

# TRAUMATOLOGY

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&

KDCHOT



# What is traumatology

„Science of injuries and following states which are connected to the injuries“

But what we need?

- Skeletal surgery – traumatology, orthopedics
- Abdominal surgery (urology, gynecology)
- Thoracic surgery
- Neurosurgery
- ENT
- Ophthalmology
- Resuscitation care
- Intensive care
- Rehabilitation care



# An adult or a child??

Administrative border divides both of the groups in their 19th birthday. Everyone is a child until their 18th + 364 days.



Biological border respects rather stadium of the development and growth.



# Epidemiology of injuries

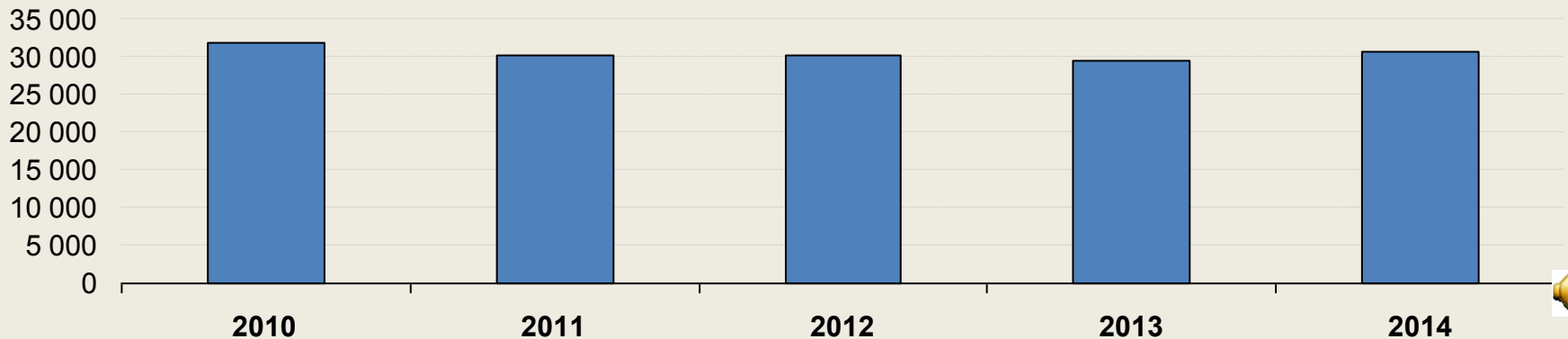
- The most frequent reason of the doctor appointment and hospitalization up to the age of 25
- The most frequent cause of death up to the age of 40
  - Economical aspects of the injuries!!!!
- Every third person in their life is hospitalized because of the injury
- Each person experiences the skeleton fracture up to the age of 18



# Epidemiology of injuries

|                         | 2017      | 2018      | 2019      |
|-------------------------|-----------|-----------|-----------|
| Adults – hospitalized   | 156 789   | 157 987   | 159 700   |
| Children – hospitalized | 31 090    | 30 456    | 31 786    |
| Adults – everyone       | 2 456 789 | 2 435 678 | 2 501 434 |
| Children - everyone     | 492 789   | 501 123   | 500 879   |

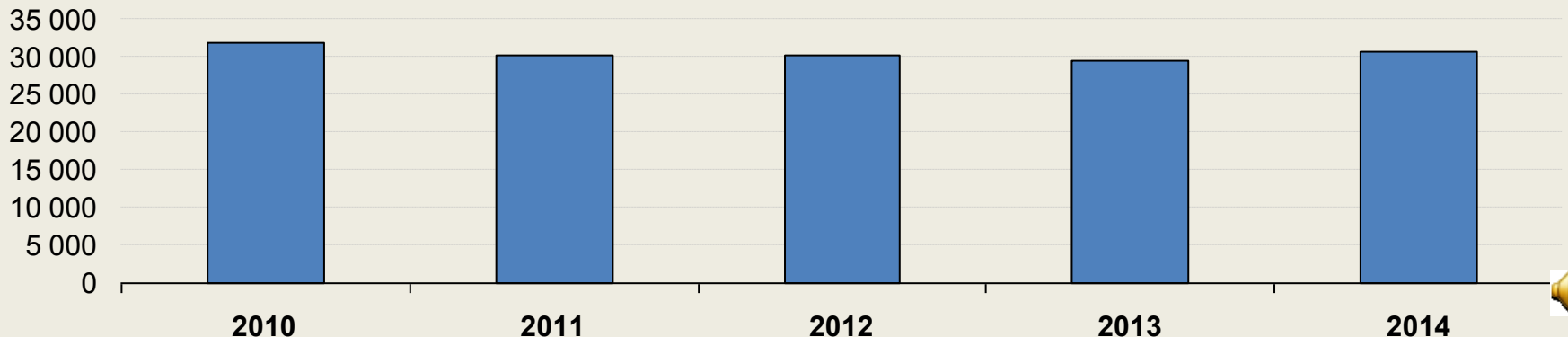
|                 | 2015         | 2016         | 2017         | 2018         | 2019         |
|-----------------|--------------|--------------|--------------|--------------|--------------|
| Injuries in all | 31 866       | 30 214       | 30 200       | 29 423       | 30 706       |
| Deaths          | 168 (0,53 %) | 161 (0,53 %) | 133 (0,44 %) | 122 (0,41 %) | 112 (0,36 %) |



# Epidemiology of injuries

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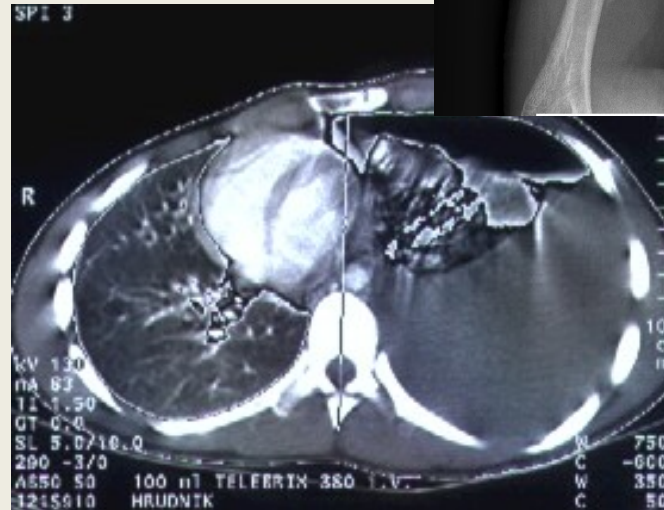
# Injury division

- **Polytrauma** – injury of multiple body systems from which at least one is life threatening
- **Multiple injury** – injury of multiple body systems from which none of them is life threatening
- **Serious monotrauma** – injury of one of the body system which is life threatening
- **Monotrauma** – injury of one of the body system without life threatening



