



[ Color index : **Important** | **Notes** | Extra ] Editing file [link](#)

## **Open fracture, Fracture with NV compromise and Pelvic fracture**

### **Objectives:**

- ★ To be able to **identify and diagnose** patients with an open fracture, a fracture with nerve or vascular injury and polytrauma patients with pelvic injuries
- ★ To be **knowledgeable** about the **pathophysiology and morbidity** associated with these injuries
  - ★ To be able to **apply the principles of management** of these injuries at the site of accident and in the emergency room

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**References:** 435 Lectures And Notes,+Apley

# Open Fracture

## Definition:

- A fracture that at some point **communicated** with the **outer** environment
  - An open **joint** is managed similarly. In a joint, it is enough to have an opening (exposure of the joint capsule to the outer environment) **without any fracture, we consider it as emergency!**
  - exposed **bone** without fracture is not an open fracture, it's just a wound.

## Etiology:

- **Usually** requires higher injury. usually car accidents / high energy trauma  
يعني حادث قوي لدرجة أنه يخلي البون ينكسر ويقطع الجلد أو أنه حاجة جاية من برا وقطعت الجلد ووصلت للعظم وكسرت  
☆ **\* Not always!** a very old pt. who has a very fragile skin with osteoporosis can develop an open fracture with minor trauma \*twisted her leg\*
- Sometimes can be missed العظمة انكسرت يعني لما طاح فراكترس يكون كبير وواضح من جوا وشوية فتافيت صغيرة قعدت تتسحب وتتسحب لين وصلت للجلد وسوت جرح صغير مو واضح! موب كل أوبن فراكترس لازم يكون كبير وواضح فانتبهوا
- Commonly occurs in bones with minimal soft tissue coverage. In these bones, you can have low energy open fracture but most common scenario is high energy. like anterior part of tibia
- Usually higher energy is required in deep bones. like Femur, usually with this high energy look for other injuries.

## Pathology:

**Traumatic energy** to the soft tissue and bone, can cause:

at time of injury, the soft tissue got a strong hit leading to bleeding, bad vascularity and there is increased permeability and injury to the soft tissue so there will be:

- Necrotic tissue dead tissue which is basically a culture agar
- Inoculation of organisms " introduction of organisms" (we have dead tissue exposed to the outer environment, وليمة, مفضلة للأورقترمز كأنك تتاديهيا يلا حياكم المكان مفتوح والوجه جاهزه so it's a good growth media for the organisms)
- Injury to vessels and microvasculature
- Can cause Raised compartment pressure

➔ Ischemia and lack of immune response ➔ so the chance to get **INFECTION** is very high

## Infection in the presence of a fracture [ **NIGHTMARE** ]:

- Difficult to eradicate
- Prolonged antibiotics
- Multiple surgeries
- Significant morbidity
- Significant costs

★ The most important consideration when dealing with an open fracture is to reduce the risks of infection

طبعاً أكثر شيء نخاف منه في الأوبن فراكترس هو الانفكشن بما أن الجلد مليء بالبكتيريا عكس العظام اللي مو كولونايذد فاحنا نحاول أنه نمنع حصول الانفكشن من البداية لأن معالجة البون انفكشن از فري هارد تحتاج وقت طويل وعدة جراحات لدرجة أنه ممكن المريض يخسر وظيفة العضو بسبب كثرة العمليات اللي نسويها \*3-4 عمليات على الأقل\* وبكذا حيصير فيه مسهل اتروفي وويكنس وستفنس\* المريض عالاقل يحتاج يقعد ست اسابيع بالمستشفى\* و نعطيه مضادات حيوية وكل هذا فيه تكلفة، عشان كذا الأوبن فراكترس تعتبر **رد فلاق** عندنا ونحتاج مانجمنت بأسرع ما يمكن.

## Important considerations:

- An open fracture is usually a **"red flag"** warning of **significant trauma** ➔ therefore Detailed assessment of the patient is necessary
- An open fracture is associated with significant morbidity ➔ **Must act quickly**
- A delay in management is proven to increase the likelihood of complications ➔ So Give urgent priority while triaging, provide initial management and consult urgently

## Diagnosis:

- **Sometimes obvious!**

- **Other times, settle → be observant** ما هي واضحة تكون شرح بسيط بالجلد زي الصورة، هنا صعب نفرق إذا الجرح هذا من اوبن فراكشر ولا بسبب شيء شرح الجلد من برى، بهذه الحالة ننتبه للقواعد التالية:

- **A wound close to a fracture is an open fracture until proven otherwise!** it's better to be safe than sorry ;)
- Whenever a fracture is diagnosed, go back and check the skin
- A small wound **CONTINUOUSLY oozing blood**, especially, if you see **fat droplets within the blood \*very suggestive\***, is an open fracture! that means it's coming from the bone marrow
- Not always close to the fracture, Wound can be far away from the fracture, It doesn't have to be accurately overlapping with x-ray. It can happen due to bone recoil. (طلعت من مكانها جرحت الجلد ثم ارتدت لمكانها ثاني)
- Don't probe!! bc even with using sterile probe maybe the skin is not sterile so u r gonna introduce the bacteria inside ; we use probe to make sure is the wound reaching bone or not. If you really don't know, and you need to probe it to make sure it's deep enough → don't probe and just call it an open fracture
- 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 !



