Open Fractures & Pelvic Fracture

◈ Open Fractures: (all facts here are also applied on Open joins)

❖ **Definition:**
- A fracture that at some point communicated with the environment. (we mean by open here any form of communication even if it needle inserted inside)
  - An open joint is managed similarly
- Usually requires higher injury
- Old patient may fall down and have open fracture because of the bone and tissue weakness, so Not always higher injury!
- Sometimes can be missed, maybe there are small wound and the physician miss it.
- Commonly occurs in bones with minimal soft tissue coverage. (E.g. Tibia)
- Usually higher energy is required in deep bones → ex , Femur bone need very high energy because it covered with Soft tissues

❖ **Pathology:**
- Traumatic energy to the soft tissue and bone (communication with environment)
- Inoculation of organisms
- Necrotic tissue
- Injury to vessels and microvasculature
- Raised compartment pressure
- Ischemia and lack of immune response
- ***Infection***:
  - Difficult to eradicate the infection
  - Prolonged antibiotics
  - Multiple surgeries
  - Significant morbidity → slow healing
  - Significant costs

❖ An open fracture is a usually a "red flag" warning of significant trauma
- Detailed assessment of the patient is necessary

❖ An open fracture is associated with significant morbidity
- Must act quickly → take fast detailed history

❖ A delay in management is proven to increase the likelihood ofcomplications
- Give urgent priority while triaging, provide initial management and consult urgently

❖ **Diagnosis:**
- Sometimes obvious!
- Other times, settle,,, be observant → (need high suspension)
  Signs : 1- main sign is seeing the bone) other signs : (continouse loss of black ozzing blood and droplet of fat)
- A wound close to a fracture *is an open fracture* until proven otherwise. مهمه
- Whenever a fracture is diagnosed, go back and check the skin مهمه
  - A small wound continuously ***oozing blood***, especially, if you see ***fat droplets*** within the blood, is an open fracture!

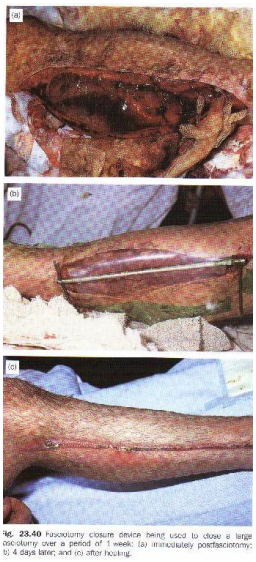
- Not always close to the fracture, it may be around it
- Don't probe!!
- If in doubt, use good light, if there is a break in the dermis or fat is seen, call it an open fracture
- Better to overcall than miss it!

❖ **Algorithm:**

- Assess and stabilize the patient, ATLS principles
- Assess the condition of the soft tissue and bone to help grade the open fracture
- Manage the wound locally
- Stabilize the fracture
- IV antibiotics
- Tetanus status

❖ **Assessment:**

- If polytrauma, apply ATLS principles
- If isolated injury: مهمه → in Hx take : (MCQ – OSCE) /
  - Mechanism and circumstances of injury
  - Time since injury
  - PMH/PSH/Allergy/Drugs/Smoking
  - Tetanus vaccination status
    - If the patient get the tetanus vaccine in the within the past 10 year don't give him any thing
    - If the patient unconscious or he answers you that he got it in more than 10 years then give him the vaccine.



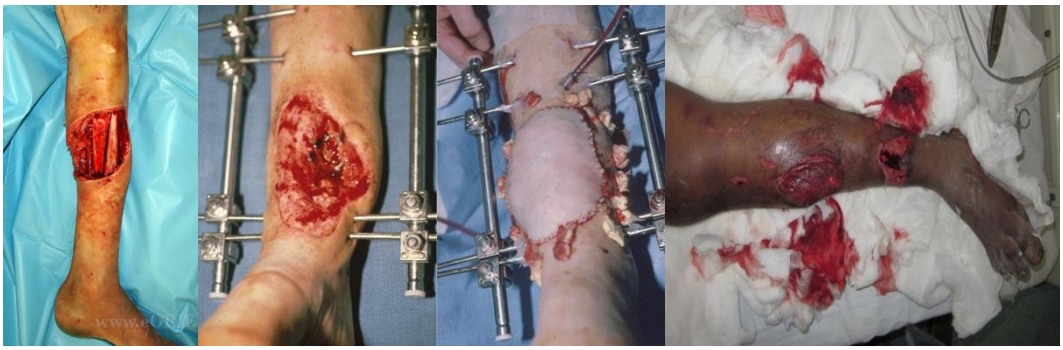
- Examine the affected region for:
  - ***Soft tissue:***
    - Degree of contamination (look for dirt)
    - Necrotic and devitalized tissue
    - Size of wound
    - Coverage loss
    - Compartment syndrome
  - ***Bone:***
    - Comminution
    - Stripping of bone periosteum
    - Away from injury to joint above and below
    - X-rays to joint above and below
  - ***Neurovascular status distally:***
    - On arrival and post reduction and splinting later.
      - You need to document everything the patient came with to avoid any medico legal problems