# Polytrauma

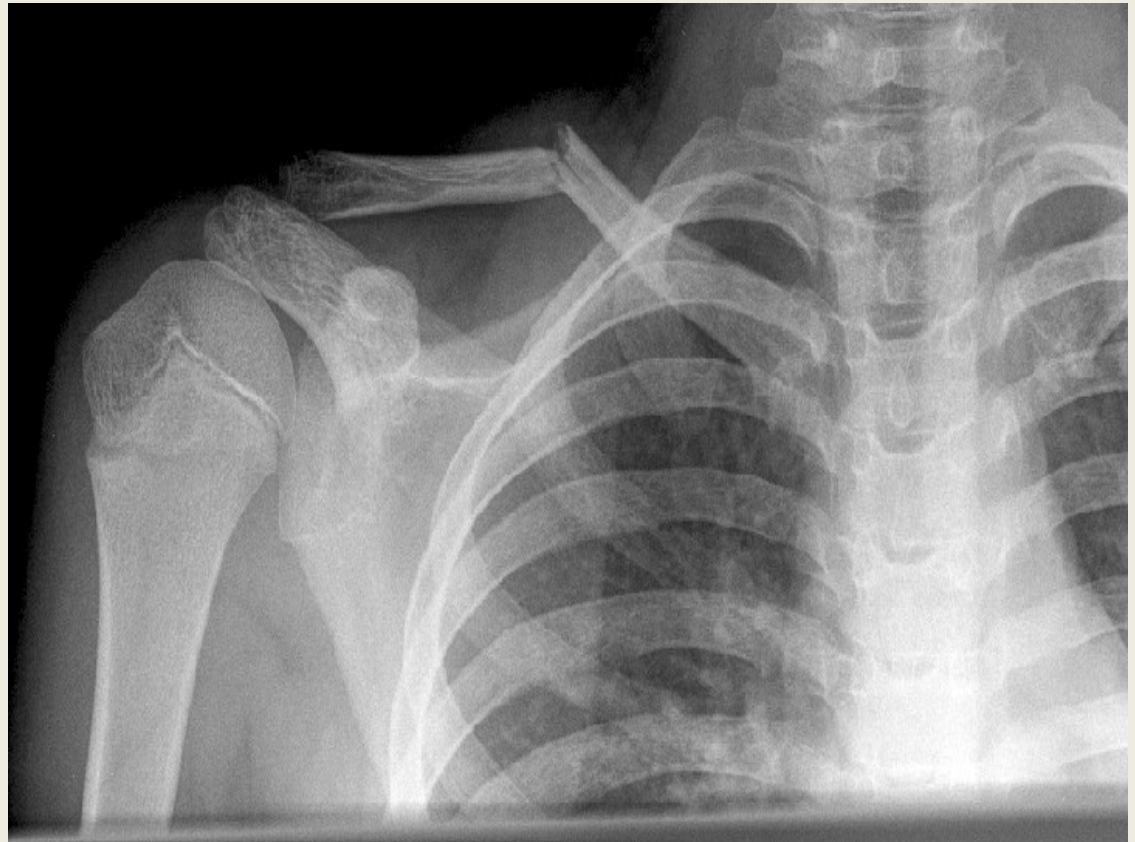
- Lung laceration, hemothorax (ventilation threatening)
- Humerus fracture on the right side
- Concussion, superficial wound of frontal area





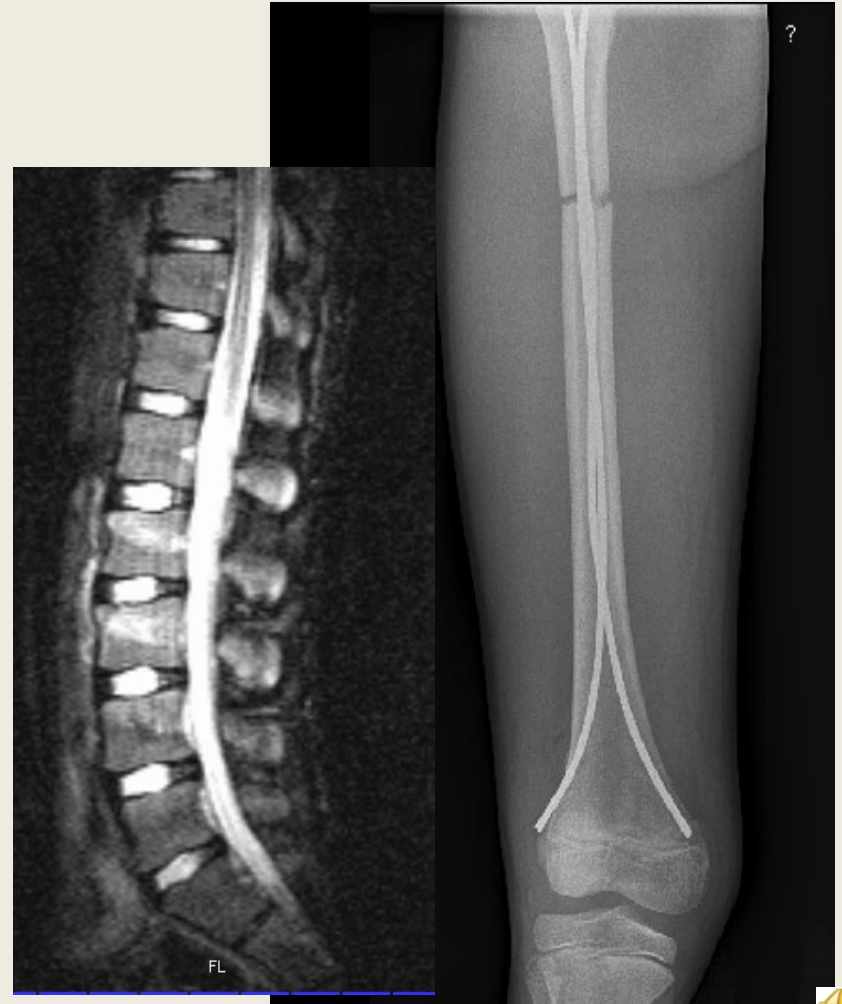
# Monotrauma

- Clavicle fracture



# Multiple injury

- Open shin wound with muscles injury
- Compression fracture of lumbar vertebrae
- Femoral fracture



# Serious monotrauma

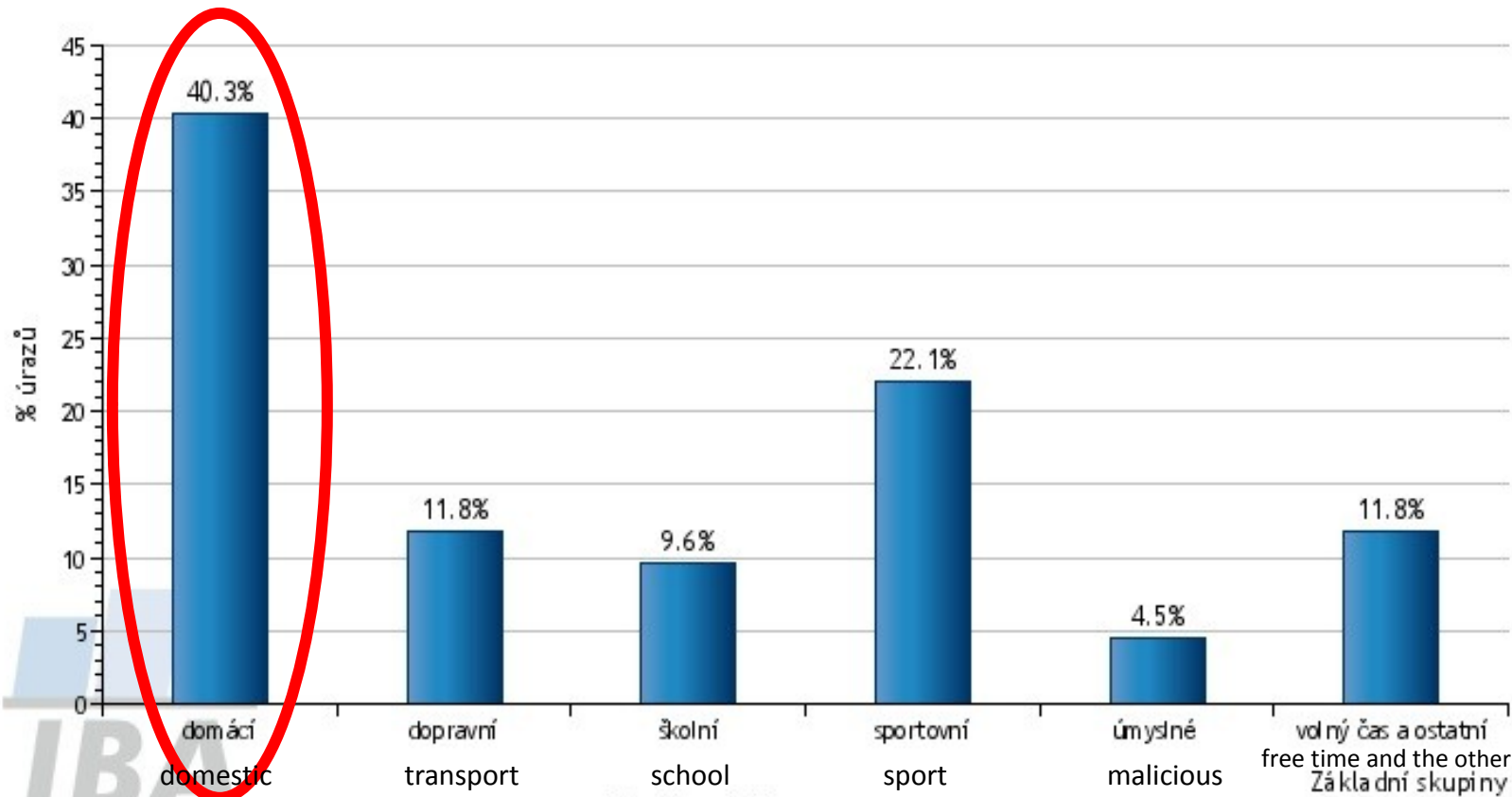
- Kidney rupture



# Etiology of injuries

*All injuries*

Mechanism of injuries according to IDB – basic groups  
Mechanismus úrazu dle IDB - základní skupiny



