

By the Name of ALLAH the Most Gracious the Most Merciful



# Truama

L2

د . أحمد اسامة حسن

Specialist in General Surgery & Laparoscopic Surgery

To be read in

Bailey & Love's Short Practice of Surgery 28<sup>th</sup> Edition.

Truama Ch 26 – 34 .

# Maxillofacial trauma

Soft-tissue injuries

Lacerations

Facial nerve

Parotid duct

Mandibular fractures

Zygomatic fractures

Maxillary bone fractures

Orbital fractures

Frontal sinus fractures

Dental injuries

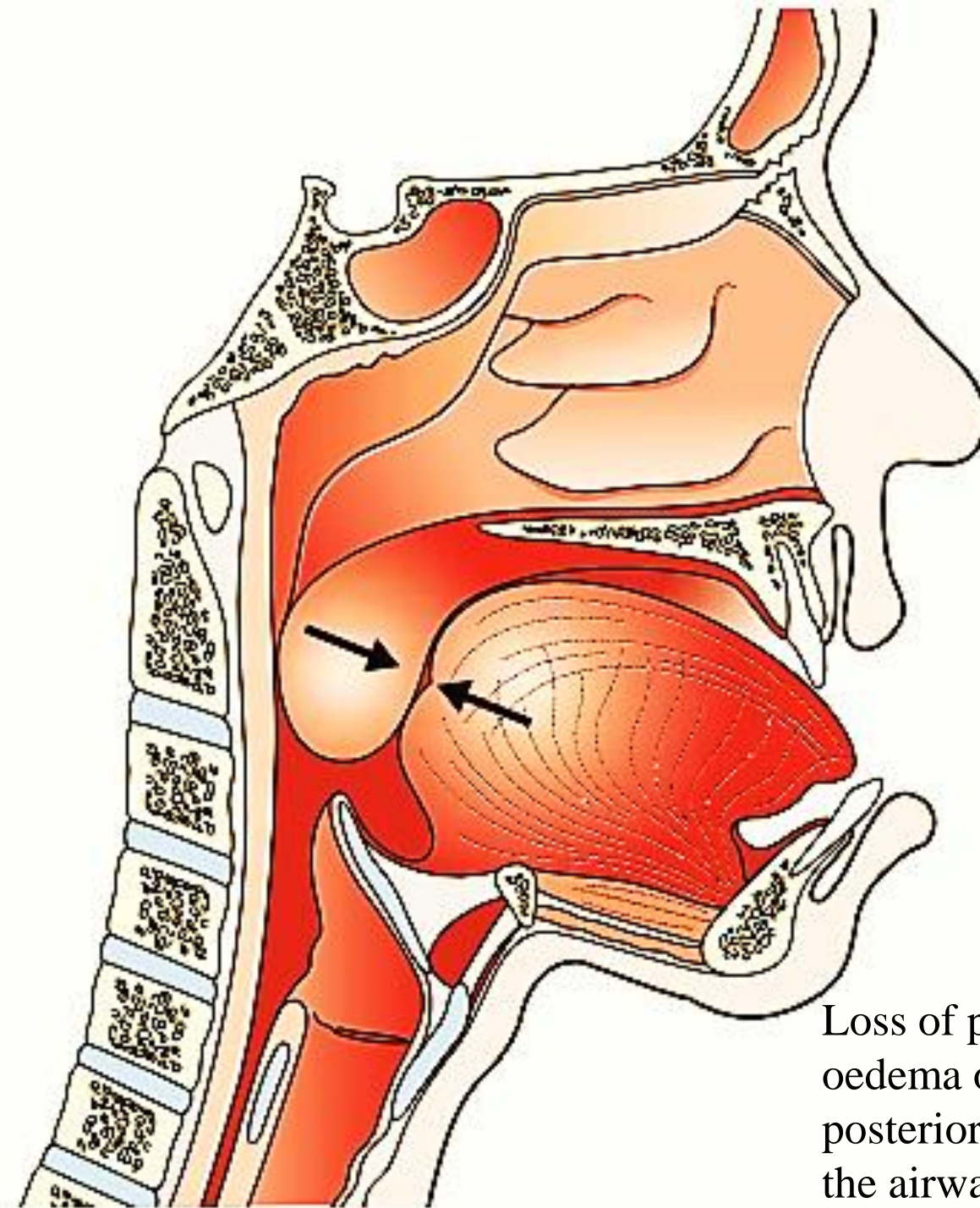
(b)



**Extensive soft-tissue laceration, the full extent of which may only be revealed on careful examination. Corneal protection in situ.**

## Emergency assessment and management

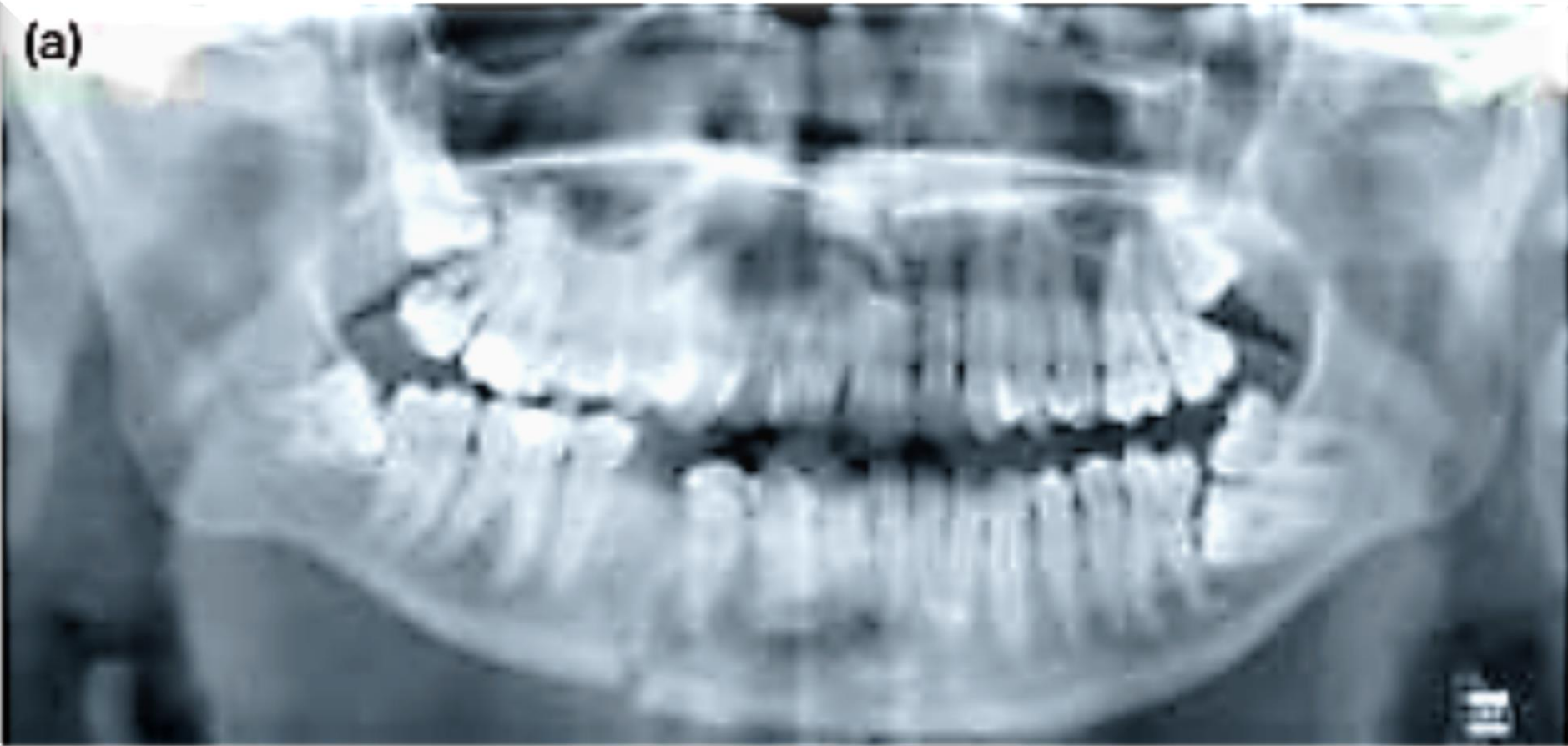
- Immediate management must include assessment of ABC with cervical spine protection, following which a more detailed assessment should ensue.
- Life- and sight-threatening facial injuries should be treated immediately
- The clinical team should be prepared for endotracheal intubation or, if required, a surgical airway