Before going to the management have a look on this [pic](#) ( overview about the stages of care for open fracture)

## Open fractures Algorithm (initial management at ER):

- 1) Assess and stabilize the patient, ATLS principles
- 2) Assess the condition of the soft tissue and bone to help grade the open fracture.
- 3) Manage the wound locally
- 4) Stabilize the fracture
- 5) IV antibiotics initiate as soon as possible حتى قبل التيتيس فاكسين
- 6) Tetanus status initiate as soon as possible

Now Let's discuss each step one by one:

1 Assess and stabilize the patient, ATLS principles	
	<ul style="list-style-type: none"> <li>■ If polytrauma, first apply ATLS principles (<b>life before limb!!!!</b>)</li> <li>■ if isolated injury and the pt stable proceed to the next point</li> </ul>
2 Assess the condition of the soft tissue and bone to help grade the open fracture	
Take a history:	<ul style="list-style-type: none"> <li>■ Mechanism and circumstances of injury, when you are called as a resident or if you are at ER → take FULL history ( is there LOC / trauma details “seatbelt / ejected or not ejected” / presence of other injuries / hemodynamic stability) basically we manage as ATLS case.</li> <li>■ Time since injury</li> <li>■ <b>past medical history/past surgical history/Allergy/Drugs/Smoking/when was the last meal</b> it makes a difference on the chances of infection and complications especially smoking</li> <li>■ Tetanus vaccination status.</li> </ul>
Examine the affected region for:	<p>⇒ <b>Soft tissue:</b></p> <ul style="list-style-type: none"> <li>■ Degree of contamination في طين؟ غرقان في موية؟ في مستنقع؟ كان في مزرعة فيه سماد؟ فيه بس حصى في الجرح والباقي نظيف؟ ولا مرة متلوث الجرح</li> <li>■ Necrotic and devitalized tissue</li> <li>■ Size of wound</li> <li>■ Coverage <b>loss</b>: can u close it manually or not : for example, in case of fasciotomy in compartment syndrome at the end I can attach the skin together again but if he lost his skin in the street so he requires a grafting to cover <b>-if you can bring the edges of skin together, or if you cannot bc of skin or soft tissue loss-</b>.</li> <li>■ <b>Compartment syndrome</b></li> </ul>

⇒ **Bone:**

- Comminution? **segmental? or not?**
- Stripping of bone periosteum **تقشر البريستيوم من العظم** \*u can see the periosteum obvious in children bc it's thick unlike adult\*. periosteum is a good source of blood supply to the bone → at higher risk of complications bc there is not enough blood flow to the bone.
- Assess Away from injury to joint above and below
- X-rays to joint above and below for example if fracture in forearm I need x-ray showing wrist, elbow and whole forearm




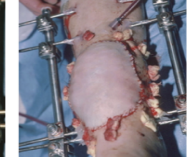

⇒ **Check the Neurovascular status distally:**

- Examine the peripheral nerves not the central. Gross assessment for the nerves, if the nerve is cut → complete absence of movement. Ask the patient to move, ask about sensation don't perform a full neurological assessment **بس نحتاج نعرف أنه الكهرباء واصلة لو حركة بسيطة في أصابعه عشان أتأكد أنه العصب مو مقطوع** كمان نحس النبض عشان أشوف إذا الدم واصل أو لا
- vascular → normal pulses, warm limb and pink
- **When to perform it? On arrival and post reduction and splinting later** \*من الأسباب الرئيسية ان الطلاب ينقصون\* بالالوسكي انهم ما يقولوا نوروفاسكولار اسمنتت الامرة وحدة so always REcheck.

**Open fracture grades (gustilo grading):**

**in order to grade u need to take hx, assess the soft tissue, assess bone if not obvious do x-ray \*3 things\***

فيذا جاتكم صورة لا تقفوا على طول وتقولوا القريد ما يصحش, تحتاجوا تعرفوا الثلاث نقاط التي ذكرناها عشان تقدرنا تسوا قرينق صح