Základní skupiny Basic groups

Zdroj dat: Úrazový registr ČR

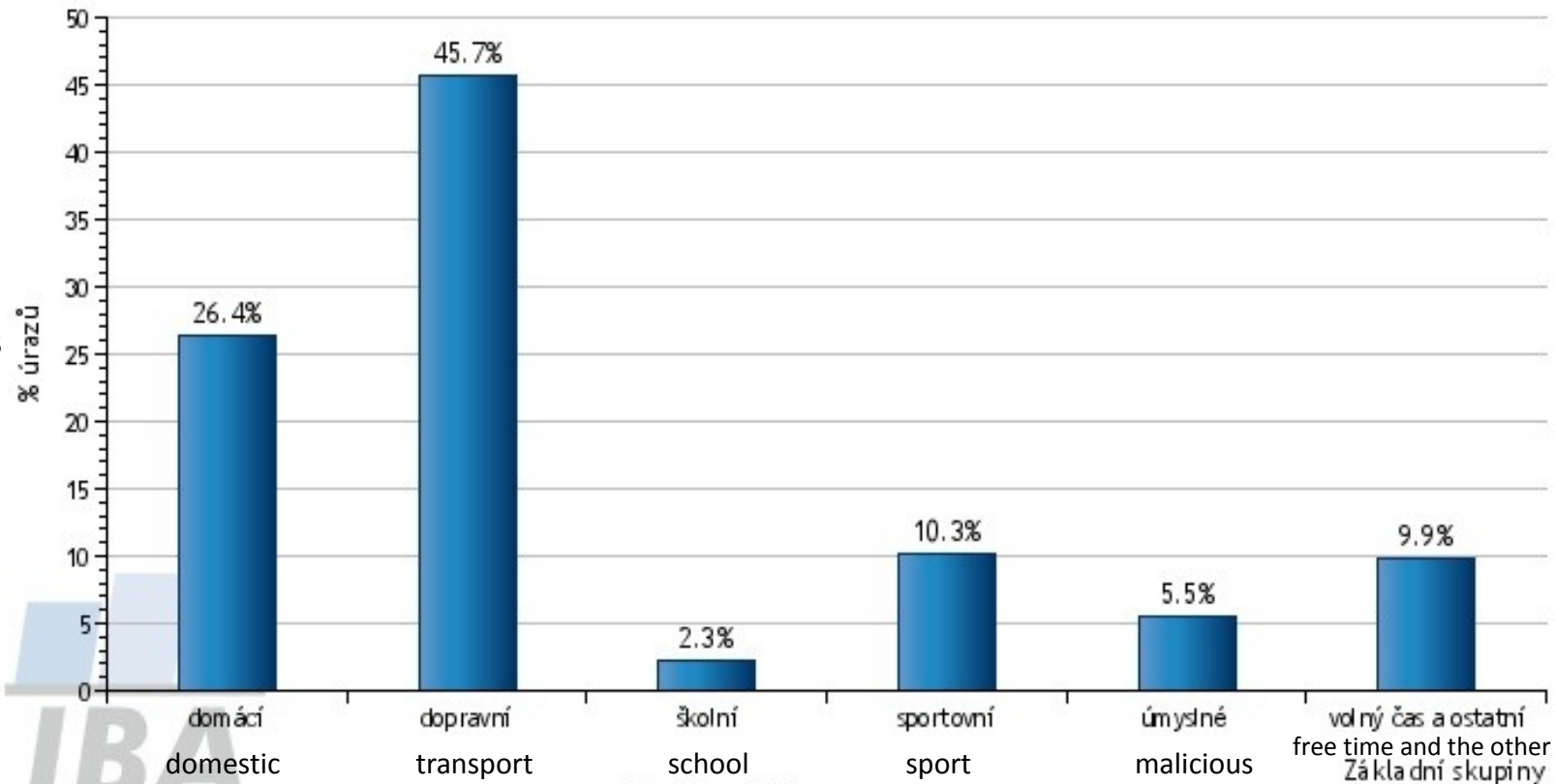


# Etiology of injuries

## Serious injuries

Mechanism of injuries according to IDB – basic groups

Mechanismus úrazu dle IDB - základní skupiny



<http://www.detskeurazy.cz>

Základní skupiny

Zdroj dat: Úrazový registr ČR

Basic groups



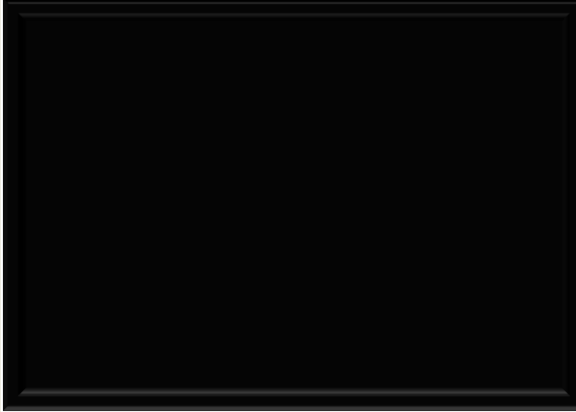


# Etiology of injuries

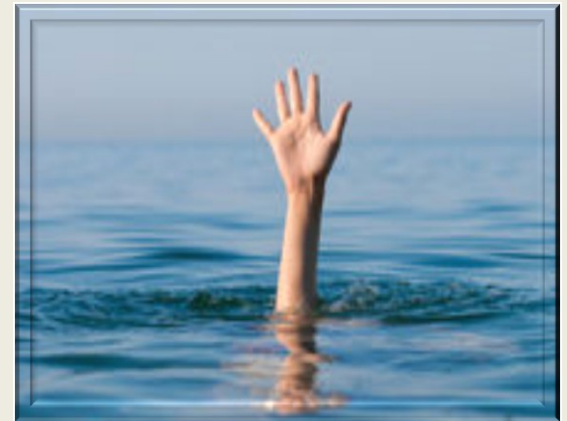
## 1. Falls



## 2. Hitting and punching



## 3. Traffic accidents



## 4. Burn

## 5. Poisoning

## 6. Drowning .....



# Trauma care system

*Prehospital care*

Selected score value

- ISS
- RTS (PTS)
- GCS (MGCS)
- Risk facts



Triage +



Triage -



# Trauma care system

## *Prehospital care*

### Selected score value

- ISS  $\geq 16$
- RTS (PTS)  $\leq 8$
- GCS (MGCS)  $\leq 12$
- Risk facts
  - Fall from height  $\geq 6$  m
  - Hit by car in speed  $\geq 35$  km/h
  - Run by vehicle
  - Vehicle catapult
  - Vehicle impaction
  - Burn  $\geq 12$  %
  - Penetrating neck, chest, abdomen, groin injury
  - Waving chest
  - Age  $< 5$  let
  - Comorbidity





# Trauma care system

## *Paediatric trauma score*

| Category    | +2         | +1           | -1                  |
|-------------|------------|--------------|---------------------|
| Size        | > 20 kg    | 10-20 kg     | < 10 kg             |
| Airway      | Normal     | Maintainable | Not Maintainable    |
| Systolic BP | > 90 mm Hg | 50-90 mm Hg  | < 50 mm Hg          |
| CNS         | Awake      | Obtunded     | Comatose            |
| Open Wound  | None       | Minor        | Major               |
| Skeletal    | None       | Closed Fx    | Open or Multiple Fx |

|     |                                 |
|-----|---------------------------------|
| > 8 | < 1% Mortality predicted        |
| < 8 | Suggests need for trauma center |
| 4   | predicts 50% mortality          |
| <1  | predicts > 98% mortality        |