Loss of pharyngeal space secondary to oedema of the soft palate and the posteriorly displaced tongue may restrict the airway.

# CLINICAL ASSESSMENT

- History .
- Examination  
Primary survey  
Secondary survey
- Investigations  
routine haematology and biochemistry investigations,  
and imaging (mandibular fracture is suspected, an  
orthopantomogram (OPT) and a posteroanterior (PA)  
radiograph and A three-dimensional (3D) reformatting  
of the CT scan .



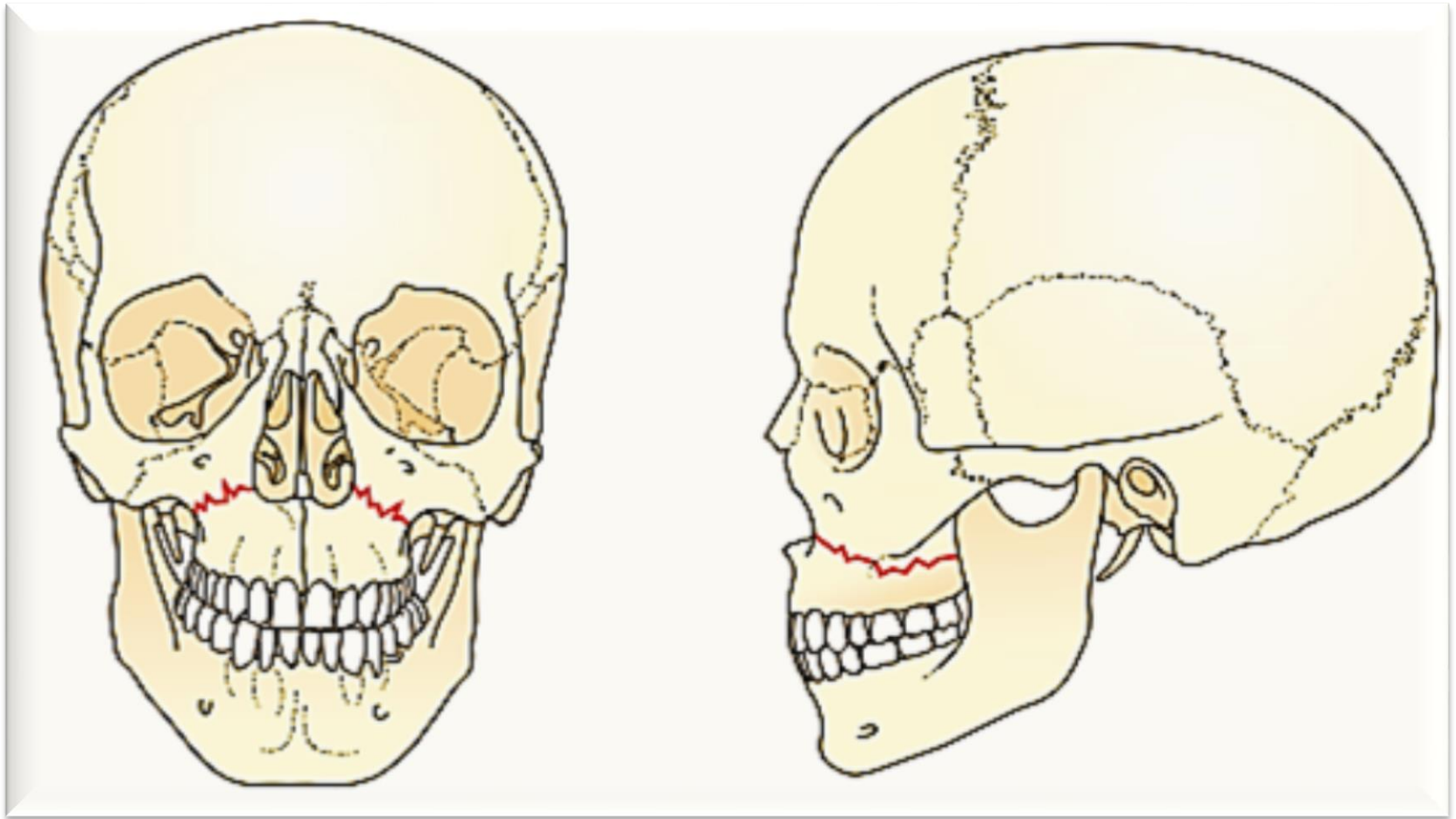
Orthopantomogram (OPT) demonstrating a right mandibular body and left condylar fracture.



