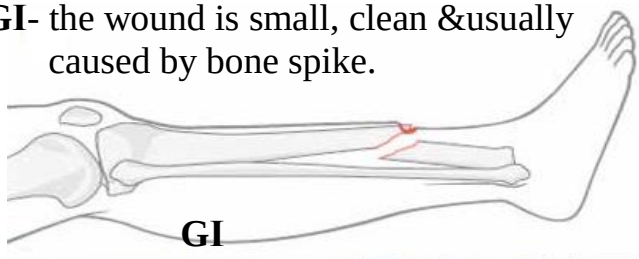
Lecture (1)- 2020 **Prof.Dr.Alaa Al-algawy**

Learning objectives :
1- to define compound fracture .
2-to know classification of .
3-outline the principles of management.
4- to know the types of war injuries .
5- mechanisms of affection .
6-outline the management lines of .

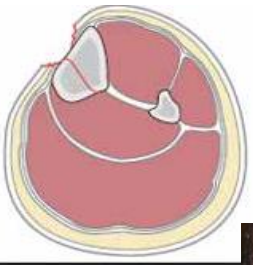
Compound fracture:

Compound fractures are classified according to the severity of tissue destruction into 3 types (Gustilo classification):

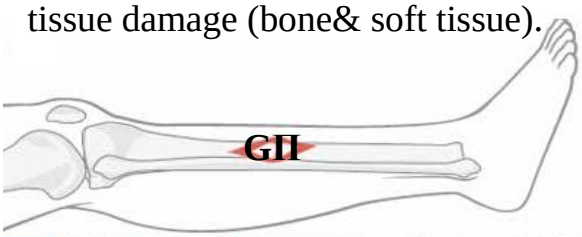
GI- the wound is small, clean &usually caused by bone spike.



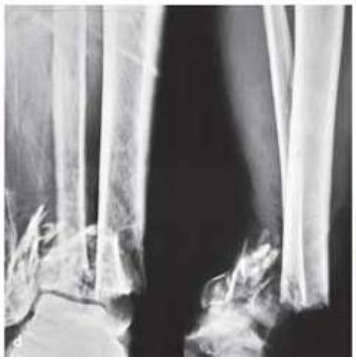
GI

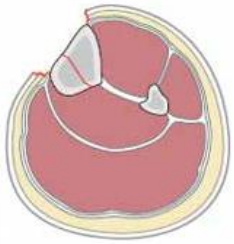


GII - the wound is >1cm with moderate tissue damage (bone& soft tissue).



GII

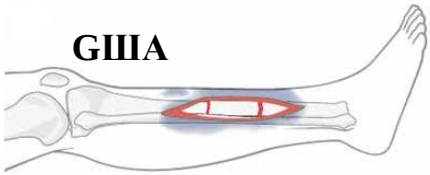


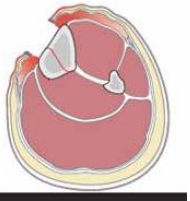


GIII- there is extensive skin, soft tissue, bone &neurovascular damage with considerable contamination:

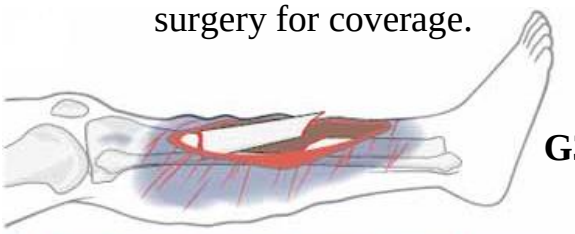
GIIIA- If the fracture can be covered by soft tissue.