# Trauma care system

## Glasgow coma scale with infant modification

| Hodnocení Assessment                        | Kojenec Infant  | Dítě Child  | Počet bodů |
|---|---|---|------------|
| <b>Otevírání očí</b><br>Eyes opening        | spontánní spontaneous   | spontánní spontaneous   | 4          |
|   | na oslovení on addressing   | na oslovení on addressing   | 3          |
|   | na bolestivý podnět on painful stimuli  | na bolestivý podnět on painful stimuli  | 2          |
|   | bez odpovědi without responding   | bez odpovědi without responding   | 1          |
| <b>Slovní odpověď</b><br>Verbal response    | brumlá a žvatlá gurgles and babbles   | orientovaná, případná oriented, possible  | 5          |
|   | podrážděný pláč cranky crying   | zmatená confusing   | 4          |
|   | na bolestivý podnět pláče cries on painful stimuli                                  | slovní odpověď nepřipadná, dezorientovaná verbal response impossible, disorientated | 3          |
|   | moans due to painful stimuli<br>na bolestivý podnět sténá                           | difficult to understand words or sounds<br>nesrozumitelná slova či zvuky            | 2          |
|   | bez odpovědi without responding   | bez odpovědi without responding   | 1          |
| <b>Motorická odpověď*</b><br>Motor response | spontaneous and effective movement<br>spontánní a účelná hybnost                    | vyhoví výzvám comply with commands  | 6          |
|   | uhýbá před dotykem dodges touch   | targeted reaction on pain<br>cílená reakce na bolest                                | 5          |
|   | dodges painful touch<br>uhýbá před bolestivým dotykem                               | dodges painful touch<br>uhýbá před bolestivým dotykem                               | 4          |
|   | posture decortication in reaction of pain<br>dekortikační držení v reakci na bolest | flexion reaction on pain<br>flexní reakce na bolest                                 | 3          |
|   | decerebrate posture in reaction of pain<br>decerebrační držení v reakci na bolest   | extensive reaction on pain<br>extenzní reakce na bolest                             | 2          |
|   | bez odpovědi without responding   | bez odpovědi without responding   | 1          |



# Trauma care system

*Trauma centers for adults*



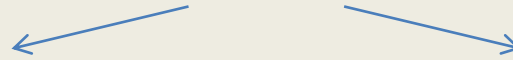
# Trauma care system

*Trauma centers for children*



# Traumatology

Injury

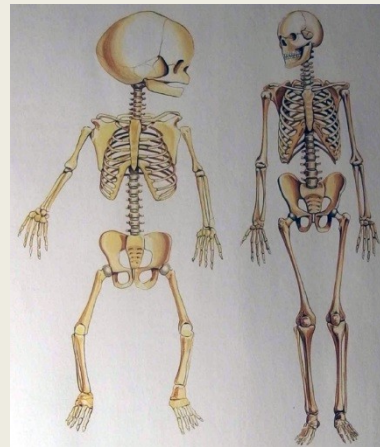


## Soft tissues

Organs and organ system  
Muscles, ligaments, joints  
Skin, subcutaneous tissue



Normal  
Great  
Minimal  
Low tendency  
High  
Very active  
Short



## Skeletal injury

Flat skull bones  
Spine injury  
Limb skeleton



Coagulation  
Circulation reserves  
Respiratory reserves  
Post-op complication  
Speed of healing  
Bones remodeling  
Rehabilitation

Modified by medicaments  
Low due to comorbidity  
Mostly great  
High tendency  
Lowering  
Null  
Long





# Skeletal injury

## Diagnosis

- Clear signs of fracture
  - Shape change
  - Crepitus
  - Pathological movement
  - Visible bone
- Unclear signs of fracture
  - Hematoma
  - Swelling
  - Pain
  - Function suppressed



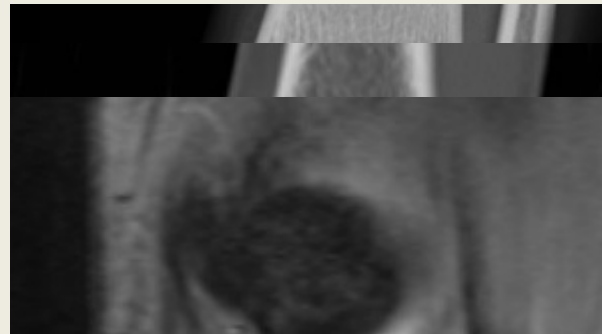
# Skeletal injury

## Diagnosis



RTG in two projections  
US examination  
CT examination

Magnetic resonance imaging



RTG in two projections  
CT examination



# Skeletal injury

## Diagnosis



Separation and fracture epiphysis



Epiphyseal injury

Intra-articular fractures





# Skeletal injury

## Diagnosis

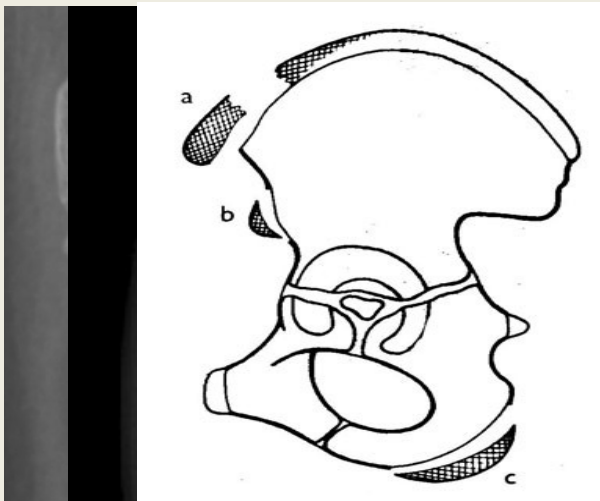


Separation and fracture epiphysis  
Avulsive fractures



Epiphyseal injury

Intra-articular fractures



# Skeletal injury

## Diagnosis



Separation and fracture epiphysis  
Avulsive fractures  
Torus fractures  
Greenstick fracture

Epiphyseal injury

Metaphyseal injury



Intra-articular fractures

Comminuted fractures

Complete fracture



# Skeletal injury

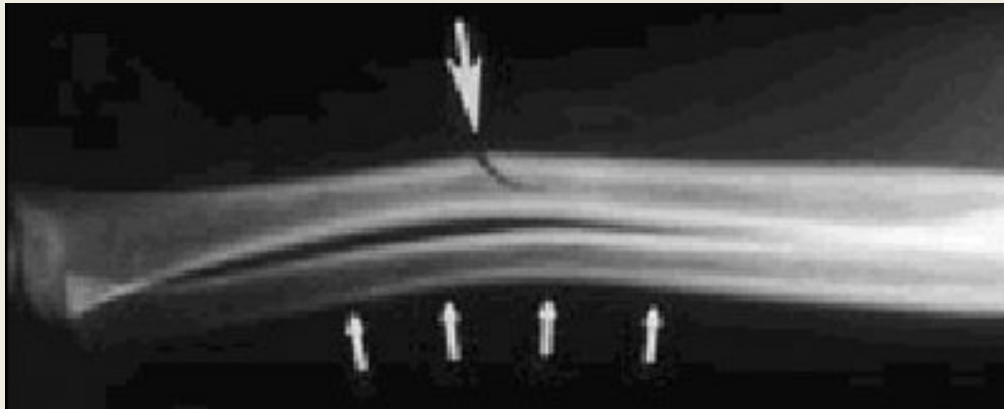
## Diagnosis



Separation and fracture epiphysis  
Avulsive fractures  
Torus fractures  
Greenstick fracture  
Fracture due to flexion

Epiphyseal injury  
Metaphyseal injury  
Diaphysial fractures

Intra-articular fractures  
Comminuted fractures  
Complete fracture  
Complete fracture