Grade 1	<ul style="list-style-type: none"> <li>➤ <b>Less or equal to 1 cm</b></li> <li>➤ A clean <b>wound. not deeply contaminated</b> or in a farm: stone, dust..</li> <li>➤ non segmental nor severely comminuted fracture</li> <li>➤ less than 6 hours since injury</li> </ul>	
Grade 2	<p>The only difference between grade 1 &amp; 2 is the <b>SIZE</b></p> <ul style="list-style-type: none"> <li>➤ <b>&gt;1 cm</b> wound</li> <li>➤ Not extensive soft tissue injury or contamination,</li> <li>➤ Non segmental nor severely comminuted fracture</li> <li>➤ No bone stripping and <b>with adequate soft tissue coverage</b></li> </ul>	
Grade 3A	<p>[ to make it easier: anything that does not fit 1&amp;2 criteria automatically will be 3A, except if it required soft tissue flap (grade 3B) or vascular repair(grade3C)]. grade 1 &amp; 2 can change into grade 3. How? <b>if 6 hours past without treatment</b></p> <p>Any size with extensive soft tissue <b>contamination</b> -farming injury or <b>submerged wound-</b> <b>or</b> injury but <b>NOT</b> requiring soft tissue coverage procedure, <b>or</b> with a segmental or severely comminuted fracture, <b>or</b> late presentation more than 6 hours</p>	 <small>الصورة هذي للنظرة الأولى ممكن نقولي 3c بس لألو شقناها نقدر ندخل العظم ونسحب الجلد ويتسكر</small>
Grade 3B	<p>Any open fracture that <b>requires soft tissue coverage</b> procedure in these pictures the grade is 3B because there is loss requires grafting.</p>	
Grade 3C	<p><b>ANY</b> open fracture with vascular injury that <b>requires vascular surgery to repair</b>, regardless of degree of soft tissue injury.</p> <p><b>this not consider grade 3c, grade 3c → vascular injury requiring vascular surgery to repair it.</b></p> <p><small>بعض النظر عن البراميتز الثانيه اول ماتشوفين اوين فراكتشر وفاز كيلر انجري تحتاج ريبز جراحي عللى طوول قول قريد 3c</small></p>	

★ **Notice:** Neuro is not part of grading

★ If the patient needs **both** soft tissue coverage and vascular repair which grade is it 3B or 3C? → **3C**

### 3 Manage the wound locally

- Take a picture! **Dr:said** plz it's not part of the management don't mention it in the osce (لاتوهقوني افولكم (o): أنا حظيتها عشان افولكم لو اول شخص شاف الجرح بصور صورة وباقى التيم اللي بعده راح يشوفوا الصورة بدل ماكل واحد يفتح الجرح عشان ننقل خطر الانفكشن ناخذ قارورة \*at least 2 L\* never water \*at least 2 L\* زي الي بالصورة نخرقها خرقة صغيرة ونعبيها نورمال سلاين فكأننا نسوي شاور للجرح من بعيد
- If dirty, irrigate with **normal saline** to remove gross contamination **never water**
- If bone sticking out try to reduce gently then immobilize and **re-check** neurovascular status
- Cover with **sterile wet gauze** قطنه مبللة بنورمال سلاين عشان لو حظينا قطنه ناشفة عالجرح لما نجى نشيلها حتنز عه
- If bleeding, apply direct **pressure** on wound ,do not use the tourniquet it will affect the blood supply to the limb leading to ischemia.
- No culture swabs in ER **useless: no changes in treatment**



### 4 Stabilize the fracture

- after covering & realigning it u have to apply a splint or back slap to prevent any displacement of the fracture that may cause vessels or nerve injuries and at the same time, it allows expansion and swellings

### 5 IV antibiotics

to keep it easy we agreed that grade 1: 1 antibiotic, grade 2: 2 antibiotics, grade 3: 3 antibiotics.\*not EBM\*

- 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 (if allergic to penicillin give clindamycin)** for clostridium "anaerobe" in grade 3 open fractures and all farm and soaked wounds.

**To sum up:**

**Grade 1:** First generation Cephalosporin (for 24 hrs)

**Grade 2:** First generation Cephalosporin +Aminoglycoside (for 72 hrs)

**Grade 3:** First generation Cephalosporin +Aminoglycoside+penicillin if allergic use clindamycin (for 72 hrs)

### 6 Tetanus status and prevention

►**General Notes (the types of wounds):** WHO divided the wound in general into:

- Clean wounds:** any doctor should know the definition of clean wound
  - <6 hours from injury
  - Not a farm injury
  - No significant devitalized tissue
  - Non immersed wound
  - Non contaminated wound **not grossly contaminated**
- Other wounds** \*not clean: that doesn't fit the clean criteria\*

#### Tetanus prevention:

مهم تعرفوها ايش ما تخصصتم لأنه حتى لو أحد من أهلكم طاح في البر وانجرح بدون كسر لازم تعرفوا تعطوه ولا ما تعطوه الفاكسين



**Two forms of prophylaxis:**

- tetanus-diphtheria toxoids(Td): dose 0.5 mL, regardless of age ,active immunity
- immune globulin (TIG),passive immunity

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 < 5 years	Booster > 5 years	TIG 250U And Td 0.5ml IM
nothing	Td 0.5 ml IM		nothing	Td 0.5ml IM	