❖ **Open fracture grade: (take full Hx to grade correctly)**

- ***Grade 1:***
  - Less or equal to ***1 cm***, it has to be :
    - Clean
    - Non-segmental NOR severely comminuted fracture
    - less than 6 hours since injury
    - NB : Grade I has low incidence of infection

- ***Grade 2:***
  - > 1cm wound: < 6 h
    - Not extensive soft tissue injury or contamination
    - Non segmental nor severely comminuted fracture
    - No bone stripping and with adequate soft tissue coverage

    NB : differ only in size
- ***Grade 3:***
  - ***3A:*** Any size with:
    - extensive soft tissue contamination or injury but not requiring soft tissue coverage procedure, or with a segmental or severely comminuted fracture, or late presentation more than 6 hours
  - ***3B:*** Any open fracture that requires soft tissue coverage procedure ***(soft tissue loss)***
  - ***3C:*** Any open fracture that requires vascular repair
    - If you exam patient with grade 3C, you will find him pulseless and when you investigate him there will be vascular injury indicate the pulseless.



3B 3B after graft

❖ Management

- ***Local:*** **1st step : Analgesics**
  - Take a picture, to avoid the needing to open it again for examination.
  - 2nd step : If dirty, irrigate with normal saline to remove gross contamination
  - If bone sticking out try to reduce ((only Reduction) gently then immobilize and re-neurovascular status مهمه
  - Cover with sterile wet gauze (by normal Saline) and do not remove it , apply the new Ones on top of it
  - If bleeding apply direct pressure on wound
  - No culture swabs in ER
  - Then stabilize it by Back slap

- ***Antibiotics:***
  - First generation Cephalosporin for gram positives (Ex: Cefazolin) in all open fractures
  - Aminoglycoside to cover gram negatives (Ex: Gentamicin) sometimes not required in grade 1 but *in general it is safer* to give in all grades.
  - Add penicillin or ampicillin or clindamycin for clostridium in grade 3 open fractures and all farm and soaked wounds سقط في ماء عكر او في مزرعه

- ***Tetanus prevention:***
  - Wound types:
    - Clean wounds:
      - <6 hours from injury
      - Not a farm injury
      - No significant devitalized tissue
      - Non immersed wound
      - Non contaminated wound
    - Other wounds

MCQ الجدول مهم جدا –

Clean wounds			Other wounds		
Completed vaccination		Not completed or unknown	Completed vaccination		Not completed or unknown
Booster < 10 years	Booster >10 years	Td 0.5ml IM	Booster < 5years	Booster > 5 years	TIG 250U And Td 0.5ml IM
nothing	Td 0.5 ml IM		nothing	Td 0.5ml IM	

- As soon as patient is stable and ready, alert the OR, and consent for surgery
- Plan: Irrigation, debridement and fracture stabilization
- The sooner the less risk of further morbidity

- ***In the OR:***
  - Extend wound if necessary
  - Thorough irrigation (with normal saline)
  - Debride all necrotic tissue
  - Remove bone fragments without soft tissue attachment except articular fragments and the ones attached to cartilages مهمه جدا
  - Usually requires second look or more every 48-72 hours
  - Generally do not close open wounds on first look اول عمليه

- ***Fracture management:***
  - Generally avoid internal fixation (plate and screw) مهمه
  - Generally external fixator is used.
  - Femur and tibia fractures can usually be treated immediately with IM nail except severe injuries and contamination مهمه
  - Observe for compartment syndrome post-operatively

Results :

- ***If all principles applied: (as guidelines)***
  - 2% complication rate in grade 1
  - 10% complication rate in grade 2
  - Up to 50% complication rate in grade 3
    Complications like : Infection – pain – stiffness

◈ Fractures with nerve or vascular injuries:

- ❖ Don’t miss it!
- ❖ Always perform an accurate assessment at presentation, post manipulation and reduction, post-surgical fixation, serially until condition stabilizes
- ❖ Serial examination helpful in deciding line of treatment
- ❖ Serial examination helps avoid confusion
- ❖ High correlation between vascular injury and nerve injury
  - Proximity between them anatomically.