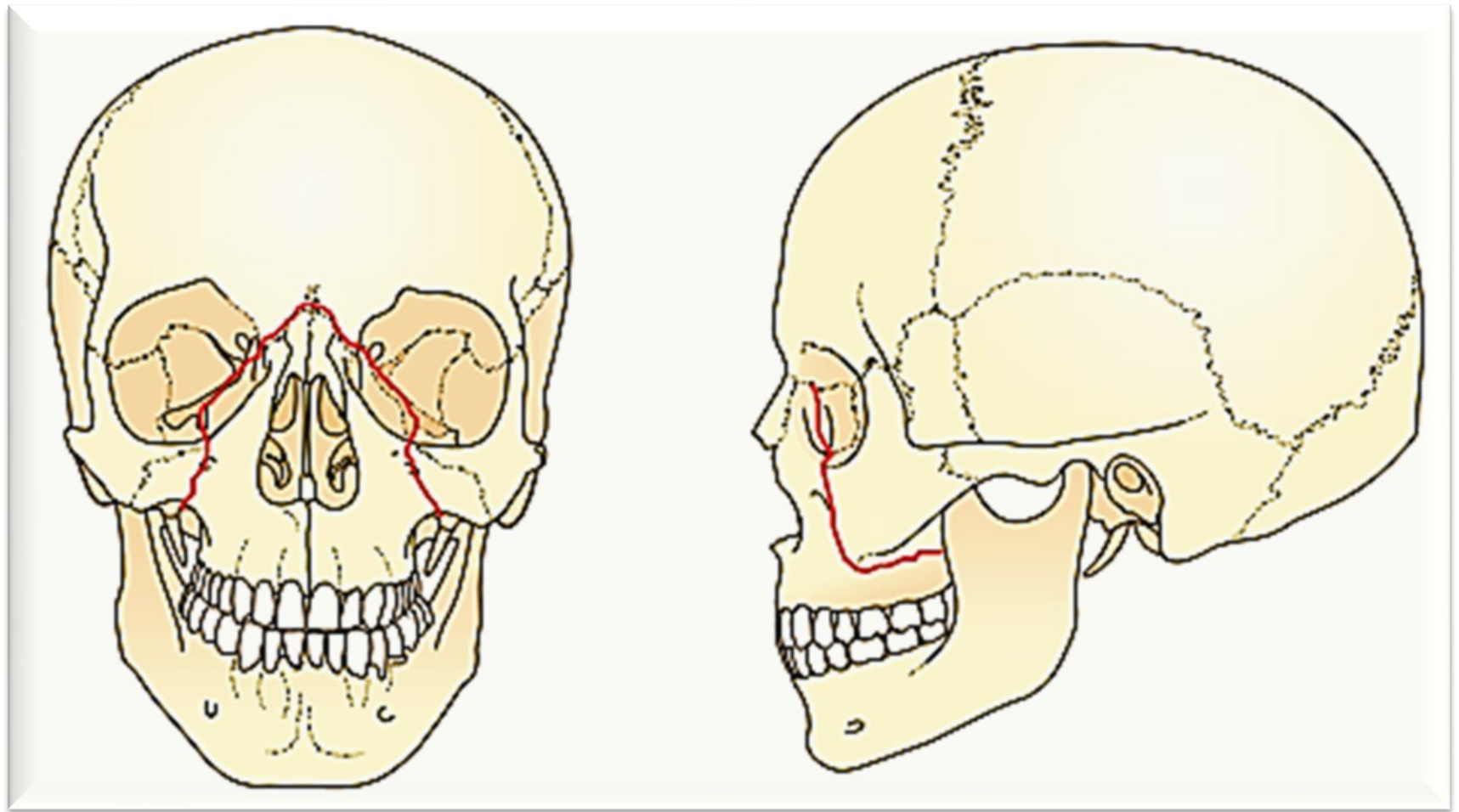
A posteroanterior mandible radiograph reveals the left low condylar fracture



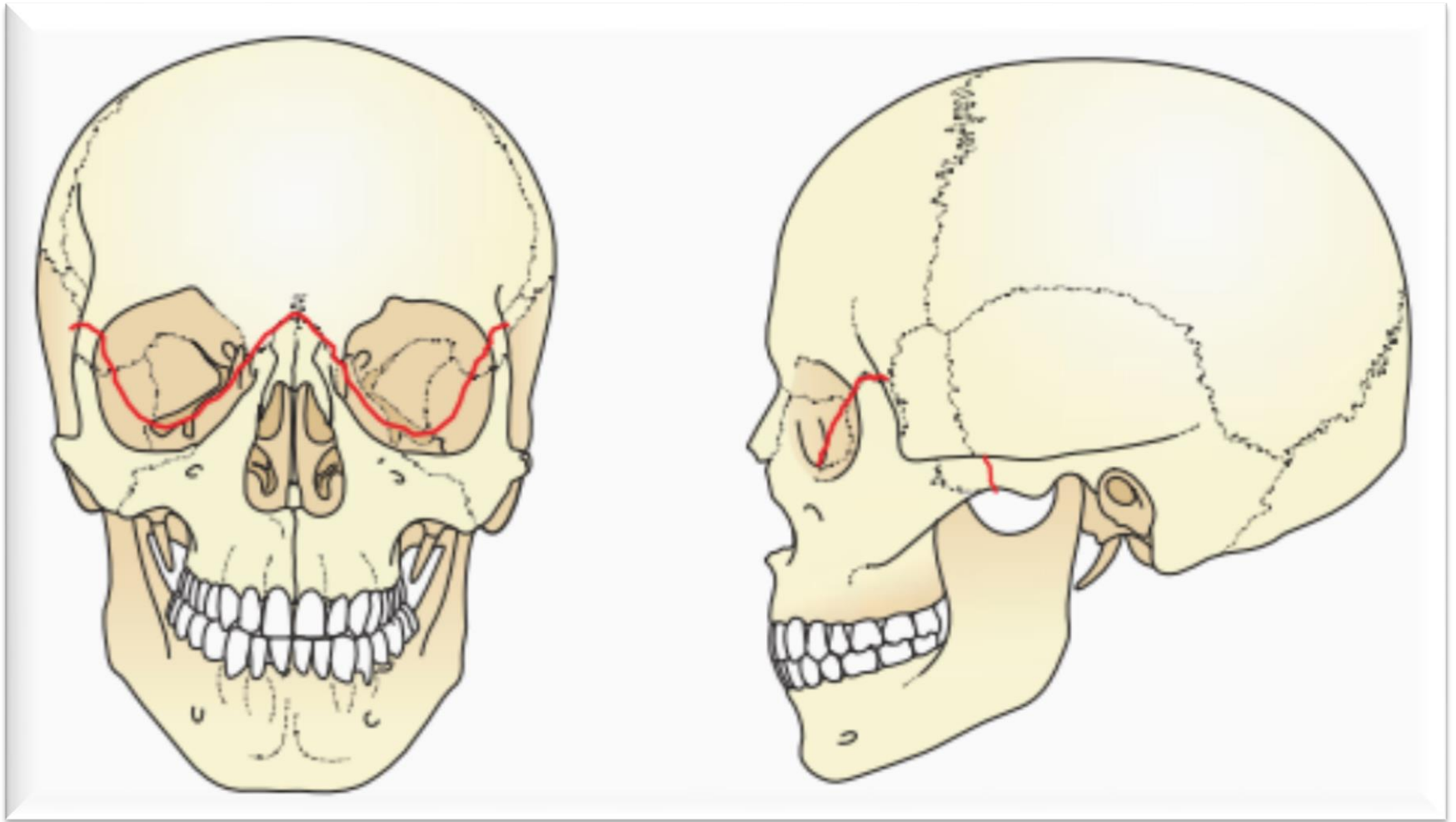
# Maxillary bone fractures



- Le Fort I involves a fracture line extending from the pterygoid plates through the lateral wall of the maxillary sinus and piriform aperture of the nose.