# Skeletal injury



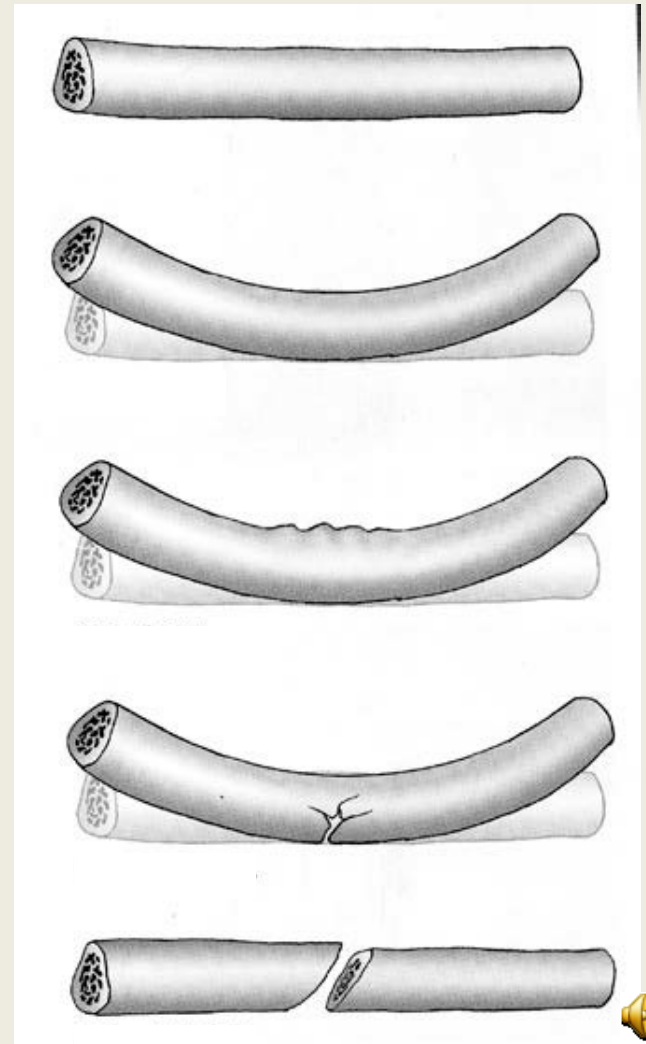
**Healthy bone**

**Bowing fracture**

**Torus fracture**

**Greenstick fracture**

**Complete fracture**



# Skeletal injury

## Classification



Salter – Harris classification

Local specific classification

AO classification

Epiphyseal injury

Metaphyseal injury

Diaphysial fractures

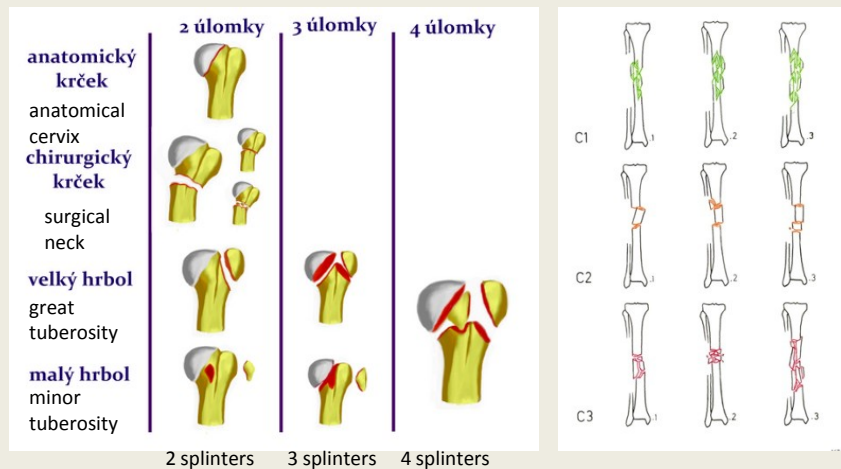
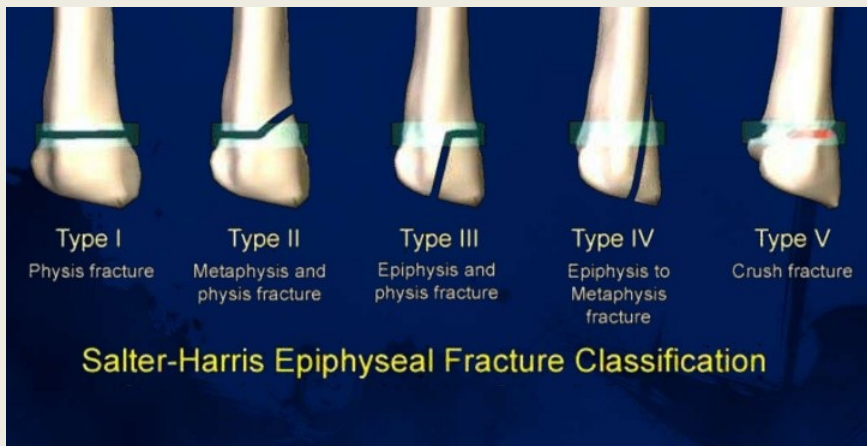
AO classification

Local specific classification

AO classification

Local specific classification

AO classification



# Skeletal injury

## Therapy



Frequently closed

Possible

Cast fixation is often enough

Miniinvasive, adaptive

Shorter

After healing

Kirschner wire

FFS

Kirschner wire

Tractional screw

Elastic nails

External fixator

Reposition

Dislocation left

Retention

Osteosynthesis

Length of healing

Rehabilitation

Epiphysis fractures

Metaphysis fractures

Diaphysis fractures

Open fractures

Frequently open

Necessary anatomical reposition

Osteosynthesis

Stabel

Long-term

Right after OS

Reconstructive splint

Tractional screws

Splint systems

Rigid nails

External fixator



# Skeletal injury

## Nursing intervention



- Fixation**
- Soft bandage
  - Semirigid
  - Rigid
  - Braces

- Reposition**
- Critical
  - Manipulation in callus
  - Plaster cast wedging

- Traction**
- Cutaneous
  - Skeletal
  - Traction bandages
  - Temporary
  - Definitive



# Skeletal injury

Nursing intervention



Operative  
treatment

MIO

Nursing  
intervention





# Skeletal injury

Surgical care

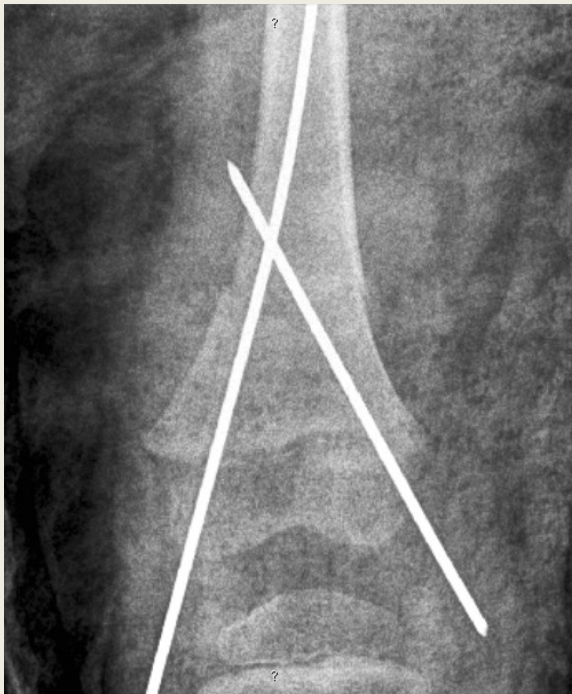


Splint systems



# Skeletal injury

Surgical care



Splint systems  
Kirschner wire



# Skeletal injury

Surgical care



Splint systems  
Kirschner wire  
FFS



# Skeletal injury

Surgical care



Splint systems  
Kirschner wire  
FFS  
Compressed screws

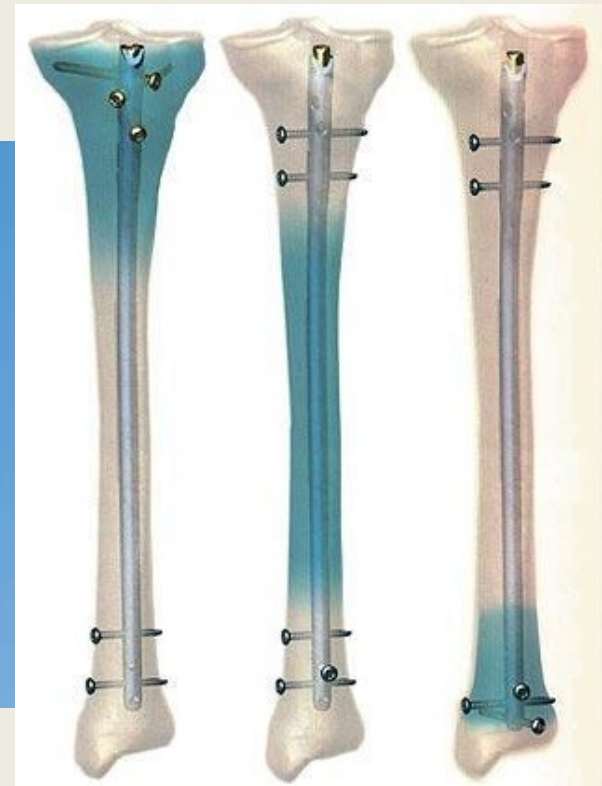


# Skeletal injury

Surgical care



Splint systems  
Kirschner wire  
FFS  
Compressed screws  
Inter-medullary nail



# Skeletal injury

## Surgical care



Splint systems  
Kirschner wire  
FFS  
Compressed screws  
Inter-medullary nail  
External fixation