## Open fractures management at OR (primary operation):

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

<b>Irrigation and debridement</b>	<ul style="list-style-type: none"> <li>Extend wound if necessary</li> <li>Thorough irrigation in ER it is just an external cleanup, in OR you will clean deeply and check the edges of bone for presence of dirt/ extensive cleaning by around 15 L of NS</li> <li>Debride all necrotic tissue</li> <li>Remove bone fragments without soft tissue attachment except articular fragments, bc bone fragments without soft tissue don't have blood supply so they'll die and cause infection. but if the bone was attached to articular cartilage we leave it * in the periarticular fracture* .</li> <li>Usually requires <b>second look</b> or more every 48-72 hours لأنه أحياناً ما تبيان كل النكروتك اريا من أول يوم وحكم كل ٤٨ ساعة أدخله غرفة العمليات الين اليوم اللي أدخله وما الاقي نكروسس</li> <li><b>Generally do not close open wounds on FIRST look</b>, even if you clean the wound and debride all the necrotic tissue don't close the wound from the first time, bc you don't know if the area of necrosis may expand more later.</li> <li>the cases where we close the bone primarily: •low energy •soft tissues are clean •not dirty= clean wound •small •no contamination. But in most cases we will not do a primary closure.</li> </ul>
<b>fracture stabilization</b>	<ul style="list-style-type: none"> <li>Generally avoid internal fixation (plate and screw) .</li> <li>Generally external fixator is used. If u say in <u>ALL</u> open fracture don't do internal fixation from the first time rether apply external fixation, u will get full mark "the safest answer for u", لكن فقط, لمعلوماتكم فيه استثناء وحيد نقدر نسوي له انترنال فيكسيشن من أول مره إلي هو <ul style="list-style-type: none"> <li>Grade 1&amp;2 Femur and tibia fractures can usually be treated immediately with intramedullary nail except severe injuries and contamination → evidence shows that the complications are less</li> </ul> </li> </ul> <p>لكن المعلومة هذه نعتبرها متقدمة عليكم فلو ماقلنوها راح تاخذون الدرجة كاملة بأمان</p>
 <b>Observe for compartment syndrome intra and post-operatively</b> 	

## Open fracture results:

طيب in optimal situation إذا طبقنا كل شيء مثلاً جانا المريض بعد الكسر بخمس دقائق وكان الاي ار كونسلتنت والاورثو كونسلتنت والانسثيزيا كونسلتنت معه بالسيارة وهو جاي يعني خلال الخمس دقائق أخذ الانتيبيوتكز والتيتناس وكل شيء وطلعناه فوق لغرفة العمليات يعني مره مره الوضع كان بيرفكت, كم بيكون الرسك اوف كومبلميشنز:

### If all principles applied:

- 2% complication rate in grade 1
- 10% complication rate in grade 2
- Up to 50% complication rate in grade 3

e.g of complications: multiple procederes, long stay in hospital, loss his limb

Table 23.2 Local complications of fractures

Urgent	Less urgent	Late
Local visceral injury	Fracture blisters	Delayed union
Vascular injury	Plaster sores	Malunion
Nerve injury	Pressure sores	Non-union
Compartment syndrome	Nerve entrapment	Avascular necrosis
Haemarthrosis	Myositis ossificans	Muscle contracture
Infection	Ligament injury	Joint instability
Gas gangrene	Tendon lesions	Osteoarthritis
	Joint stiffness	
	Algodystrophy	

# Fractures with neurovascular injuries

## Important considerations:

- neurovascular injury can happen in both open and closed fractures
- Don't miss it !!!! مثلاً يجي المريض ويقول اوكي جيتكم المستشفى واي نعم كنت مكسر بس لما خرجت من المستشفى عندي دروب فوت → وعادي جداً يرفع قضية ويكسبها bc you didn't document and you didn't asses before surgery and write in the patient's chart that he had an injury.
- when to do neurovascular exam?** Always perform an accurate assessment at presentation, post manipulation and reduction, post surgical fixation, serially until condition stabilizes (always REcheck) هذي اللي تتسوها بالاوزكي
- Serial examination helpful in deciding line of treatment. pt presented with only numbness then he started to lose feeling or he started to improve → the two cases have different management approach
- Serial examination helps avoid confusion, bc sometimes the arterial injury is delayed so u have to check frequency. for example in vascular injuries sometimes if you have fracture around the knee (proximal tibia) high energy dashboard injury directed to the tibia → when the patient initially presents he had perfect pulses in his foot then next day you find the leg necrotic and black what happened? sometimes the injury in the artery does not occur immediately (when the intima gets injured with time blood starts to flow slowly into the arterial wall → dissect → occlude → acute limb ischemia (SO SERIAL Examination every 2-4 hours depending on risk).
- Routinely any knee fracture we do ABI. If we couldn't perform ABI → monitor every hour for the next 24 hours or until we can perform angio.
- High correlation between vascular injury and nerve injury, bc they are proximal to each other

## Mechanisms: كيف بينجرح الشريان أو العصب

could be either:

- Penetrating trauma
- High energy blunt trauma
- Significant fracture displacement يتحرك العظم الين ما يقطع
- Keep in mind tissue recoil ارتداد at presentation ممكن وقت الإصابة العظم رجع ورا جرح الشريان بعدين رجع مكانه فلهما تشوفيه باللام ار اي تحسین مكانه طبيعي بس أنت ماتدرين شصار وقت الإصابة! \*شيك ع النبض كل شوي\*
- Direct laceration
- Traction and shearing (with vascular injury) ينشد الشريان إلين يتقطع



## Vascular injury with fracture:

### Assessment of vascular injury with fracture:

#### 1 always check and recheck the vascular status

##### Always check:

- Pulse, Color, Capillary refill, Temperature, compartment pressure

##### Keep high index of suspicion, when:

- High energy trauma
- Associated nerve injuries
- Fractures/ Dislocations around the knee

