



# OPEN FRACTURES

Banan  
Bassam

An open fracture is a fracture in which there is an open wound or break in the skin near the site of the broken bone. Most often, this wound is caused by a fragment of bone breaking through the skin at the moment of the injury.





# Cause

**Most open fractures are caused by some type of high-energy event such as a gunshot or motor vehicle accident. These patients will often have additional injuries to other parts of the body.**

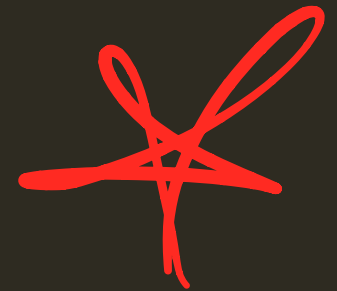
**An open fracture can also result from a lower-energy incident, such as a simple fall at home or an injury in playing sport.**

# GUSTILLO-ANDERSON CLASSIFICATION

☆  
"نظام" -  
"نظام" -  
"نظام"

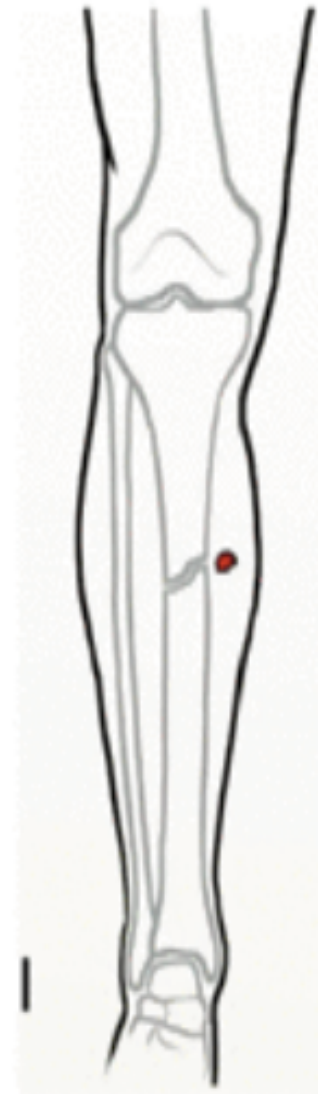
**This** classification describes the 1-amount of energy 2-extent of soft tissue injury 3-the extent of contamination and 4-Bone injury(Commuitate)

**It is divided** into three types.



# TYPE I

- 1-Wound is less than 1cm.
- 2-clean puncture wound.
- 3-There is little soft tissue damage with no signs of crushing injuries.
- 4-Low energy trauma.





# TYPE II

- 1-Wound is more than 1cm but less than 10cm.
- 2-There is no extensive soft tissue damage.
- 3-Moderate comminution.
- 4-Moderate contamination.



Type III *نوع III* *حالة كسر مع إصابة في العظام* -

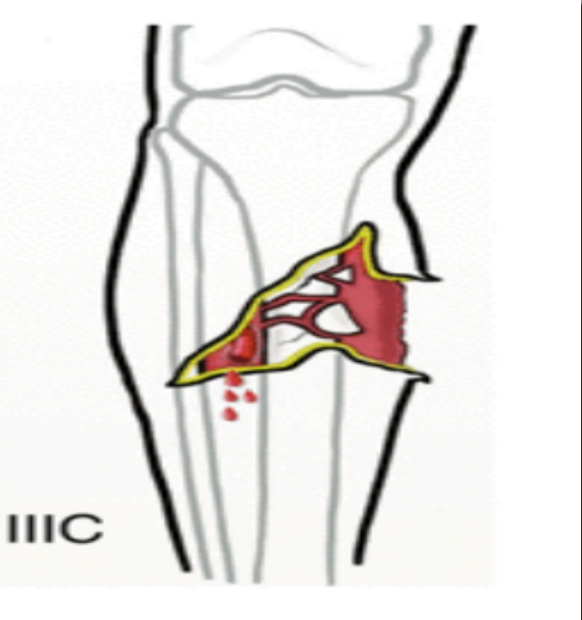
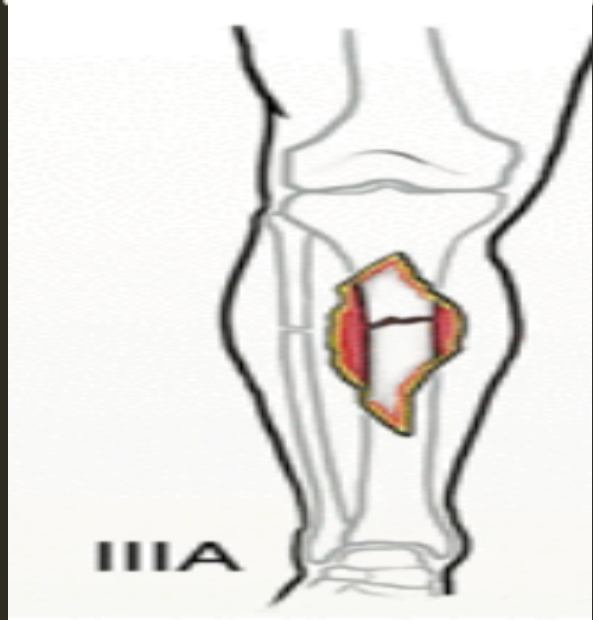
\* Fr case of fracture with *إصابة* high energy trauma but *جرح < 1cm?*