- ***Mechanisms:***
  - Penetrating trauma
  - High energy blunt trauma
  - Significant fracture displacement
  - Keep in mind tissue recoil at presentation ترجع لمكانها وقت الفحص – مخادعه

Vascular injuries:

- Direct laceration
- Traction and shearing



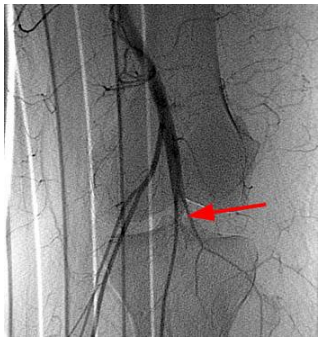
مهمه

- **Assessment:**
  - Always check: مهمه
    - Pulse, Color, Capillary refill, Temperature, compartment pressure
  - Keep high index of suspicion:
    - High energy trauma
    - Associated nerve injuries
    - Fractures/ Dislocations around the knee
  - Hard signs > realignment of limb > if persistent > ➔ vascular intervention
  - Hard signs > realignment of limb > improved > ➔ Close observation ➔ Realignment can result in unkincking of vessels, lowering compartment pressure, relaxation of arterial spasm
  - ABI (ankle brachial index)
    - < 0.9 associated with vascular pathology
    - Rarely can give false negative result (Ex. Profundafemoris)
    - Always used in high risk fractures (knee)
    - If positive > Urgent vascular intervention

Table 1

Hard and Soft Signs of Vascular Injury Associated With Extremity Trauma

Hard signs
Pulselessness
Pallor
Paresthesia
Pain
Paralysis
Rapidly expanding hematoma
Massive bleeding
Palpable or audible bruit
Soft signs
History of bleeding in transit
Proximity-related injury
Neurologic finding from a nerve adjacent to a named artery
Hematoma over a named artery