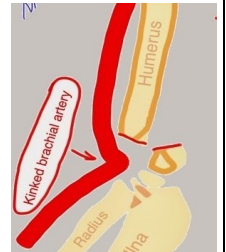
## 2 Realignment of the limb if soft or hard signs of vascular injury present

Hard and soft signs of vascular injury associated with extremity trauma	
<b>hard signs</b>	pulselessness <sup>1</sup> - Pallor - Paresthesia- Pain - Paralysis - Rapidly EXPANDING hematoma - MASSIVE bleeding - audible or palpable bruit
<b>Soft signs</b>	History of bleeding in TRANSIT - Proximity related injury - Neurologic finding from adjacent nerve to a named artery - (non expanding) Hematoma over a named artery

- Hard signs → realignment of limb → if persistent → **vascular intervention**
- Hard signs → realignment of limb → improved → **Close observation put in mind intimal tear**
- ★ Realignment can result in **unkincking** of vessels, lowering compartment pressure, relaxation of arterial spasm

soft signs: need to adjunctive studies such as ABI and arteriography.

Hard signs: require vascular intervention.



## 3 Ankle-brachial index (ABI):

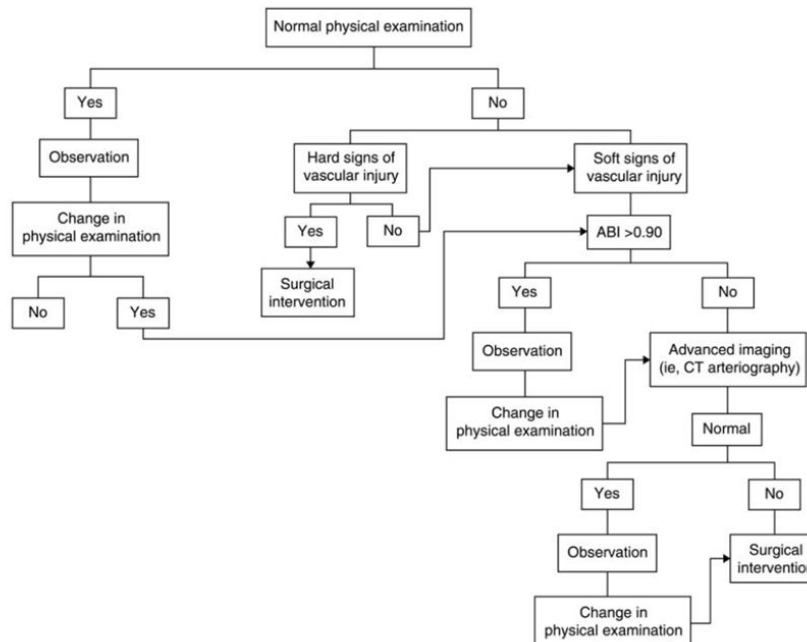
- < 0.9 associated with vascular pathology or there is 0.2 difference between the two sides. If the ABI is more than 0.9 → unlikely that the patient has intimal tear
- Rarely can give false negative result (Ex. Profunda femoris)
- Always used in high risk fractures (knee)
- If positive → Urgent vascular intervention

## 4 Angiography, CT angiography:

- Gold standard
- Not without risks sometimes they are polytrauma patient or they have pre-existing kidney injury or they are in shock then we give contrast with angio → it's not benign so we try to avoid unless we need it. nowadays we do angio on table
- Vascular surgeon to arrange with interventional radiologist



## Summary of the approach to vascular injury

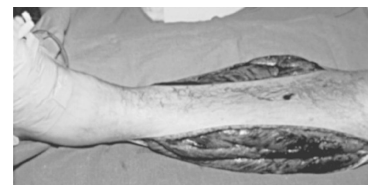


<sup>1</sup> Remember it doesn't apply on compartment syndrome.