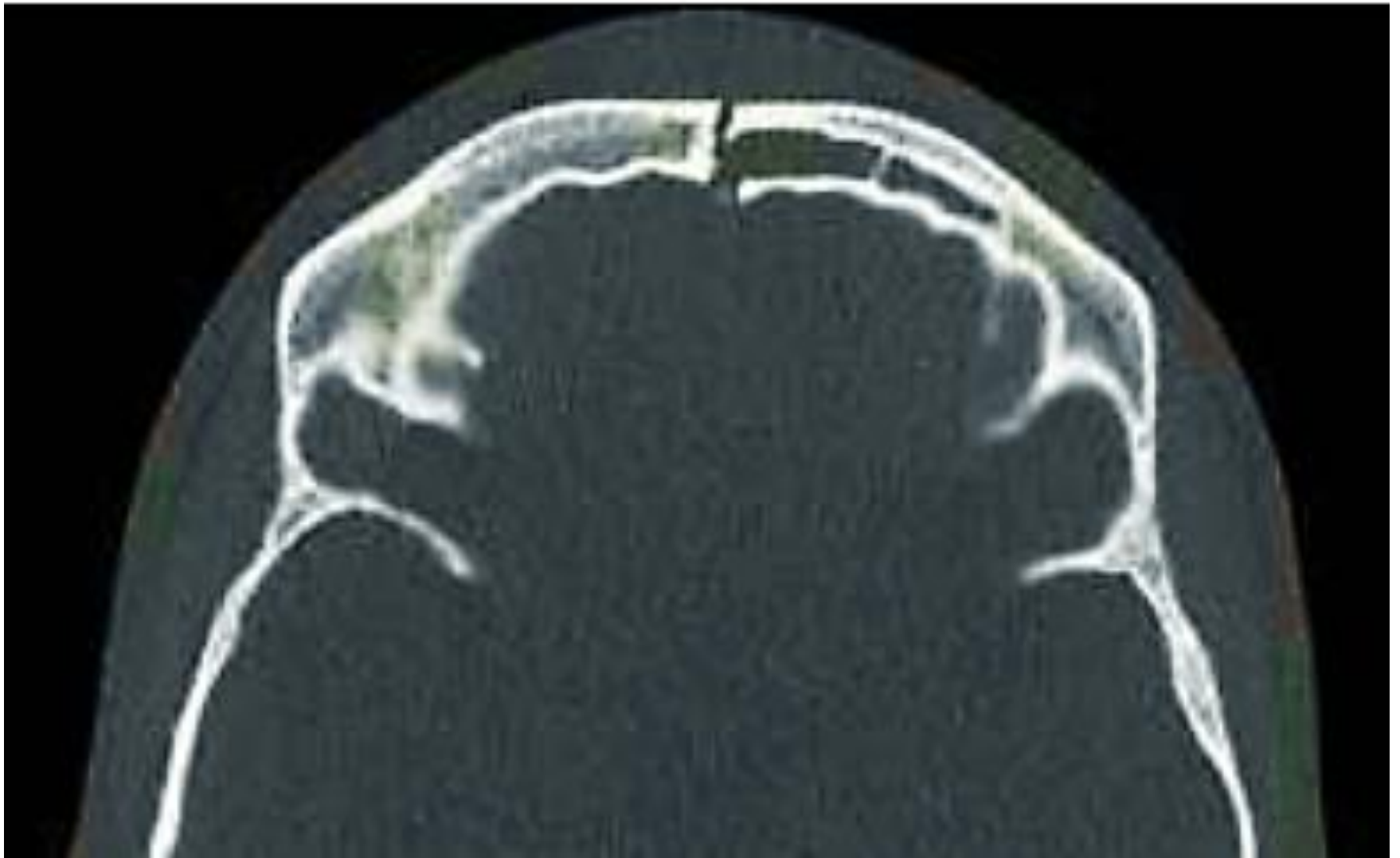
- Le Fort II involves the whole of the dentition-bearing portion of the maxilla and the nasal bones. The fracture line extends from the pterygoid plates to the inferior orbital rim and across the bridge of the nose.



- Le Fort III fracture essentially is where the whole of the midface is separated from the skull base. The fracture line runs from the pterygoid plates to the base of the zygomatic arch, the lateral walls of the orbit through the FZ suture and the nasal bridge.



Coronal computed tomography (CT) scan demonstrating a left orbital blow-out fracture, with soft-tissue herniation into the maxillary antrum



An axial CT scan demonstrating a frontal bone fracture through the anterior and posterior table of the frontal sinus.