GIIIA

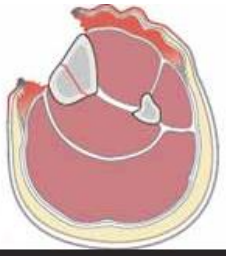




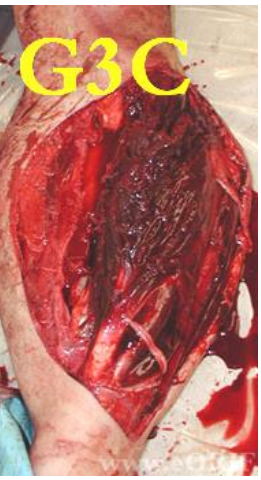
GIII B- If the # require reconstructive surgery for coverage.

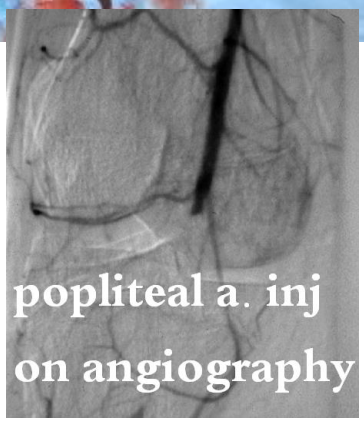


G3B



GIII C- If there is arterial injury requiring repair even if there is little tissue damage.



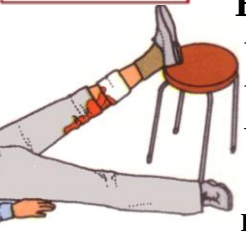


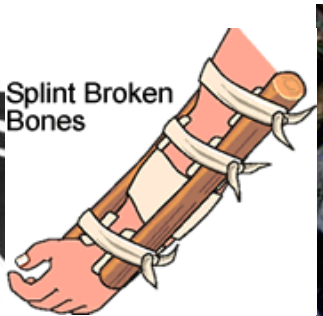
Management: open fracture is an emergency.

At the scene: ensure clean airway, stop bleeding, cover the wound, splint the # &transfer to the hospital.

In the hospital: in the emergency room re-examine the patient quickly then start resuscitation with IV line and take blood sample for cross match.

The **priority** of treatment should be for: ensuring **A**irway, **B**reathing and **C**irculation then do further assessment checking the level of consciousness, the neck &back, the abdomen, the pelvis and the limbs for wounds &fractures. After that, when the patient is resuscitated and become more stable, you can do more careful examination followed by the required investigations including x-rays.





Local treatment of open fracture: start immediately with broad spectrum antibiotics &tetanus prophylaxis.

In the theater: clean the limb with soap &water, shave the skin around the wound and sterilize it with antiseptic like chlorhexidine or povidone iodine; then expose the wound and clean it with physiological saline mixed with antibacterial agent several times.

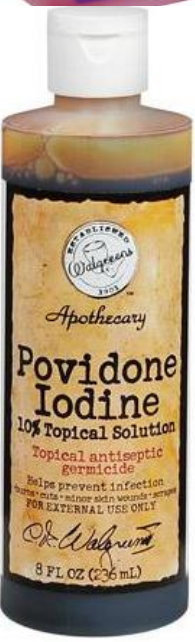
Then start **debridement**:

Skin: the dead edges are excised till get healthy oozing skin.

Subcutaneous tissue: excise all dead subcutaneous tissues.

Muscles: all dead muscles should be excised because they are good food for bacteria. A dead muscle is bluish in color (not red), does not contract if pinched and if cut it will not bleed.

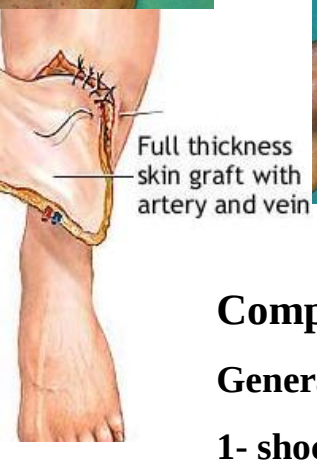
Bone: bone ends are cleaned, bone fragments are not removed unless they are small and totally detached. Then do stabilize the fracture with external fixator.