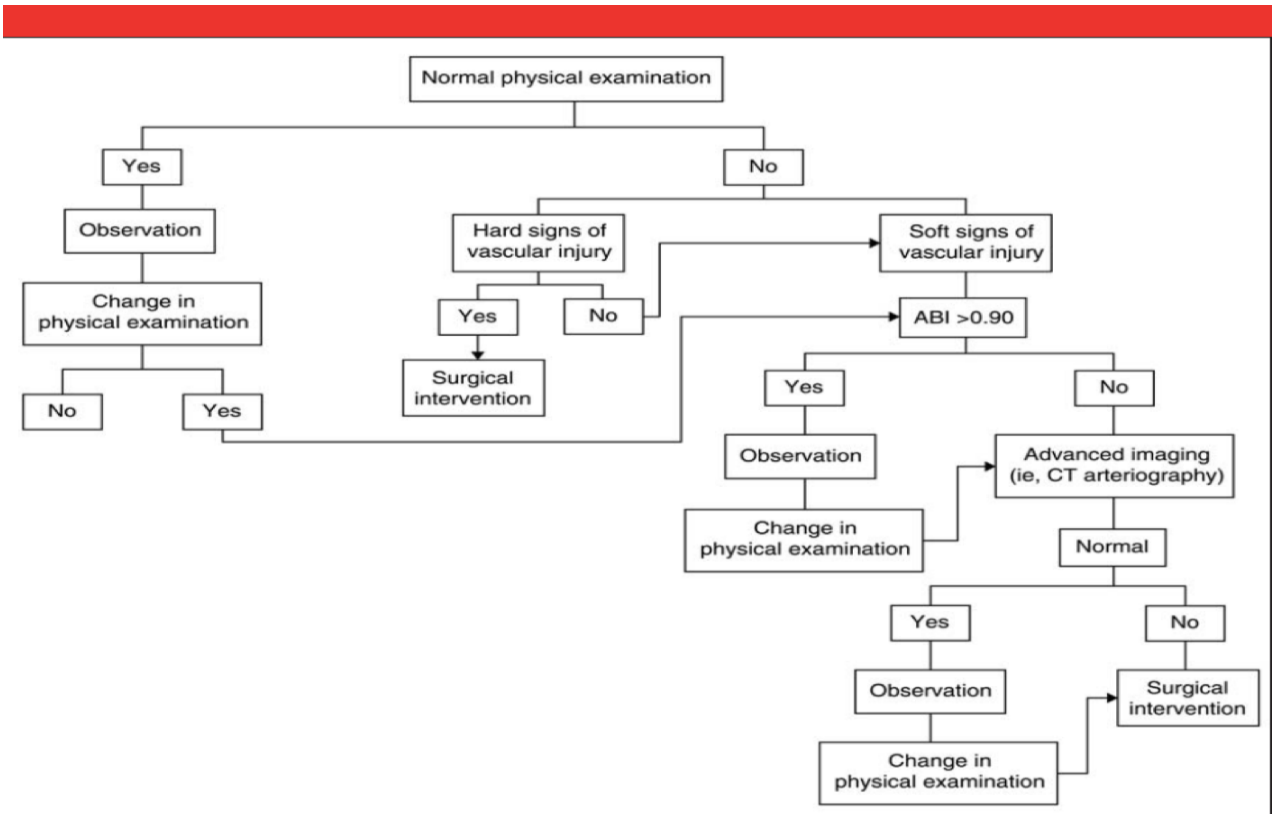


- Angiography, CT angiography
- Gold standard → But always start with simple tests
- Not without risks
- Vascular surgeon to arrange with interventional radiologist

❖ **Management:**

- Once vascular injury is confirmed:
  - Coordination between: (All AIM to save the Limb)
    - Vascular surgeon
    - Orthopedic surgeon
    - General surgeon
  - To emergently re-establish perfusion and protect repair with skeletal stabilization
- Warm ischemia بدرجه حراره الغرفه time dictates treatment
  - Warm ischemia: loss of perfusion with having the same of the room temperature.
  - Cold ischemia: like in the OR e.g. cooling limp to survive longer
- Most times, a quick external fixator is applied, followed by vascular repair
- Avoid prolonging warm ischemia to do a perfect job

- Prolonged warm ischemia >6 hours
  ➔ Prophylactic fasciotomy
- Grade 3C open fractures have the worst outcome
- Amputation may be necessary in severe cases

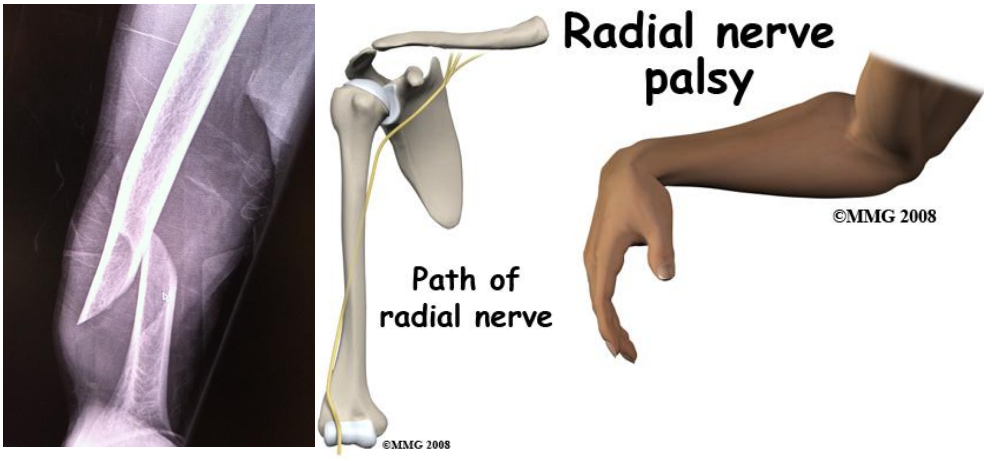


◈ Nerve injuries:

- Cause of medico-legal concern
- Accurate assessment and documentation at presentation, post reduction, post-surgery is essential
- Remember to examine for motor and sensation prior to sedation

- Closed fractures not requiring surgery with nerve injuries:
  - Usually good outcome >80% مهمه
  - Usually managed conservatively in the early stages
  - Recovery may take more than 6 months → interfere after 6 M

- Intact nerve before reduction, absent after reduction: → may due to entrapment or nuropyrexia
  Ex " in distal 1/3 of humors : if Radial nerve palsy oocur Post Op : Do
  - Controversial management
  - Usually observe