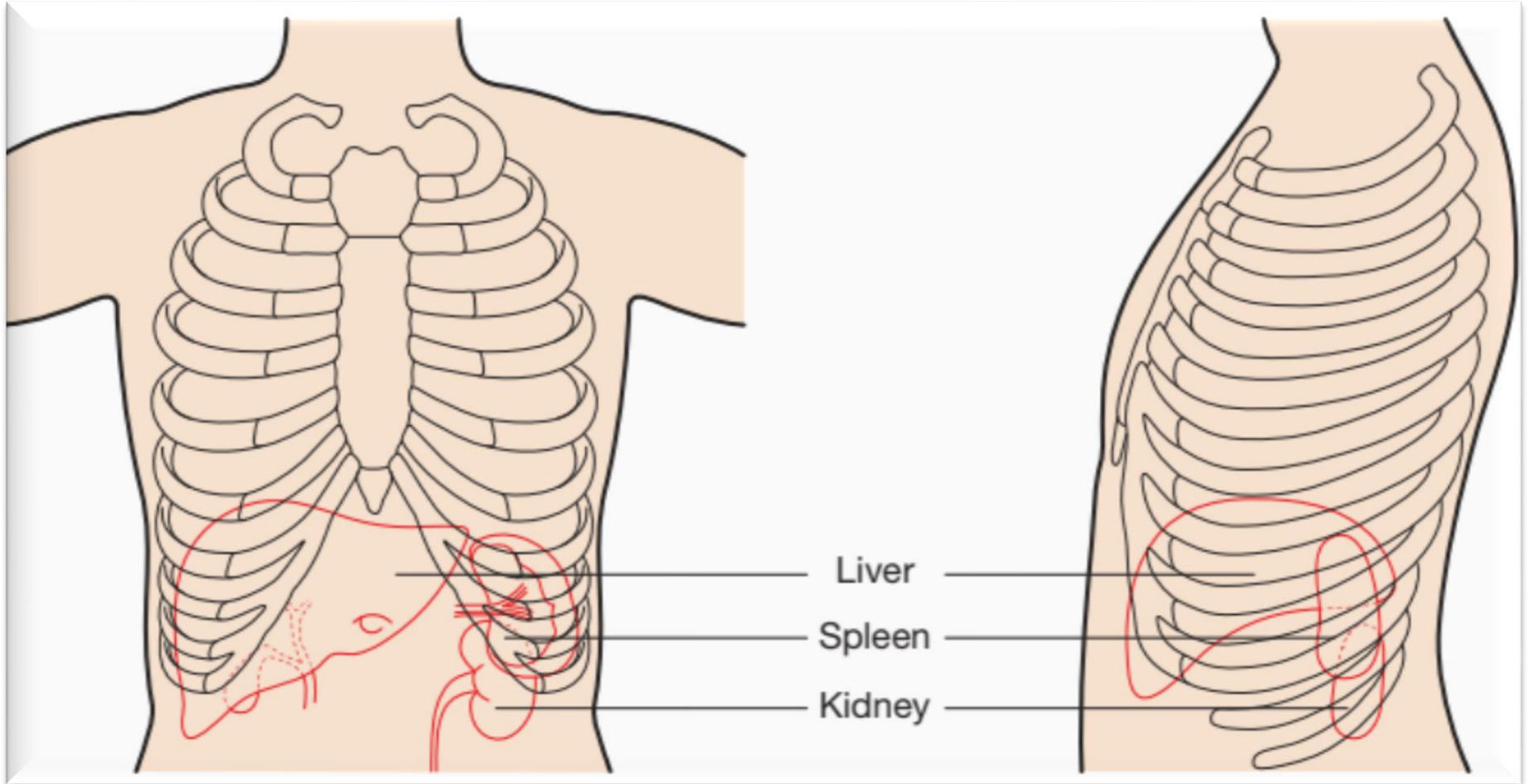
# Torso and pelvic trauma

# INJURY MECHANISMS ASSOCIATED WITH TORSO TRAUMA

- The key junctional zones are:
- between the neck and the thorax;
- between the thorax and the upper limbs;
- between the thorax and the abdomen;
- between the abdominopelvic structures and the groin.
  
- These zones represent surgical challenges in terms of both diagnosis of the area of injury and the required surgical approach.



# THORACIC INJURY



# The 'deadly dozen' threats to life from chest injury.

Immediately life-threatening

- Airway obstruction
- Tension pneumothorax
- Pericardial tamponade
- Open pneumothorax
- Massive haemothorax
- Flail chest

Potentially life-threatening

- Aortic injuries
- Tracheobronchial injuries
- Myocardial contusion
- Rupture of the diaphragm
- Oesophageal injuries
- Pulmonary contusion

## Airway obstruction

- Early intubation is very important, particularly in cases of neck haematoma or possible airway oedema.

## Tension pneumothorax

- A tension pneumothorax develops when a 'one-way valve' air leak occurs either from the lung or through the chest wall.
- The mediastinum is displaced to the opposite side, decreasing venous return and compressing the opposite lung.
- The most common causes are penetrating chest trauma, blunt chest trauma with a parenchymal lung injury and air leak that did not spontaneously close, iatrogenic lung injury (e.g. due to central venepuncture) and mechanical positive-pressure ventilation.

- The clinical presentation is dramatic. The patient is increasingly restless with tachypnoea, dyspnoea and distended neck veins (similar to pericardial tamponade). Clinical examination may reveal tracheal deviation; this is a late finding and is not necessary to clinically confirm diagnosis. There will also be hyper-resonance and decreased or absent breath sounds over the affected hemithorax. Tension pneumothorax is a clinical diagnosis and treatment should never be delayed by waiting for radiological confirmation. Always treat it with a high index of suspicion of being present .

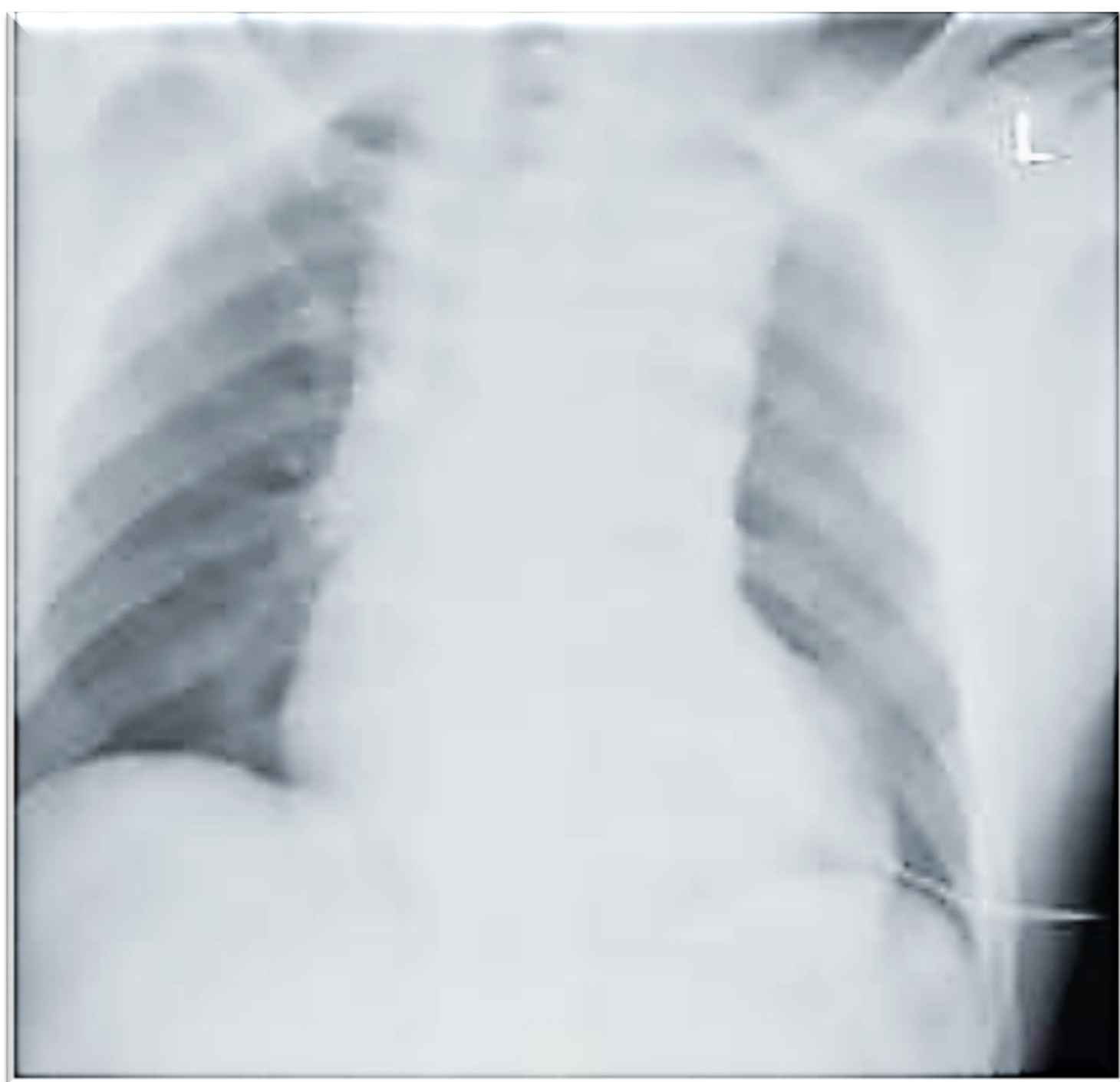
- Treatment consists of immediate decompression. This was historically taught by rapid insertion of a large-bore cannula into the second intercostal space in the mid-clavicular line of the affected side, followed by insertion of a chest tube through the fifth intercostal space in the anterior axillary line. However, current teaching advocates undertaking decompression in the safe triangle – defined posteriorly by latissimus dorsi, anteriorly by the lateral border of pectoralis major and inferiorly by a line perpendicular to the nipple going to the back, just anterior to the mid-axillary line – or, in extremis, a finger thoracostomy at the same location.