# Skeletal injury

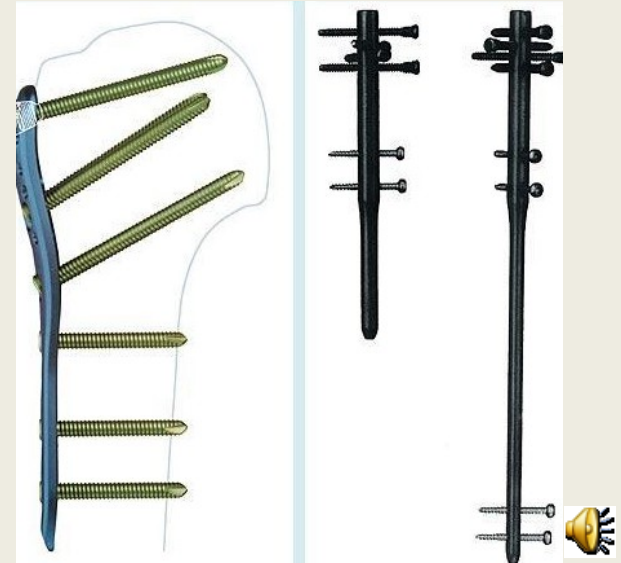
## Bone healing



Secondary healing by callus  
Ability of remodeling  
Quick course



Healing by first intention  
Necessary anatomical reposition  
Stable compressive osteosynthesis





# Growth plates

- A place which enable growth of the bone to the length
- Peripheral parts of the bones
- Histologically hyaline cartilage
- The weakest place of the child long bones
- Growth dysfunction occurs due to its injuries

Question: How many cm shorter will be thigh bone after its complete destruction of its distal growth disc. We know that the healthy bone on the other side has grown up 20 cm since the injury and the thigh bone distal growth disc provides 70% of growing of the whole bone.

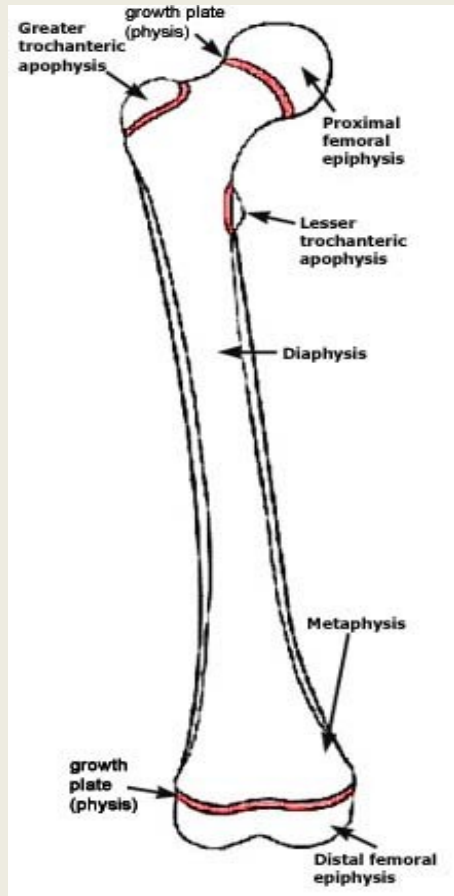
**14 cm**







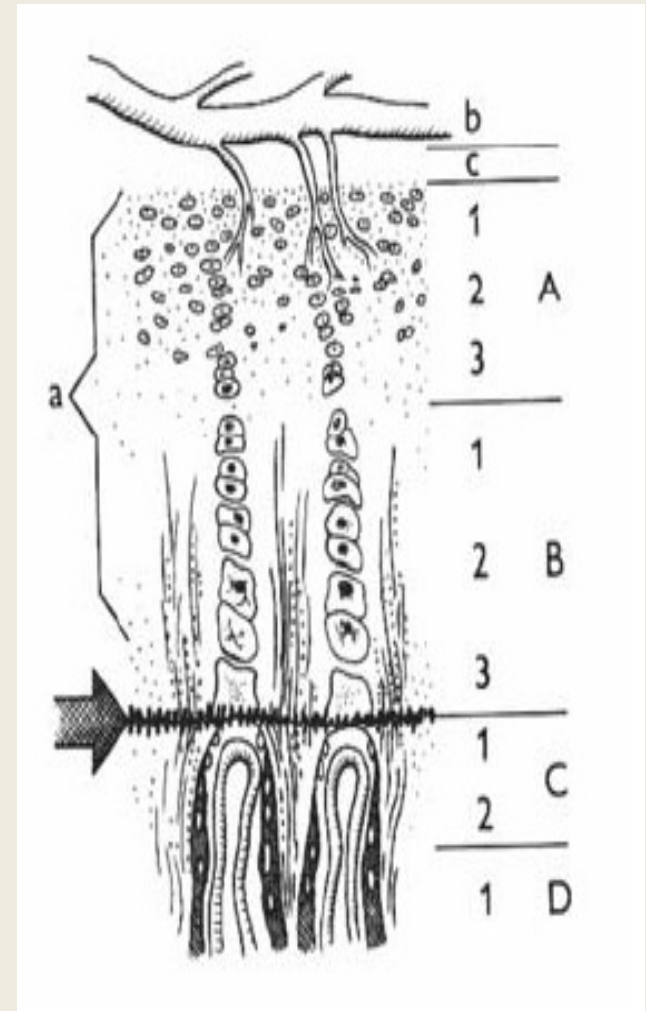
# Growth plate





# Growth plate

- A – Spare layer
  - Germinal
  - Protein synthesis
  - Low division
- B – Proliferative layer
  - Layer of dividing cells
- C – Hypertrophic layer
  - Chondrocyte regression
  - Sept calcification
  - Line refraction spot
  - Layer of dividing cells
- D – Calcified layer



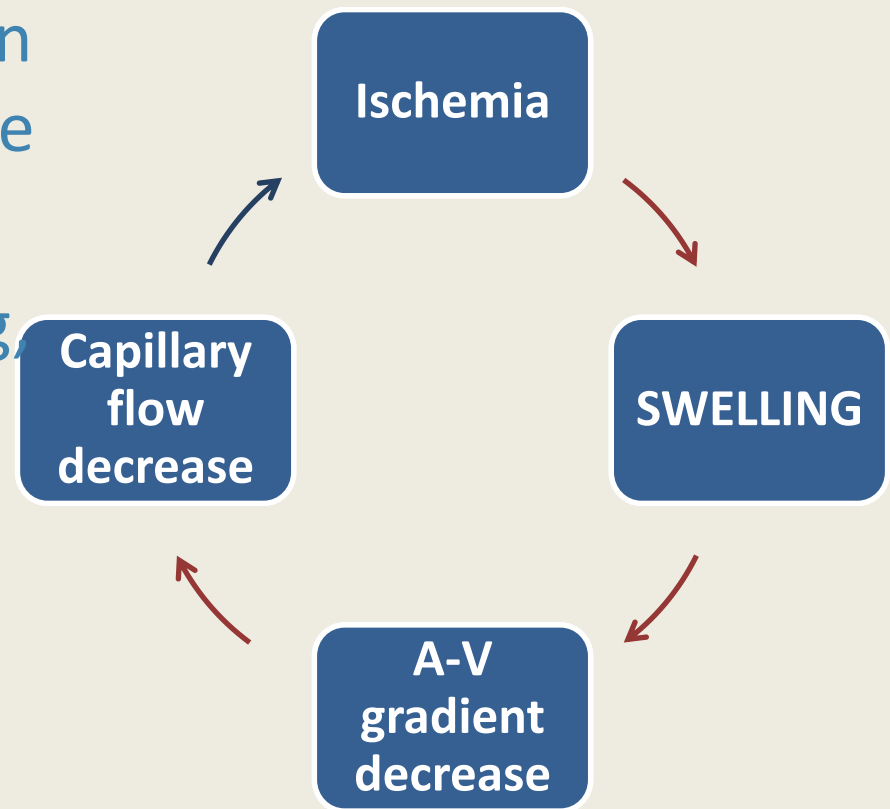
# Fracture complication

- Blood loss
  - Surrounding tissues injury
  - Compartment syndrome
  - Suppressed movement
  - Growth arrest due to GP damage
    - Growth dysfunction
    - Shape dysfunction
  - Avascular necrosis
  - False joint
    - Atrophic
    - Hypertrophic
  - Synostosis
  - Sudeck bone dystrophia
- Critical**
- Late**