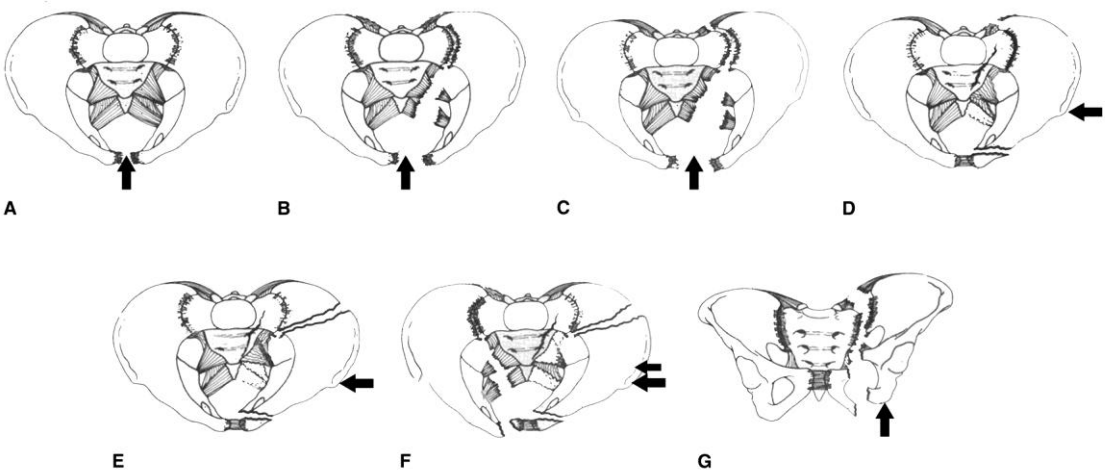
- Fracture requiring surgery with nerve injury:
  - Limited exploration
- Open fracture with nerve injury:
  - Explore, tag nerve ends for later repair

- ***Follow up:***
  - Clinically
  - Electro diagnostic assessment start at 6 weeks then serially every 6 weeks → during this time give Splint to hold the limb in its position
  - If no improvement:
    - Nerve exploration: neurolysis / repair / grafting
    - Tendon transfers to preserve function
- ***Common sites of Nerve injuries:***
  - Shoulder fracture / dislocation > Axillary nerve
  - Distal humeral shaft fracture > Radial nerve
  - Elbow fracture / dislocation > Median>radial>ulnar
  - Hip fracture / dislocation > Sciatic nerve
  - Knee fracture / dislocation >Peroneal nerve

◈ Pelvic trauma:

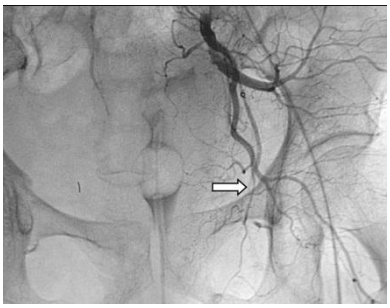
- It composed of sacrum, coccyx, ilium, ischium and pubic rami
- Pelvic fractures / instability may cause life threatening bleeding
- Usually the bleeding in the pelvis is venous it reach 90% of pelvic bleeding
- Diagnosing pelvic instability can save lives

- **Pathology:**



  - A- anterior force causing a little opening in the sacro-illiac joint
  - B- anterior force causing opening in the sacro-illiac joint and instability
  - C- More force cause open book pelvis
  - D, E and F lateral compression. e.g. car accident
  - G- Vertical shears pelvic fracture.

- ***In polytrauma Pt, :***
- ***Diagnosis:***
  - History: High vs. Low energy trauma
  - Mechanism of injury: Anterior vs. Lateral vs. Axial force
  - Pelvic skin contusion, bruising
  - Short extremity
  - Careful neurologic assessment



  - ***Primary survey : part of "C"***
    - Assess stability by gentle compression on the ASIS
    - Traction on the leg and assess pelvic instability
      - If unstable or painful: (pelvic binder)
        - Apply sheet around hips and close the pelvis gently
        - This results in decreased intra-pelvic volume leading to tamponading the bleeding → BP will rise
        - Traction on the leg to stabilize vertical instability

- This minimizes ongoing vasculature injury and bleeding

- ***Rectal exam:***
  - Bone fragments (be careful)
  - High riding prostate
  - bleeding
- Blood at the meatus
- Labial or scrotal ecchymosis
- Vaginal exam

❖ ***Management:***

- Stabilize pelvis with binder
- If vertically unstable apply traction
- IV resuscitation
- Look for other injuries
- Check response
- If partial response, may require angiography for embolization of bleeders
- May require external fixator and/or pelvic clamp

❖ ***Early diagnosis***

- Aggressive resuscitation
- Coordinated team effort
  - Save lives