good blood supply)
- Refracture with early splint removal and return to activity (before 6 weeks)
- Growth disturbance (overgrowth or undergrowth)
- Neurovascular injuries with extreme positions of immobilization

## Femoral Shaft Fractures:

### Incidence:

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

### Mechanism of injury:

- Direct trauma
  - RTA, falls, child abuse
- Indirect trauma
  - Rotational injury
- Pathologic fractures
  - Osteogenesis imperfecta, nonossifying fibroma, bone cysts, and tumors

### 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
- Check for knee and hip injuries (joint above and joint below)



AP and lateral views  
Must include hip, knee joints

### Classification:

#### Descriptive:



- Open or closed
- Fracture pattern: transverse, spiral, oblique, butterfly fragment
- Comminution
- Displacement

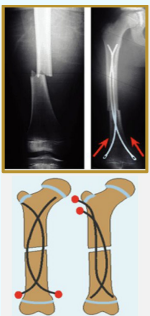
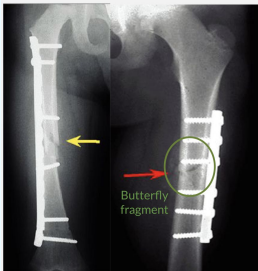
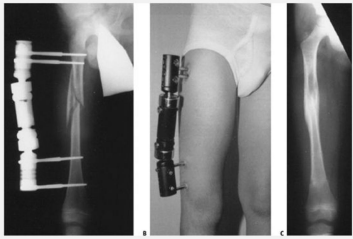

#### Anatomic:

- Subtrochanteric
- Shaft
- Supracondylar



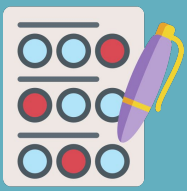
# Femoral Shaft Fractures cont..:

|                |   |  |
|----------------|---|--|
| <b>&lt;6mo</b> | <ul style="list-style-type: none"> <li>● Pavlik harness (best treatment)</li> <li>● Traction and spica casting</li> </ul>   |  |
| <b>6mo-4yr</b> | <ul style="list-style-type: none"> <li>● CR and immediate casting (&gt;95%)</li> <li>● Traction followed by spica casting if there is difficulty to maintain length and acceptable alignment</li> </ul> |  |

| <b>4yr-12yr</b>  | <b>4yr-12yr</b>  | <b>4yr-12yr</b>  | <b>12yr+</b>  |
|--|--|--|---|
| <p><b>Flexible IMN</b><br/>(Transverse fracture)</p>  | <p><b>Bridge plating</b><br/>(Comminuted or spiral fracture)</p>  | <p><b>External Fixation:</b></p> <ul style="list-style-type: none"> <li>● Multiple injuries</li> <li>● Open fracture</li> <li>● Comminuted</li> <li>● Unstable patient</li> </ul>  | <p><b>Intramedullary fixation:</b><br/>either flexible or interlocked nails</p>  |

## Complication:

- 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 (iatrogenic)



# Quiz

**Q1: Which of the following definitive fixation methods is most suitable for multiple trauma injury?**

**A**

Casts

**B**

Plates

**C**

K-wires

**D**

Screws

**Q1: Which of the following physis fractures is most commonly diagnosed late?**

**A**

Salter-Harris type 1

**B**

Salter-Harris type 2

**C**

Salter-Harris type 3

**D**

Salter-Harris type 5

**Q1: A 3-year-old patient presented with a painful, swollen left thigh and is unable to bare weight after falling from 3 meters high. Patient is stable, and X-ray shows left femoral shaft fracture. What's the management of choice for this patient?**

**A**

Closed reduction and immediate casting

**B**

Flexible IMN

**C**

Bridge plating

**D**

External fixation

**Q1: A 4-year-old boy presented with a closed fracture of the right femur. Reduction and fixation was done and the fracture healed in 8 weeks. What is the most likely complication that can happen to this patient?**

**A**

Knee fraction contracture

**B**

Leg length discrepancy

**C**

Femoral condyle avascular necrosis

**D**

Chronic osteomyelitis

**Q5: A 6-year-old boy presented with pain in his left arm after a fall. Physical examination shows a swollen, tender, and angulated elbow with skin dimpling. What is the most commonly injured nerve in this type of fracture?**

**A**

Ulnar nerve

**B**

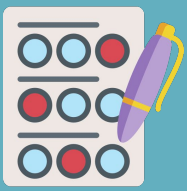
Leg length discrepancy

**C**

Femoral condyle avascular necrosis

**D**

Chronic osteomyelitis



# Quiz

## SAQ

438:

- List the indications for ORIF in distal radius metaphyseal fractures

439:

- What's the type of fracture, and mention 2 of its complications

**Extra:**

- Explain the three types of supracondylar fracture based on Gartland classification
- Mention three methods of treatment for pediatric fracture & trauma

441:

- Mention 5 differences between pediatric and adult bone features



Q1

Irreducible fracture, Open fracture, Compartment syndrome

Q2

(Salter-Harris type 4). Physeal bridging, joint stiffness..

Q3

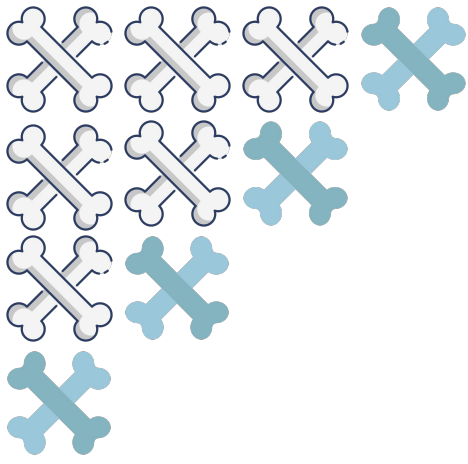
Page 15

Q4

Casting, K-wires, Screws, Elastic nail

Q5

In the beginning of the lecture



# Team Leader

## Abdulrahman Alroqi

Done by

Malik Albahlol

وَفَقَّكُمْ اللَّهُ