wound < 1cm?  
Type III

# TYPE III

1-High energy trauma. 2-Wound is more than 10cm. 3-High degree contaminated. 4-Comminuted fractures.

Type IIIA	Type IIIB	Type IIIC
Sever soft tissue injury soft tissue <u>coverage of the bone is possible.</u>	Sever loss of soft tissue <u>,no possible bone coverage.</u> maybe moderate to sever bone commination <u>requires local or distant flap</u> ← Eg. Open fractures at the distal part of the tibial can be reconstected by using latissimus dorsi free flap.	<u>Vascular injury requiring repair or amputation</u>





# MESS score

Factors used?  
- age  
- Ischemia  
- Energy  
- shock

The mangled extremity severity score (MESS) is a **scoring** system that can be applied to help one determine which mangled limbs will eventually come to amputation. The MESS is a graduated grading system based on **skeletal and soft tissue injury, shock, ischemia, and age.**

-The MESS can potentially identify at time of initial evaluation patients who are candidates for successful limb salvage vs future amputation.

The MESS utilizes variables that can be readily obtained without extensive and complicated measurements or calculations

**Table 1 – Mangled Extremity Severity Score Index.**

Type	Characteristics	Lesions	Sutures
<b>Group of skeletal lesions and soft tissue</b>			
1	Low energy	Sharp wound, simple closed fracture, projectile low-caliber firearm	1
2	Medium energy	Multiple or exposed fractures, dislocation, moderate crush injury	2
3	High energy	Explosion gunshot wound from a high-speed firearm	3
4	Massive crushing	Fall from a tree, train accident, smothering	4
<b>Shock group</b>			
1	Hemodynamically normotensive	Stable blood pressure	0
2	Transient hypotension	Unstable pressure, but responding to intravenous fluid	1
3	Prolonged hypotension	Systolic pressure of < 90 mmHg and responding to intravenous infusion of fluid only in the operating room	2
<b>Ischemic group</b>			
1*	Absence	Pulse without signs of ischemia	0*
2*	Mild	Pulse reduced without signs of ischemia	1*
3*	Moderately	No pulse on Doppler imaging, prolonged capillary refill, paresthesia, decreased motor activity	2*
4*	serious	Pulseless, cold limb, which is paralyzed and numb without capillary refill	3*
<b>Age group</b>			
1		< 30 years	0
2		30–50 years	1
3		> 50 years	2

\*Multiply by 2 if ischemia persists for > 6 hours.

Limbs with scores of 7–12 points usually require amputation. Limbs with scores of 3–6 points are usually viable.

# INITIAL MANAGEMENT :

Many patients with open fractures have multiple injuries and severe shock; for them, appropriate treatment at the scene of the accident is essential. The wound should be covered with a sterile dressing or clean material and left undisturbed until the patient reaches the accident department. This will reduce the risk of further contamination and wound desiccation.

In hospital a rapid general assessment is the first step, and any life-threatening conditions are addressed

\* Tetanus prophylaxis is administered.

\* Antibiotics should be given once the diagnosis of an open fracture is confirmed – the sooner the better

The wound is carefully inspected; ideally it should be photographed with a Polaroid or digital camera, so that it can again be kept covered until the patient is in the operating theatre.