# Pericardial tamponade

- (50 mL) .
- Needs to be differentiated from a tension pneumothorax in the shocked patient with distended neck veins.
- Commonly is due to penetrating trauma.
- Increased JVP, hypotension with muffled heart sounds ( Beck triad ), and tachycardia .
- eFAST showing fluid in the pericardial sac, which is the most expeditious and reliable diagnostic tool, or chest radiography, looking for an enlarged heart shadow.
- Pericardiocentesis has no role in the management of cardiac tamponade secondary to penetrating myocardial injury.
- A left anterolateral thoracotomy or sternotomy should be performed with evacuation of the haematoma and repair of the myocardium





## Open pneumothorax (‘sucking chest wound’)

- This is due to a large open defect in the chest (>3 cm), leading to immediate equilibration between intrathoracic and atmospheric pressure.
- Initial management consists of promptly closing the defect with a sterile occlusive plastic dressing, taped on three sides to act as a flutter-type valve. A chest tube is inserted as soon as possible in a site remote from the injury site

# Massive Haemothorax

- Presentation is with haemorrhagic shock, flat neck veins, unilateral absence of breath sounds and dullness to percussion.
- The initial treatment consists of correcting the hypovolaemic shock, insertion of an intercostal drain and, in some cases, intubation. Initial drainage of more than 1500 mL of blood or ongoing haemorrhage of more than 200 mL/h over 3–4 hours is generally considered an indication for urgent thoracotomy.

The following points are important in the management  
of  
an open pneumothorax/haemothorax:

- If the lung does not reinflate, the drain should be placed on low-pressure (5 cmH<sub>2</sub>O) suction;
- Clot occlusion of a chest drainage tube may result in ‘no’ drainage, even in the presence of ongoing bleeding;
- A second drain is sometimes necessary .
- A chest radiograph or eFAST can help identify the presence of blood.
- A physiotherapy and active mobilisation should begin as soon as possible.

# Flail Chest

- blunt trauma associated with multiple rib fractures, and is defined as three or more ribs fractured in two or more places.
- Paradoxical motion of a chest wall segment.
- There is a high risk of developing a pneumothorax or haemothorax.
- The CT scan remains the gold standard for diagnosis of this condition.

# Management

- oxygen administration.
- adequate analgesia (including opiates) .
- physiotherapy.
- Chest tube .
- Ventilation is reserved for patients developing respiratory failure despite adequate analgesia and oxygen.
- Surgery to stabilise the flail segment using internal fixation of the ribs .

# Diaphragmatic injuries

- Any penetrating injury below the fifth intercostal space should raise suspicion of diaphragmatic penetration and, therefore, injury to abdominal contents.
- Blunt injury to the diaphragm is usually caused by a compressive force applied to the torso. The diaphragmatic rupture is usually large, with herniation of the abdominal contents into the chest. Diagnosis of diaphragmatic rupture can easily be missed in the acute phase, and may only be discovered at operation or through the presentation of complications.

- Historically and in limited resource environments, chest radiography after placement of a nasogastric tube may be helpful (as this may show the stomach herniated into the chest). CT scan and ultrasound scan all lack positive or negative predictive value. The most accurate evaluation is by video-assisted thoracoscopy or laparoscopy.
- All penetrating diaphragmatic injury must be repaired via the abdomen – and not the chest – to rule out penetrating hollow viscus injury.



# EMERGENCY THORACIC SURGERY

- Immediate thoracotomy in the emergency department for the control of haemorrhage, cardiac tamponade or internal cardiac massage.
- Emergency sternotomy for anterior mediastinal structures and the heart.

(Emergency department thoracotomy or sternotomy)

- Planned thoracotomy for definitive correction of the problem.

# **ABDOMINAL INJURY**

## Physiological categories after initial resuscitation:

- Physiologically ‘normal’ – investigation can be completed before treatment is planned;
- Physiologically ‘non-compromised’ – investigation is more limited; it is aimed at establishing whether the patient can be managed non-operatively, whether angioembolisation can be used or whether surgery is required;
- Physiologically ‘compromised’ – investigations need to be suspended as immediate surgical correction of the bleeding is required.
- **Examination** ( Shock, abdominal distention, peritoneal irritation, oliguria, palor, cold extremities.

## Investigation

- ( **peritoneal aspirate & diagnostic peritoneal lavage** ).

The cannula is aspirated for blood (>10 mL is deemed as positive) following by infusion, 500 mL of warmed Ringer's lactate intraperitoneally from a 1-litre bag. The bag, with 500 mL remaining, is placed on the floor and the intra-abdominal fluid is allowed to flow under the influence of gravity – this aids drainage. The presence of frank blood or similar contents to a nasogastric tube or urinary catheter denotes a positive DPL. The presence of >100 000 red cells/ $\mu$ L or >500 white cells/ $\mu$ L is deemed positive (this is equivalent to 20 mL of free blood in the abdominal cavity), as is a raised amylase level. In the absence of laboratory facilities, a urine dipstick may be useful. Drainage of lavage fluid via a chest drain indicates penetration of the diaphragm.

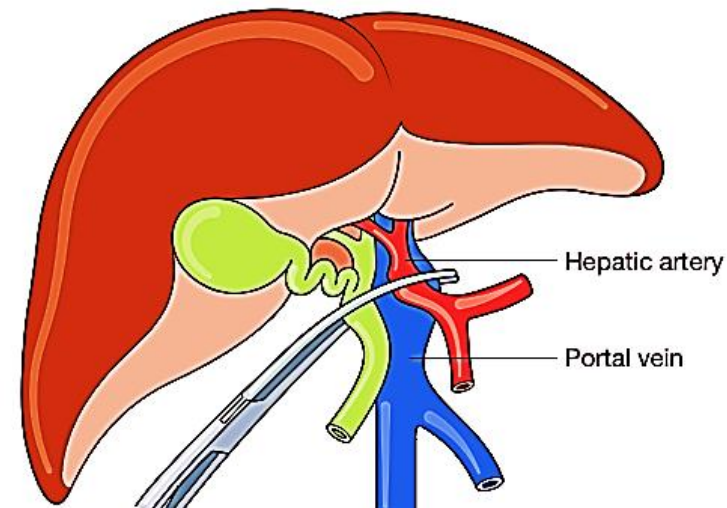
# FAST and eFAST

Although DPL has largely been replaced by eFAST, it remains the standard in many institutions where eFAST is not available or is unreliable.