## Management of vascular injury with fracture:

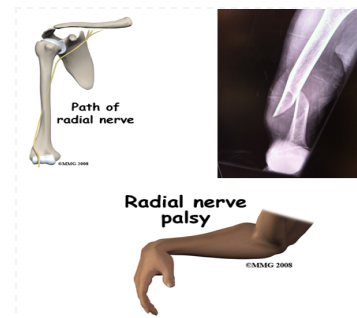
- Once vascular injury is confirmed Coordination between: Vascular surgeon+Orthopedic surgeon+General trauma surgeon is needed to emergently **re-establish perfusion** and **protect repair with skeletal stabilization**. Our first concern is the perfusion (life then limb function and survival then bone is the least imp).
- Warm ischemia time dictates treatment, so avoid prolonging it [**prolonged warm ischemia >6 hours**] we should minimize warm ischemia time as much as we can. We know that once you have warm ischemia time of 6 hours, the complications really jump high → permanent changes in the nerves and muscles / reperfusion injury → the cells started dying, after reperfusion → permeability of cell membrane bursts results in elevation of compartment pressure, The other living-cells will be affected by this increase in the compartment pressure and started to die → more leakage → higher increase in the compartment pressure. so we need to do prophylactic fasciotomy within 6-8 hours
  - Dr. said General information out of the topic: we have two types of ischemia cold & warm ischemia, warm ischemia when the organ remains at body temperature, cold ischemia used in transplant surgery they put the organ in ice because, cold ischemia time is longer than warm ischemia time
- Most times, a quick external fixator is applied, followed by vascular repair صح الفاز كيولر أهم من الاورثو بس احنا نقول للفاز كيولر خرينا اول نثبت الكسر سريع جدا يادوبك تثبيت بسيط ثم تبدأ أنت عشان ما يخرب الفاز كيولر ريبير لو بدينا بعدك, لأنه حصلت معنا جانا ببشنت باسكيما متأخر أكثر من ست ساعات فبدأ الفاز كيولر سير جن قبلنا عشان الاسكيما تايم وأول مابدينا بعده نثبت الكسر من حركه بسيطه خرب الفاز كيولر ريبير اللي سواه [so: ortho start general fixation “ not the permanent true fixation of the bone” → vascular repair → ortho surgeon came back for permanent fixation]
- Prophylactic fasciotomy to prevent reperfusion compartment syndrome
  - ⇒ within **6-8 hours** of total ischemia time, studies show that the pts who underwent fasciotomy of an open fracture after 48 hrs : 100% of them either died or developed severe infection that requires amputation \*bc u have like a culture agar which will be fibrous tissue with time so if we open the area they will develop very severe infection within 24 hrs\*
- Grade 3C open fractures have the worst outcome
- Amputation may be necessary in severe cases



## Nerve injury

### Important considerations:

- ★ 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



### What to do in such situations:

#### Closed fractures not requiring surgery with nerve injuries:

a pt comes in, following a closed humerus fracture with radial nerve injury, the usual outcome: spontaneous return of sensation. Therefore treat it with a cast not with surgery (don't explore just for the nerve)

- Usually good outcome >80%
- Usually managed conservatively in the early stages
- Recovery may take more than 6 months

#### Intact nerve before reduction, absent after reduction:

- Controversial management الدكتور قال هذي الحالة متقدمه عليكم مانسالكم لأن عليها خلاف حتى بين الكونسلتنتس
- (Usually) **observe**, DON'T remove the cast and DON'T explore surgically
- if 6 months passed without improvement: consider interventions

#### Fracture requiring surgery with nerve injury:

a pt comes in, following a closed humerus fracture that needs surgery but the nerve is away from the surgical field: do ur surgery & don't repair the nerve but if the nerve is within ur surgical field explore it

- Limited exploration**, دامنا فاتحين عشان الكسر خل نشيك العصب اذا كان في طريقي, طيب ايش نسوي بالعصب اذا سويناله اكسيلور؟ اذا عالق بين عظمين شليليه, اذا مقطوع سوي تاق (علامه) عشان بعدين البلاستيك سيرجري يصلحه

#### Open fracture with nerve injury:

a pt comes in, following an open fracture with nerve injury: since u'll definitely expose the nerve just repair it

- Explore, tag nerve ends for later repair

Note from the book: Open nerve injuries With open fractures the nerve injury is more likely to be **complete**. In these cases the nerve should be explored at the time of debridement and repaired (later on) at the time or at wound closure.



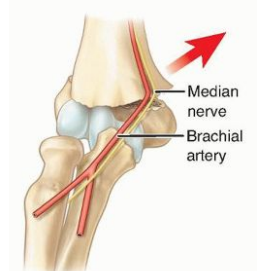
## Follow up:

- Clinically
- Electrodiagnostic assessment start at 6 weeks preferably at 3 months then serially every 6 weeks nerve conduction studies are useless before 3 months
- If no improvement:
  - Nerve exploration: neurolysis( releasing sheath surrounding nerve) / repair / grafting
  - Tendon transfers to preserve function مثلأيدي طابحة العضلات التي ترفعها خربانة بس لما اسوي فلكتشن شغالة في هالحالة اخذ وحدة من الفلكسنات واحطها فوق ع اساس تسوي الاكستشن مع شوية فيزيوثيرابي حيثحسن الوضع

## Common sites:

- Shoulder fracture / dislocation → Axillary nerve
- Distal humeral shaft fracture → Radial nerve
- Elbow fracture / dislocation → Median then radial then ulnar
- Hip fracture / dislocation → Sciatic nerve
- Knee fracture / dislocation → Peroneal nerve