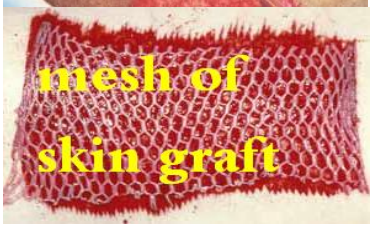


Blood vessels: large vessels are repaired, while small bleeders are ligated or clamped.

Nerves: approximate the nerve ends with sutures for later repair.

Wound closure: if the wound is small, clean and debrided within few hours, you can close it, otherwise the wound should be left open for daily dressing until it become clean with healthy granulation tissue growth, then close it (secondary suture). Skin loss can be replaced by skin graft (partial or full thickness), pedicle graft or free graft (cutaneous, myocutaneous or osteomyocutaneous).





Complications of fracture

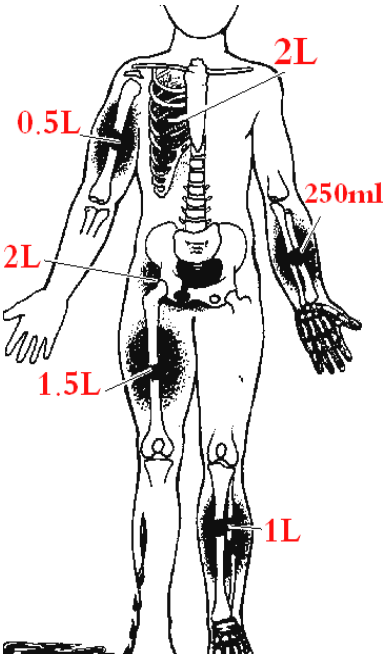
General complications

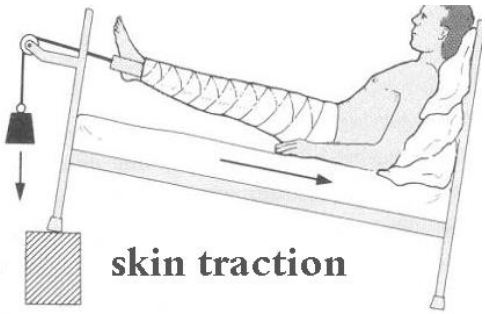
1- shock: is a generalized state of reduced tissue perfusion which if persist, it will cause damage to vital organs. In # , the shock can be:
Neurogenic shock: due to pain, the blood will pool in the skeletal muscles. Ṛ→ splint the # & give anaelgesia like morphine or pethidine.

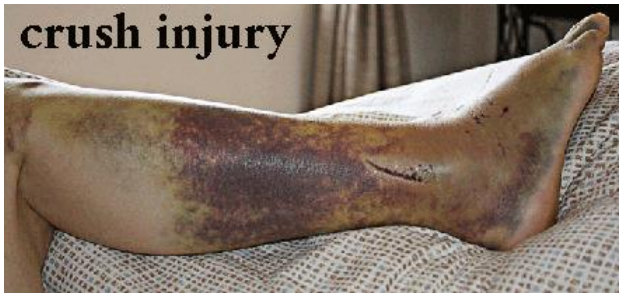
Hypovolaemic shock: is due to blood loss from bone ends, nearby soft tissue &injured blood vessels e.g. in a simple femoral shaft #, there may be 1- 1.5 liter of blood lost into the soft tissue of the thigh outside the circulation. Ṛ → arrest the bleeding & restore the lost blood.

2- crush syndrome: may occur if a large bulk of muscles is crushed or if a tourniquet has been left unreleased for > 6 hours. After release, the acid myohaematin (cytochrome C), resulting from muscle breakdown, will be released into the circulation &may block renal tubules or cause renal artery spasm, both may lead to acute renal failure. So to avoid that, the limb should be amputated above the level of the forgotten tourniquet and before releasing it. Ṛ of renal failure: ↓fluid &protein, ↑ carbohydrate intake, maintain electrolyte balance. Renal dialysis may be needed.