- Computed tomography scan with contrast.
- Laparoscopy (screening: used to exclude a penetrating injury with breach of the peritoneum; diagnostic: finding evidence of injury to viscera and therapeutic: used to repair the injury ).

# Liver

- The operative management of liver injuries can be summarised as ‘the four Ps’:
- Pressure (direct bimanual compression to achieve its normal architecture as best as possible ) .
- Pringle manoeuvre, with direct compression of the portal triad, either digitally or using a soft clamp .
- Plug using silicone tubing or a Sengstaken–Blakemore tube.
- Pack (restoring the anatomy as closely as possible ) .



# Spleen

- Splenic injury occurs from direct blunt trauma.
- Most isolated splenic injuries, especially in children, can be managed non-operatively.
- The spleen can be theoretically packed, repaired or placed in a mesh bag.
- However, in reality, splenectomy is the safer option, especially in the compromised patient with multiple potential sites of bleeding. In certain situations, selective angioembolisation of the spleen can play a role.

# Colon

- If relatively little contamination is present and the viability is satisfactory, such wounds can be repaired primarily. If, however, there is extensive contamination, the patient is physiologically compromised or the bowel is of doubtful viability, then the bowel can be closed off ('clip and drop').
- A defunctioning colostomy can be formed later or the bowel reanastomosed once the patient is stable.



# Rectum

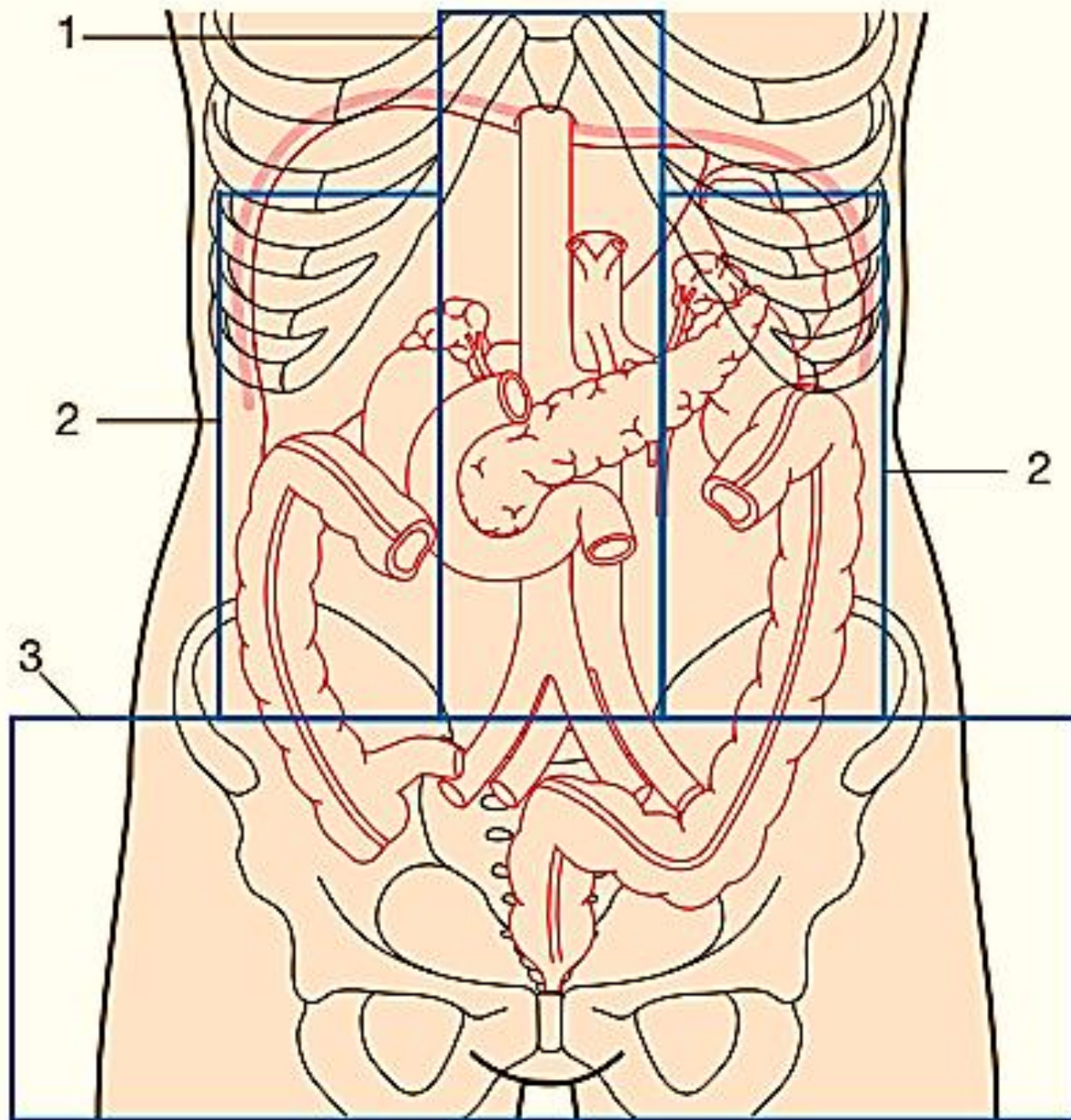
- May be damaged following fracture of the pelvis.
- Digital rectal examination will reveal the presence of blood, which is evidence of intestinal or rectal injury. These injuries are often associated with bladder and proximal urethral injury.
- With intraperitoneal injuries, the rectum is managed as for colonic injuries.
- Full-thickness extraperitoneal rectal injuries can be managed with primary repair and drainage depending on the type of injury, i.e. suitable for knife wounds but not ballistic trauma.
- Where there is extensive tissue loss, this should be managed with either a diverting end-colostomy and closure of the distal end (Hartmann's procedure) or a loop colostomy.

# Urinary Bladder

- Cystogram (leak ) .
- Intraperitoneal injury (surgical repair).
- Extraperitoneal rupture is usually associated with a fracture of the pelvis and will heal with adequate urine drainage via the transurethral route. Suprapubic drainage is reserved for when this is not possible.