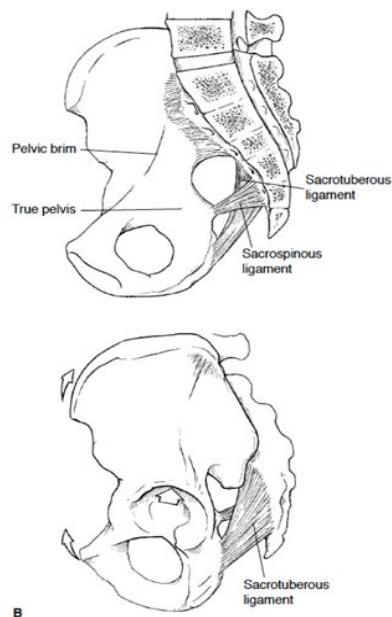
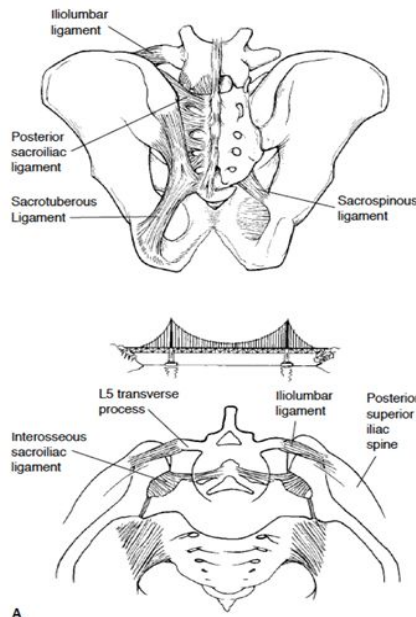
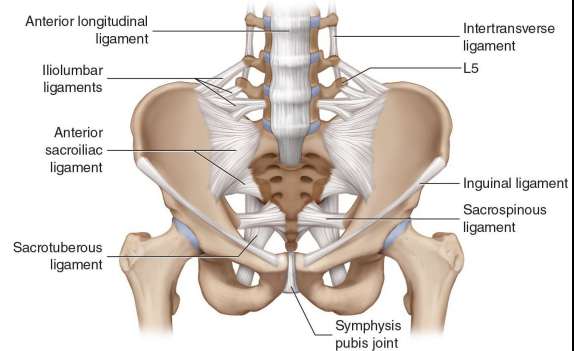
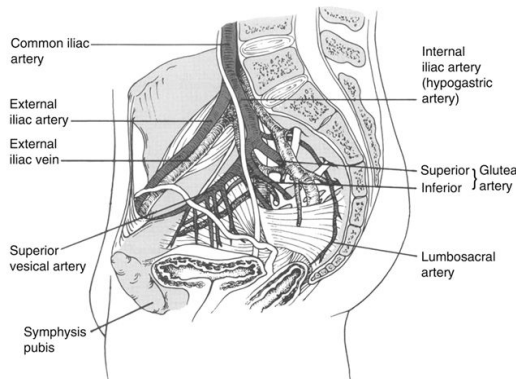
supracondylar fracture



# Unstable Polytrauma Patients With A Pelvic Fracture

## Pelvis Anatomy:

there is very complex vascularity tree around the pelvis so if there is fracture there is high risk of vascular injury: usually **venous** which will cause hematoma that is not obvious

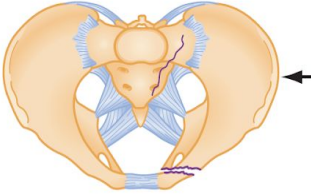
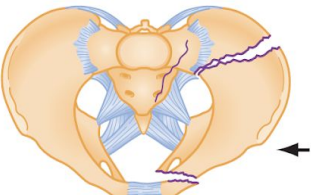
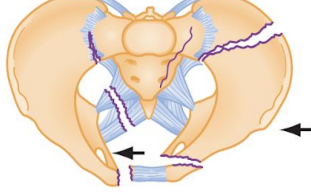
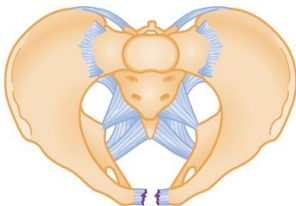
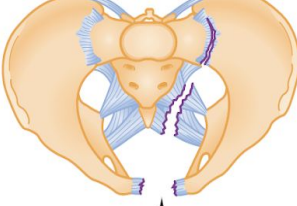
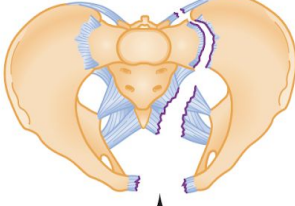


## Pelvic Fracture, The significance:

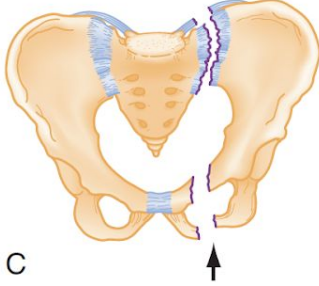
**SENARIO:** if pt presents after RTA tachycardic hypotensive you have already given him 2 L of normal saline and he improved temporarily then deteriorated so you gave him another 2 L but he did not improve "persistent bleeding", you listen to his chest and it was clear, there is no evidence of external bleeding but his BP continued decreasing \*one of you DDX must be pelvic bleeding (retroperitoneal bleeding or hematoma) \*identify it, treat it. You save a life!