Esmarch tourniquet

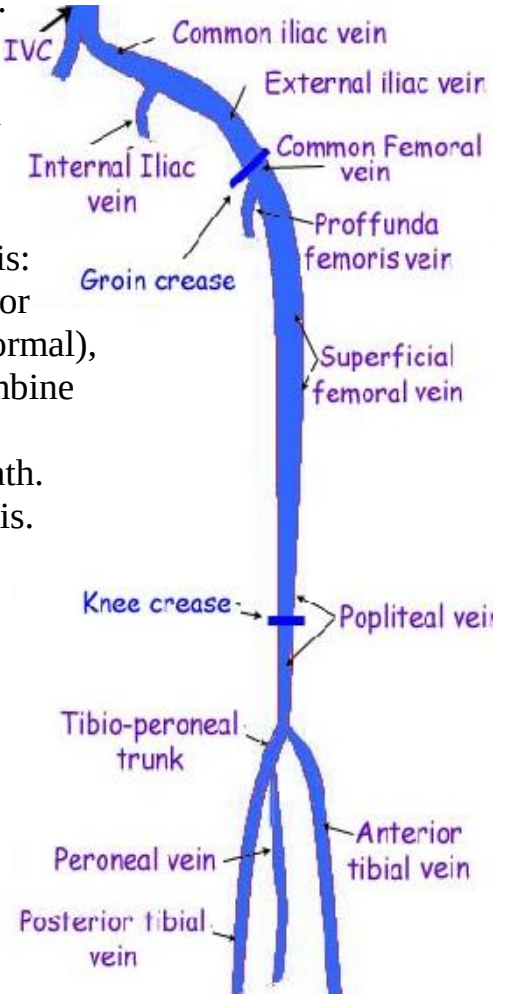


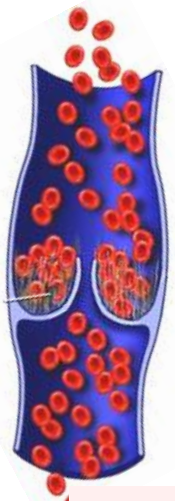


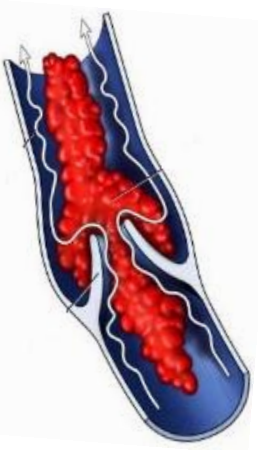


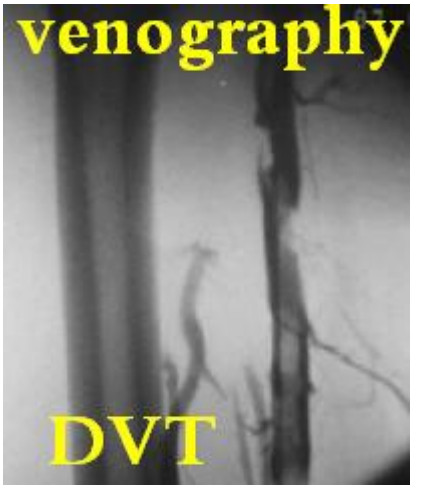
3- venous thrombosis & pulmonary embolism: the incidence

of deep vein thrombosis(DVT) following major trauma or surgery is about 30% and that of pulmonary embolism is about 5%.
Causes of DVT**:** 1-activation of factor 10 by thromboplastine released from tissue damage. 2-blood stasis. 3-endothelial damage. 4-increase number &stickiness of platelets.
Risk factors:
1-old patients. 2-cardiovascular disease.
3-Bed ridden patients. 4-hip surgery.
Prevention: 1-early mobilization &exercise of the patient. 2-elevation of affected limb. 3-elastic bandage to prevent blood pooling. 4-anticoagulants like aspirin or heparin.
Established DVT: clinically there will be slight ↑ in body temperature and pulse rate with swollen tender calf.
Diagnosis: venography or ultrasound scaning.
Treatment of extensive DVT especially in thigh and pelvis: 1-bed rest. 2-heparin IV 10 000 IU 6 hourly for 5-7 days or according to partial thromboplastin time (1.5- 2 of the normal), then shift to warfarin with the dose according to prothrombine time for 3 months.
Pulmonary embolism: if massive, will cause sudden death. If small, it may cause chest pain, dyspnea and haemoptysis.