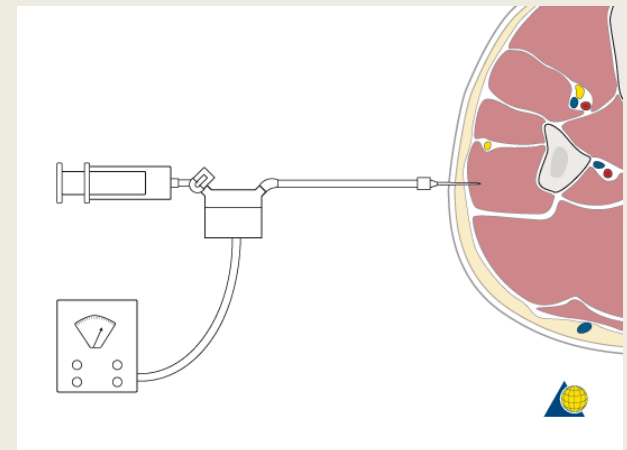
# Compartment syndrome

- A state when the perfusion pressure is the same as the tissue one (!↓BP!)
- In etiology mainly swelling, bleeding, solid bandage
- Clinical and physical diagnostics (IFP measure)
- Treatment is surgical



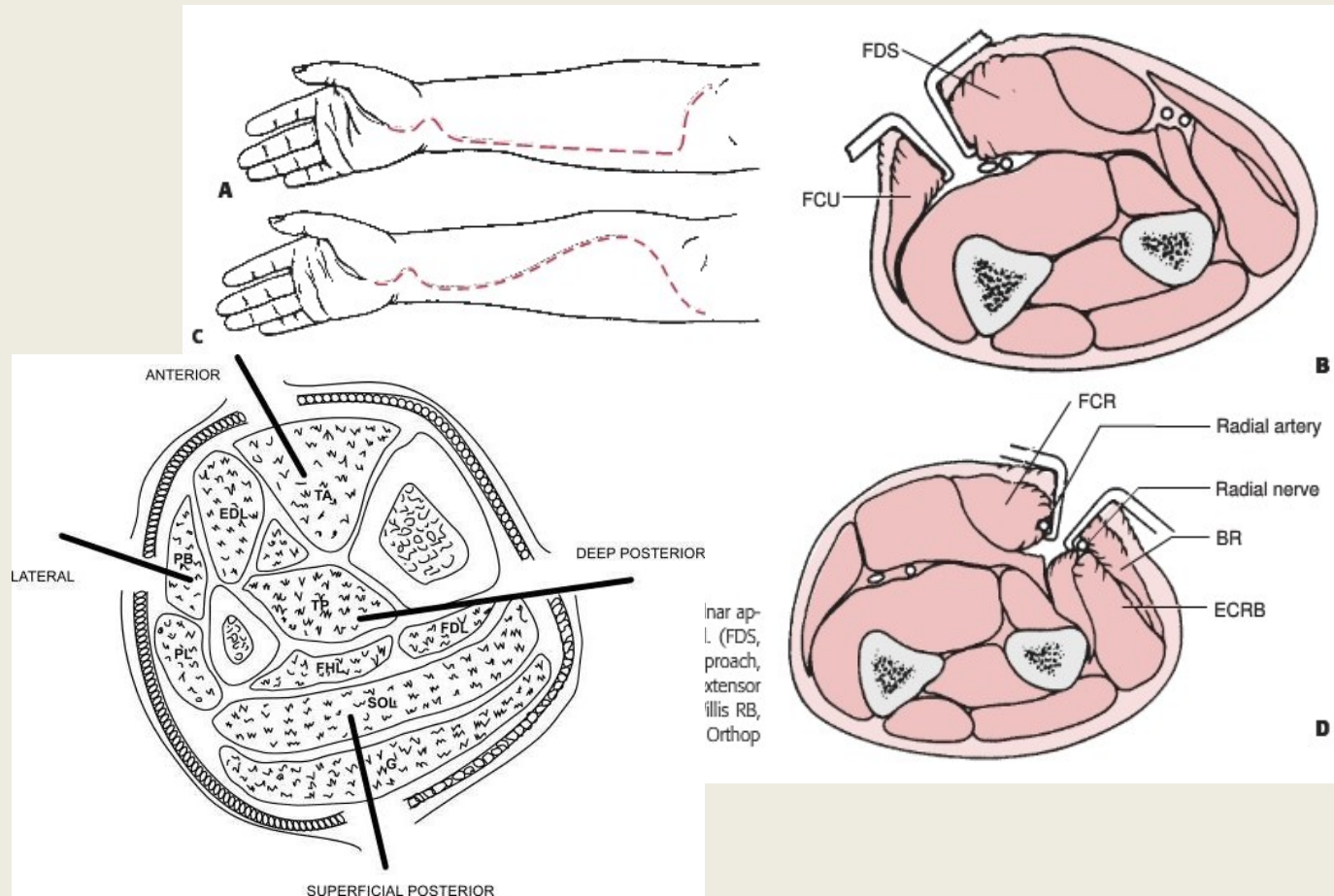
# Compartment syndrome

- Clinical symptoms
  - Resting pain (progressive) even after immobilization
  - More pain by passive finger strain
  - Sensitivity deficiency (even as paresthesia)
  - Functional failure (immobility)
  - Up to stone hardness area
  - Changes of child behaviour, growing disturbance
  - Pain does not correspond to the injury
  - Tugging is usually maintained!!!
- Tissue pressure – over 30 Torr



# Compartment syndrome

- Fasciotomy of all compartments



# Flesh wound

- **Nerve wound**
  - Neurapraxia – functional disorder, RHB
  - Neurotmesis – severance of some fibres, RHB
  - Axonotmesis – severance of nerves, necessary suture or replacement
- **Tendon wound**
  - Dislocation – reposition, immobilization
  - Tear - immobilization
  - Rupture (exceptionally at the healthy one, more likely avulsion), severance – suture, immobilization
- **Muscle wound**
  - Contusion – resting regimen
  - Rupture – minor range conservatively, great suture
  - Herniation – suture fascia
  - Crush – syndrome!! – total treatment, dialysis





# Fracture complication

- Blood loss
- Surrounding tissues injury
- Compartment syndrome
- Suppressed movement
- Growth arrest due to GP damage
  - Growth dysfunction
  - Shape dysfunction (malunion)
- Avascular necrosis
- Non union
  - Atrophic
  - Hypertrophic
- Synostosis
- Sudeck bone dystrophia



Late



# Fracture complication

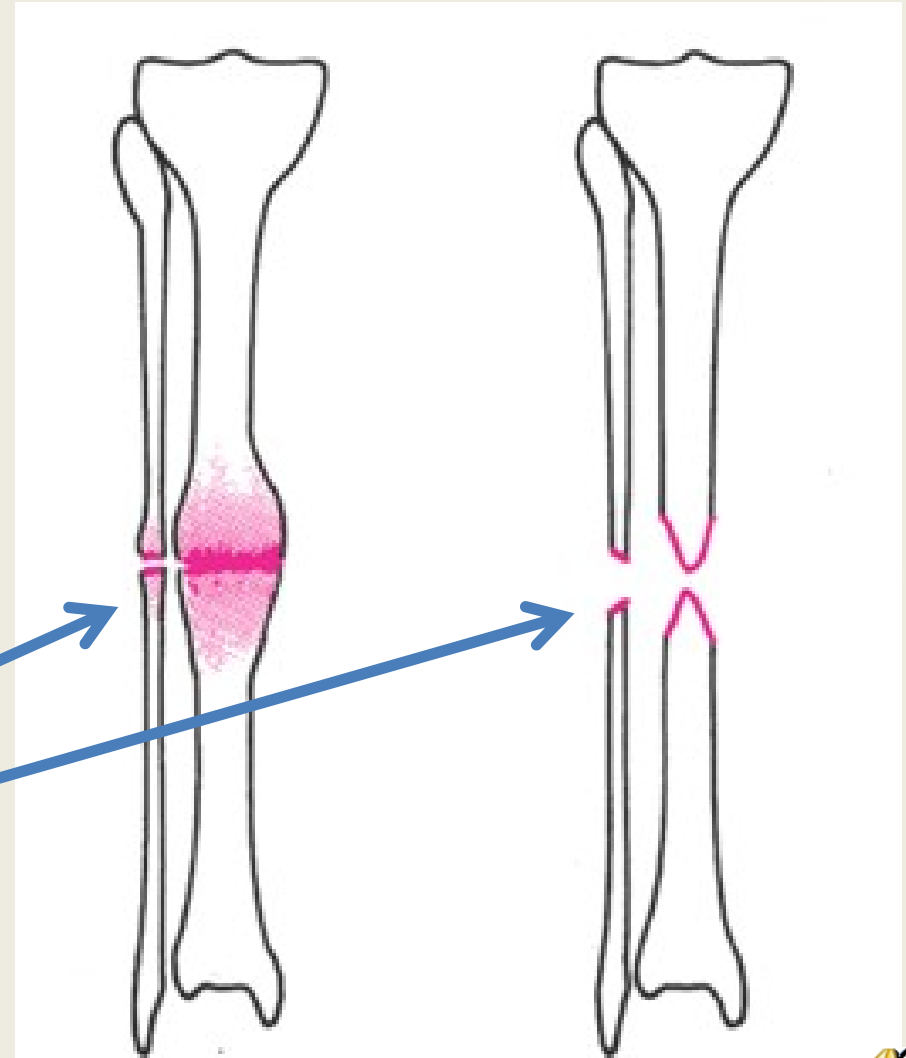
- Blood loss
- Surrounding tissues injury
- Compartment syndrome
- Suppressed movement
- Preterm extinction of physis
  - Growth dysfunction
  - Shape dysfunction
- Avascular necrosis
- Non union
  - Atrophic
  - Hypertrophic
- Synostosis
- Sudeck bone dystrophia