- Pelvic fractures / instability may cause **life threatening bleeding** (Severe bleeding is the main cause of death following high-energy pelvic fractures).
- Diagnosing pelvic instability **can save lives**

## Mechanisms of pelvic ring fracture:

Lateral compression		
		
A	I	III
<p>Appearance: Anteriorly the pubic rami on one or both sides are fractured, and posteriorly there is a severe sacroiliac strain or a fracture of the sacrum or ilium, either on the same side as the fractured pubic rami or on the opposite side of the pelvis.                      If the sacroiliac injury is much displaced, the pelvis is unstable.</p> <p><b>Mechanism of injury (MOI):</b> This is usually due to a side-on impact in a road accident or a fall from a height.</p> <p>These lateral compression injuries are associated with less blood loss compared to AP compression due to decreased pelvis volume</p>		
Anteroposterior compression (open book)		
		
B	I	III
<p>Appearance: the hallmark is diastasis (separation) of the pubic symphysis</p> <p><b>MOI:</b> this is often the result from a heavy impact to the groin (pubis) i.e. falls to the ground, a common motorcycling accident injury.</p> <p><b>how do we treat the open book?</b> by closing the book → decrease the volume → increase pressure → stop the bleeding</p>		

- ★ for the risk of bleeding the worst is the shearing then open book bc in those there is high volume available to bleed in where in close (lateral compression) there is small space for bleeding.

Vertical shear

C
<p><b>Appearance:</b> with disruption of both the sacroiliac and symphyseal regions on <u>one</u> side.</p> <p><b>MOI:</b> This occurs typically when someone falls from a height onto <u>ONE</u> leg.</p> <p><b>how do we treat vertical shear?</b> apply traction on the shorter leg</p>

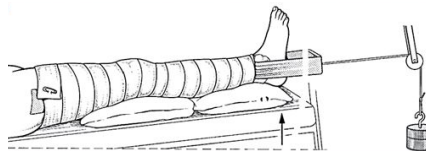
**Combination injuries** In severe pelvic injuries there may be a combination of the above.

## Diagnosis:

- **History:** High vs. Low energy trauma **u need to know the mechanism of injury in Hx**
- **Mechanism of injury:** Anterior vs. Lateral vs. Axial force
- Pelvic skin contusion, bruising
- Short extremity **one shorter than the other, suggest vertical shear**
- Careful neurologic assessment **most of pt r unconsciousness so neurologic exam can't be done but u have to document**
- **Primary survey : part of "C" \*circulation\***
  - Assess stability by **gentle** compression on the ASIS (anterior superior iliac spine)
  - Traction on the leg and assess pelvic instability
  - If unstable or painful:
    - ⇒ Apply sheet around hips and close the pelvis **gently** → This results in decreased intra-pelvic volume helping to tamponade the bleeding



- ⇒ Traction on the (shorter) leg to stabilize vertical instability → This minimizes ongoing vascular injury and bleeding



نعلق اي شي ثقيل (كيس رمل) عا لرجل الاقصر

- **Rectal exam:**
  - Bone fragments (the bone might have pierced into the rectum/vagina and might prick your finger during PR/PV if you aren't careful, wear double gloves)
  - High riding prostate
  - bleeding
  - Blood at the meatus
  - Labial or scrotal echymosis



28.2 Fractures of the pelvis This young man crashed on his motorcycle and was brought into the Accident and Emergency Department with a fractured femur. His perineum and scrotum were swollen and bruised, he was unable to pass urine and a streak of blood appeared at the external meatus. X-rays confirmed that he had a fractured pelvis.

- **Vaginal exam:** (be cautious as the bone might've pierced into the vagina, wear double gloves)
- **Imaging:** obtain single AP x-ray of the pelvis, if the film is difficult to interpret do CT(CT scans are considered the best way of visualizing the nature of the injury). بس الدكتور ذكر ان المريض بالغالب بيكون مكسر لدرجه مو قادرين ينقلوه للسي تي.

## Management:

- Stabilize pelvis with binder(effective with open book)
- If vertically unstable (vertical shear) apply traction on the shorter leg
- IV resuscitation and blood transfusion if needed
- **Look for other injuries** (remember: most of time it's polytraumatic)
- Check response: اذا طبقنا اللي فوق وما زال ينزف هنا ممكن نحتاج انجيو عشان يوقف النزيف:
  - If partial response:may require angiography for embolization of bleeders
- May require external fixator and/or pelvic clamp



Pelvic binder



Pelvic Clamp

- ★ Remember:Early diagnosis,with Aggressive resuscitation and Coordinated team effort will **save lives**

## **Complications:** from the book Apely not in the slides

- **Thromboembolism:** A careful watch should be kept for signs of deep vein thrombosis or pulmonary embolism. Prophylactic anticoagulants are advocated in some hospitals.
- **Sciatic nerve injury:** It is essential to test for sciatic nerve function both before and after treating the pelvic fracture. If the nerve is injured it is usually a neuropraxia and one can afford to wait several weeks for signs of recovery. Occasionally, though, nerve exploration is necessary.
- **Urogenital problems:** Urethral injuries sometimes result in stricture, incontinence or impotence and may require further treatment.
- **Persistent sacroiliac pain:** Unstable pelvic fractures are often associated with partial or complete sacroiliac joint disruption, and this can lead to persistent pain at the back of the pelvis. Occasionally arthrodesis of the sacroiliac joint is needed.

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The End

now check your understanding  
[MCOs & SAOs](#)