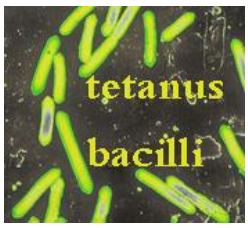






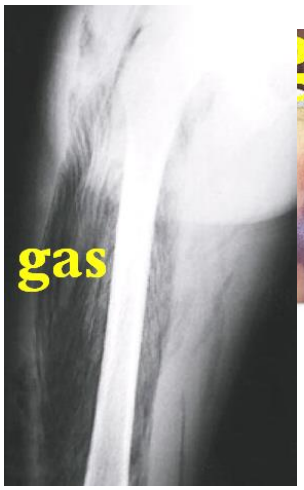


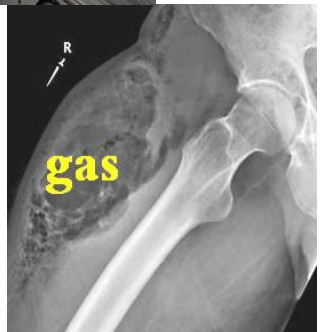
4- tetanus: the tetanus organism require dead tissue to grow, so good debridement is important in prevention. The exotoxin is carried to the central nervous system via blood and lymphatics. Once it reach the anterior horn cells, it will be fixed there and can not be neutralized by antitoxin.

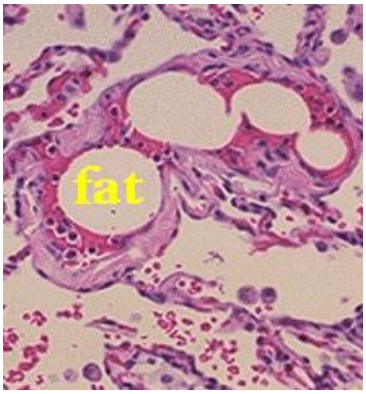


Clinical features: early tonic and later clonic muscle contraction, especially of the jaw, face, those near the wound &later, those of the
neck and back. If the diaphragm and intercostal muscles are affected,
the patient may die because of asphyxia.
Prophylaxis: good wound toilet, active immunization using toxoid and booster dose after injury (those who were not immunized, are given human antitoxin serum).
Ṛ of established tetanus: IV antitoxin, sedation, muscle relaxant (diazepam), antibiotics(penicillin) &if required, assisted ventilation.

5- gas gangrene: is caused by Clostridia perfringens(welchii), anaerobic gram +ve rods growing only in tissue with low oxygen tension, so the usual site is dirty wound with dead muscle that has been closed with inadequate debridement. Clinically, within 24 hours, the wound become swollen, painful, brown discharge with specific smell, gas in the tissue, rapid pulse, little fever and later, the patient may become toxic and comatose.
Ṛ: excision of all dead tissue, IV antibiotic, hyperbaric oxygen may limit infection. In severe cases, amputation may required.