**Critical**



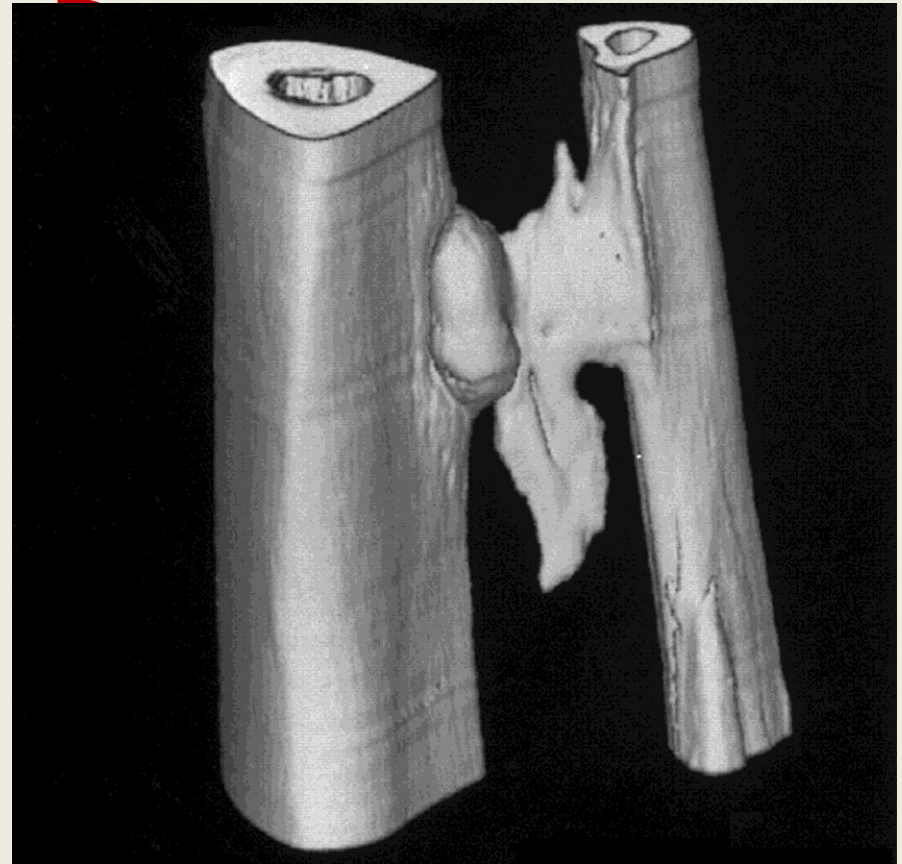
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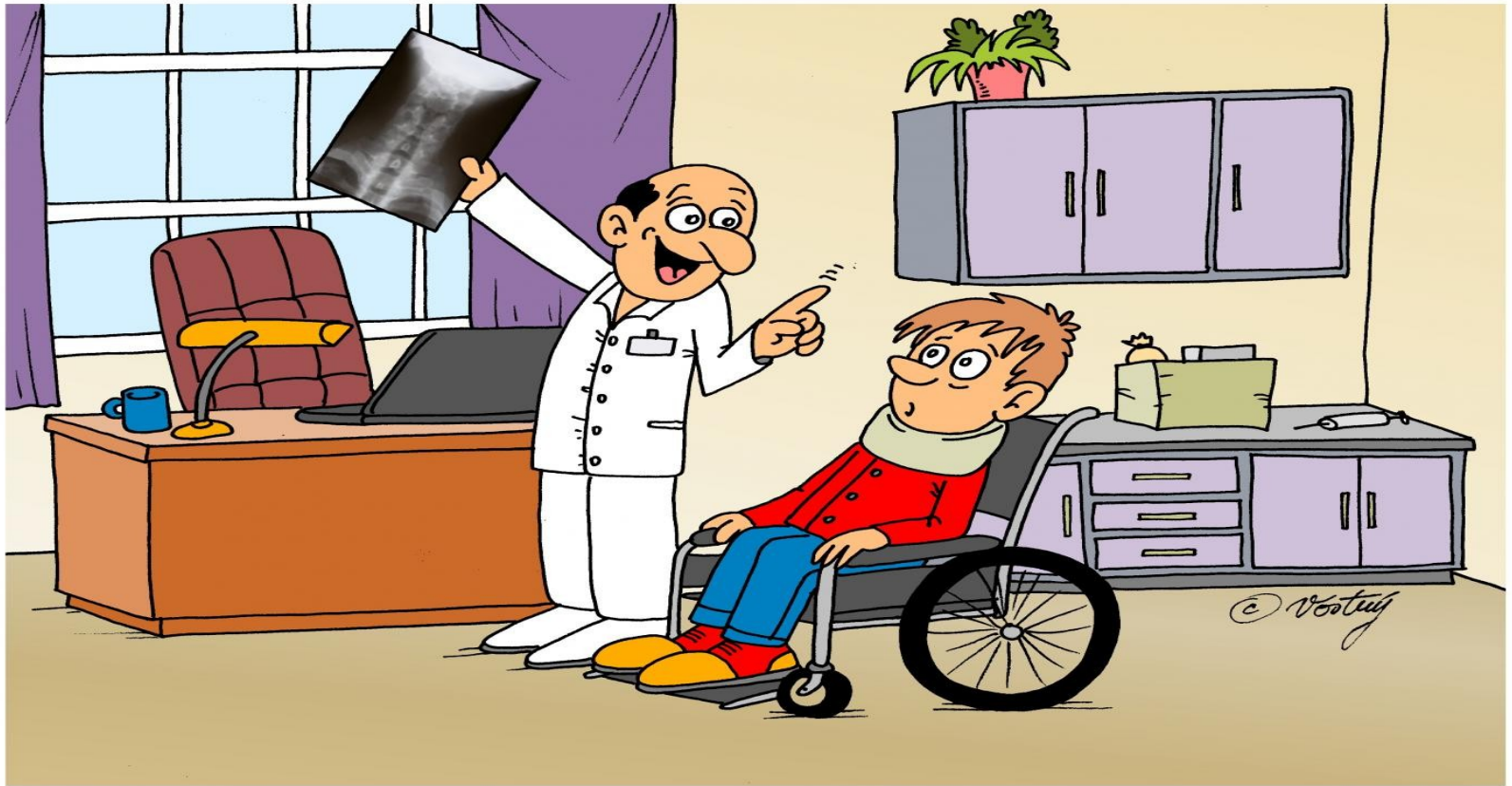


# Fracture complication

- Blood loss
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- Non union
  - Atrophic
  - Hypertrophic
- Synostosis
- Sudeck bone dystrophia



# Thank you for your attention



**Your screenshot showed that you have broken cervical vertebrae  
but you can relax as I have already changed it in Photoshop.**