# Retroperitoneum

- Injury to the retroperitoneum is often difficult to diagnose, especially in the presence of other injury, when the signs may be masked. Diagnostic tests (such as ultrasound and DPL) may be negative. The best diagnostic modality is CT, but this requires a physiologically stable patient. The retroperitoneum is divided into three zones for the purposes of intraoperative management in blunt trauma:

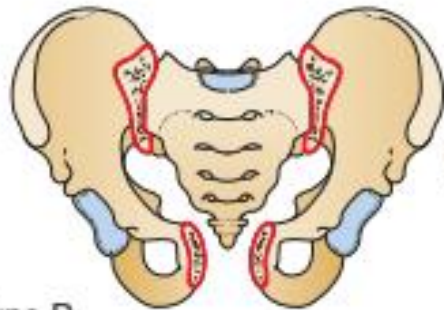
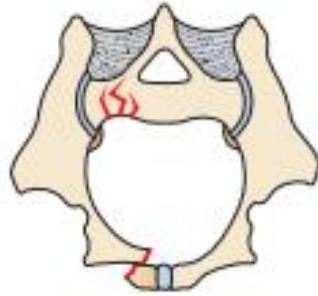


- Zone 1 (central haematomas ): , explored, once proximal and distal vascular control has been obtained.
- Zone 2 (lateral haematomas): explored if they are expanding or pulsatile or penetrating injury is present. They are usually renal in origin and can be managed non-operatively, although they may sometimes require angioembolisation.
- Zone 3 (pelvic haematomas): as with zone 2, these should only be explored if they are expanding or pulsatile or penetrating injury is present.
- Pelvic haematomas are exceptionally difficult to control and, whenever possible, should not be opened; they are best controlled with compression or extraperitoneal packing, or, if the bleeding is arterial in origin, with angioembolisation.

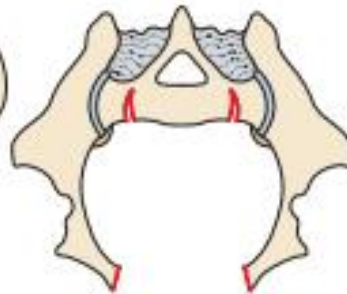
# THE PELVIS



Type A



Type B



Type C

- **Type A**
- Type A are the most common fractures and are completely stable. compression fractures of the pubic rami or compression fracture of the sacrum posteriorly.
- **Type B**
- These fractures are partially stable, and there is disruption of the anterior pelvis and partial disruption of the posterior pelvis. The pelvis can open and close 'like a book', but because the sacroiliac ligaments remain intact there is no vertical displacement. Internal or external stabilisation is required. Blood loss can be significant.
- **Type C**
- This fracture is completely unstable. Both the anterior pelvis and the entire posterior pelvic complexes are disrupted and the disrupted pelvic bones are free to displace horizontally and vertically.
- In both type B and type C pelvic injuries, there is a high risk of associated abdominal injuries (bowel perforation or mesenteric laceration) and rupture of the diaphragm.

# **DAMAGE CONTROL**

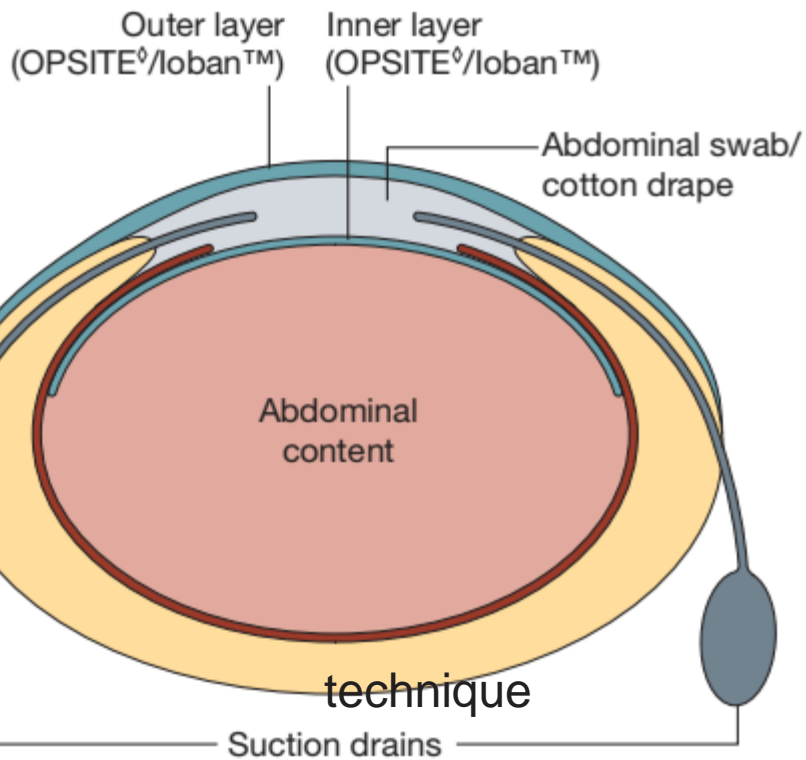
- Patients with the ‘deadly triad’ (hypothermia, acidosis and coagulopathy) are those at highest risk.
- (Damage control resuscitation) and the surgical correction of the injury (Damage control surgery).
- **Damage control**
- Resuscitation is carried out in the operating theatre using biologically active fluids (i.e. blood) – damage control resuscitation
- The surgery performed is the minimum needed to stabilise the patient
- The aims of surgery are to control haemorrhage and limit contamination
- Secondary surgery is aimed at definitive repair



# The stages of damage control surgery

| Stage | Intervention   |
|-------|--|
| I     | Patient selection  |
| II    | Control of haemorrhage and control of contamination  |
| III   | Resuscitation continued in the intensive care unit ( acidosis, coagulopathy and hypothermia) |
| IV    | Definitive surgery   |
| V     | Abdominal closure  |

(a)



# 'Vac-Pac' or 'OPSITE<sup>®</sup> sandwich technique



**ABDOMINAL COMPARTMENT SYNDROME  
AND  
THE OPEN ABDOMEN**

- Raised intra-abdominal pressure has far-reaching consequences for the patient; the syndrome that results is known as ACS ( acute compartment syndrome ).
- Measurement ( direct ( verrese needle ) / ( indirect ( intracaval pressure or intravesical pressure) ).
- The best situation is closure of the abdominal fascia, or, if this cannot be achieved, then skin closure only.
- Negative pressre wound therapy ( NPWT )  
V.A.C. ( Vacuum Assisted Closure ).

# INTERVENTIONAL RADIOLOGY

- Interventional radiology can be useful in the management of torso trauma as both an investigative and a therapeutic tool for patients with vascular injury. Angioembolisation following demonstration of ongoing bleeding in splenic and renal injury is a valuable technique.

# NON-OPERATIVE MANAGEMENT

- Conservative with monitoring and imaging.
- Failure of non-operative management is uncommon and typically occurs within the first 12 hours after injury.
- Therefore, if correctly selected, the vast majority of these patients will avoid surgery, require less blood transfusion and sustain fewer complications than operated patients.
- Ex : blunt trauma to liver, spleen and kidney.

# Extremities

- Fractures to the injured extremity, dislocation or subluxation .
  - Look.
  - Feel;
  - Move (active and passive);
  - Special tests
  - (Neurovascular examination)
  - Special investigations ( Plain X ray, CT scan )
- Mx : Reduction and fixation.

حَمْدُ اللَّهِ

**PRAISE BE TO ALLAH**