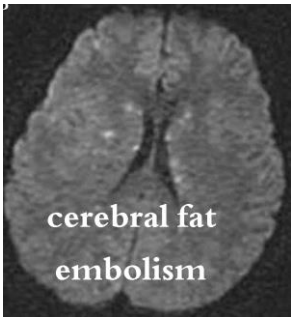


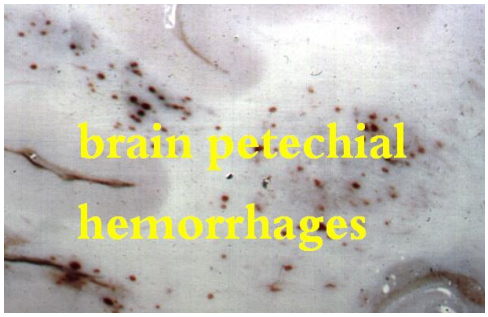




6- fat embolism: is thought to be due to liberation into the circulation of fat globules larger than 10μm, the aggregation of them may obstruct capillaries especially in the lungs.
CF: usually, a young adult, within 72 hours from injury, gets slight fever, rapid pulse, dyspnea, confusion, skin petechiae and in severe cases, respiratory distress and coma.
Diagnosis: is suspected if blood Po_2 is < 60 mmHg.
Ṛ→ assisted ventilation, fluid balance, heparin to prevent thromboembolism and steroid to decrease pulmonary edaema.

7- fever: absorption of # haematoma may ↑body temp by 0.5˚C.





War injuries

(Ballistic injuries)

Weapons are divided into:

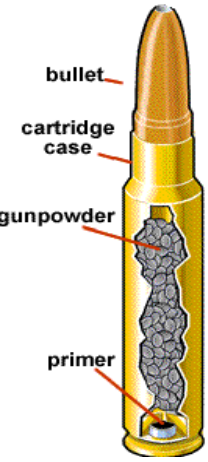
1-Small arms: like pistols, rifles and machine guns.

2-Explosive munitions: like artillery, grenades, hand grenades, mortar, bomb, mine & anti-armor weapons.

Small arm injuries:

is common in civil practice(peace time).

Pathophysiology: the injury is caused by transfer of energy of the moving projectile to the body, it depend on:



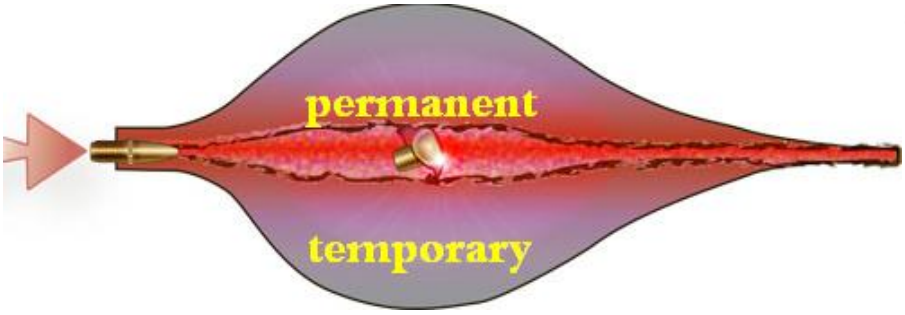
1-Projectile factors: mass, speed, nature(bullet, shrapnel or shell), composition (fragmentatiom) &stability(tilt, rotation).

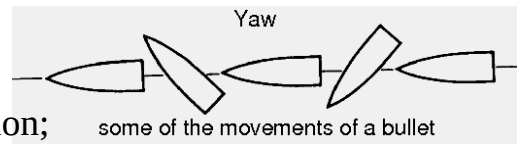
2-Anatomical factors: density &elasticity of the injured tissue.

Small arms (both high velocity missile >600m/s and low velocity missile < 600m/s): cause two areas of tissue injury:

1-permanent cavity: is a localized area of cell necrosis caused by direct injury of the missile along it's path.

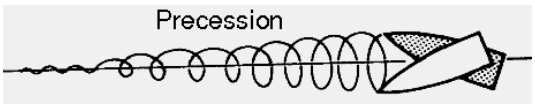
2-temporary cavity: is a transient lateral displacement of tissue surrounding the permanent cavity. Elastic tissues(skin, muscles &vessels) are pushed aside, then rebound, usually need no excision if their blood supply is intact. While, inelastic tissue, like bone, may fracture in this area.





Treatment:

I-Emergency R: 1-stop bleeding &general resuscitation;
2-cover with sterile dressing;
3-start AB &anti tetanus.

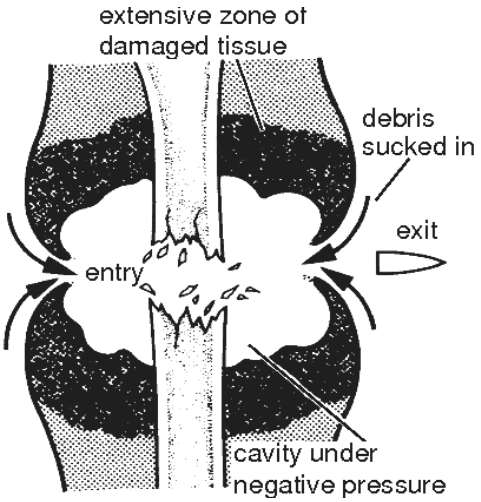


II- Definitive treatment:

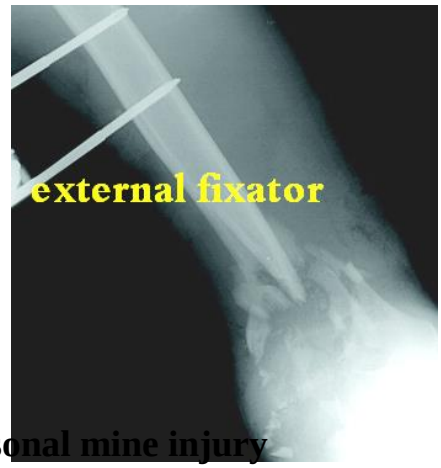
soft tissue injury:

Low velocity missile injury(pistol): there is little tissue destruction and cavitations. So, superficial debridement is enough provided the entry and exit wounds are clean.

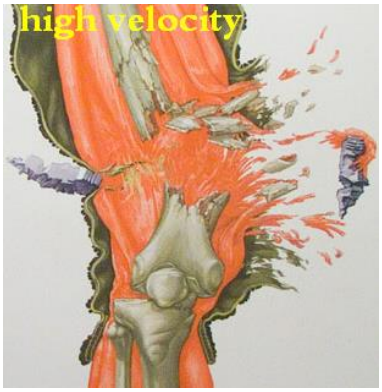
High velocity missile injury(rifle): there is marked tissue destruction &cavitation, which should be cleaned by thorough debridement &excision of all dead tissue leaving the wound open for daily dressing till become clean before closure.



Bone injury: any associated # should be stabilized using either traction, splintage or external fixation (definitive fixation or temporary external fixation for few weeks then internal fixation).



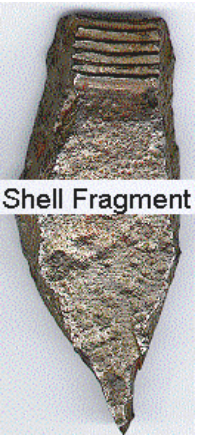
Anti-personal mine injury



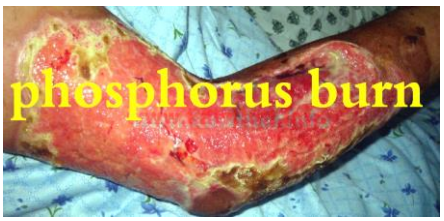
Explosive munitions injuries: common in war time

&terrorist attacks. They cause blast injuries which are divided into 4 types:
1-Primary blast (wave)injury: caused by the direct effect of blast over pressure on the tissue leading to :

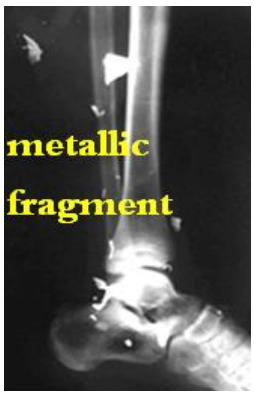
a-complete or incomplete amputation (usually irreparable).
b- injury to any gas containing organs like lungs, tympanic membrane and bowel.

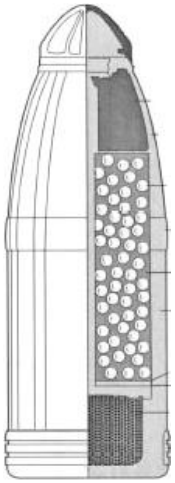


2-Secondary blast injury: is the penetrating injuries caused by the weapon shell & shrapnel (primary fragment injuries) &the fragments resulting from explosion(secondary fragment injuries).
3-Tertiary blast injuries: caused by displacement of the body by shock wave striking other objects that may cause #.
4-Quaternary blast injuries: are injuries resulting from building collapse &fire like burn &toxic chemicals poisoning.

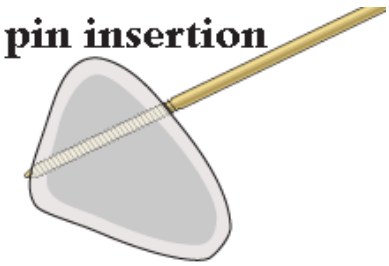


The most common pattern of injury seen in is multiple small fragment wounds of the extremities.





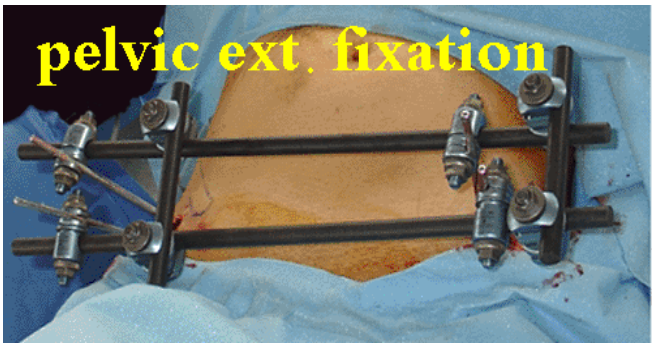
Treatment: ***(Treat the wound, not the weapon.)***
Start with: history, physical exam., radiological evaluation &classification of wounds & # (Gustillo's system), then either: non-operative(rare) or usually operative Ṛ which includes:
1-AT prophylaxis, **2**-AB., **3**-Wound irrigation &meticulous debridement (usually 2nd, 3rd look debridement).
4-Fracture stabilization which is critical for wound healing &to ↓ the risk of infection. **5**-definitive wound cover.



Fracture stabilization:
1-Traction: has limited use nowadays.
2-Splitage: used for closed # and for low energy open # of the leg, ankle & upper limb(G I & Π).
3-External fixation: is the method of choice for high energy open # (G Π & ΙΙΙ). It ↓ the systemic effect of injury in multiply injured patients by ↓ hemorrhage &↓ the release of inflammatory mediators. External fixator can be used as a **temporary** fracture stabilizer for 2 weeks then change (when the wound become clean and the risk of infection negligible) to internal fixation; or as a **definitive** fixation till # healing.

ndications of external fixation:

1- open fractures of the lower limb.
2- impending open fracture.
3- # associated with vascular injury.
4- fracture with significant bone loss.
5- to restore length and alignment.
6- pelvis fracture.
7- closed # that are difficult to splint during long transport.



Complications of external fixation:

1-joint stiffness, ***2***-pin tract infection, ***3***-pin placed into # site.
4-pin placed into the joint, ***5***-pin placed too shallow.
6-pin placed too deep causing neurovascular injury.
7-pin fracture in side the bone.

Prevention of war wound infection:
1-aggressive wound care.
2-early & enough AB.
3-fracture stabilization.

Retained missile: not all missiles, remaining in the body, could or should be removed. Many of them are small, innocent &inaccessible and attempting removal is risky because damage to nearby structures may happen during operation more than the missile caused.
Indications of missile removal:
1-persistent pain, **2**-discharging sinus, **3**-arterio-venous complication.
4-delayed nerve palsy, **5**-limitation of joint movement,
6-local &systemic effects according to chemical nature of the missile.
7-patient fear of malignancy.