\* Analgesia

\* irrigation in surgery

→ once you get  
an open wound  
fracture  
Give the 3:

1. anti-Tetanus
2. Antibiotic
3. Analgesia

# TREATMENT OF OPEN FRACTURES

All open fractures, no matter how trivial they may seem, must be assumed to be contaminated; it is important to try to prevent them from becoming infected. The four essentials are:

- 1-Treat as an emergency.
- 2-Debridement and re-debridement.
- 3-Stabilize fracture.
- 4-Early Closure.
- 5-Antibiotic prophylaxis.

Repeated examination of the limb is important; remember that open fractures also can be associated with a compartment syndrome.

## Debridement

The single and most important  
step to avoid infection and contamination  
is → Irrigation

Antibiotic → 1st or 2nd Cephalosporins



## Debridement

- ◆ Most important step.
- ◆ Aim-Removal of dead tissue and foreign material to ensure good blood supply.
- ◆ Debridement done as soon as possible.

## Irrigation



- ◆ Usual irrigation fluid used is NS
- ◆ High volume low pressure repeated lavage is performed.
- ◆ Volume of fluid used varies- usually about 3 L is used for grade 1 #; 6-10 L is used for grade 2 or 3 #.

# STERILITY AND ANTIBIOTIC COVER

The wound should be kept covered until the patient reaches the operating theatre. At the time of debridement, **gentamicin** is added to a second dose of the first antibiotic. Both antibiotics provide prophylaxis against the majority of Gram positive and Gram-negative bacteria that may have entered the wound at the time of injury. Only co-amoxiclav or cefuroxime (or clindamycin) is continued thereafter; the total period of antibiotic use for these fractures should not be longer than 72 hours. This advice is based on evidence that later infections are caused mostly by hospital-acquired bacteria and not seeded at the time of injury. Protracted use of wide-spectrum antibiotics prior to definitive wound closure only serves to select resistant bacteria from the hospital environment to contaminate the wound. Correspondingly, gentamicin and vancomycin (or teicoplanin) are given as a single dose at the time of definitive wound cover as these antibiotics are effective against methicillin-resistant *Staphylococcus aureus* and *Pseudomonas*, both of which are near the top of the league table of bacteria responsible for deep infection after open fractures.

Table 24.1 Antibiotics for open fractures<sup>1</sup>

	Grade I	Grade II	Grade III A	Grade III B/III C
<b>As soon as possible (within 3 hours of injury)</b>	Co-amoxiclav <sup>2</sup>	Co-amoxiclav <sup>2</sup>	Co-amoxiclav <sup>2</sup>	Co-amoxiclav <sup>2</sup>
<b>At debridement</b>	Co-amoxiclav <sup>2</sup> and gentamicin	Co-amoxiclav <sup>2</sup> and gentamicin	Co-amoxiclav <sup>2</sup> and gentamicin	Co-amoxiclav <sup>2</sup> and gentamicin
<b>At definitive fracture cover</b>	Wound cover is usually possible at debridement; delayed closure unnecessary	Wound cover is usually possible at debridement. If delayed, gentamicin and vancomycin (or teicoplanin) at the time of cover	Wound cover is usually possible at debridement. If delayed, gentamicin and vancomycin (or teicoplanin) at the time of cover	Gentamicin and vancomycin (or teicoplanin)
<b>Continued prophylaxis</b>	Only co-amoxiclav <sup>2</sup> continued after surgery	Only co-amoxiclav <sup>2</sup> continued between procedures and after final surgery	Only co-amoxiclav <sup>2</sup> continued between procedures and after final surgery	Only co-amoxiclav <sup>2</sup> continued between procedures and after final surgery
<b>Maximum period</b>	24 hours	72 hours	72 hours	72 hours

<sup>1</sup>Based on the Standards for the Management of Open Fractures of the Lower Limb, British Orthopaedic Association and British Association of Plastic, Reconstructive and Aesthetic Surgeons, 2009.

<sup>2</sup>Or cefuroxime (clindamycin for those with penicillin allergy).

# Skeletal Stabilization

do it even before  
fixing the  
Artery →

لا بد حتى لو عملنا الرضوخ قبل فيه احتمال الاضلع منزعجه عن شريك

- ◆ Done once vascular repair is completed and limb salvaged or once irrigation and debridement is done.
- ◆ Restoring the length, rotational, and angular alignment has many benefits for healing of soft tissues.
- ◆ Fracture reduction unkinks NV conduits and helps in soft tissue healing.
- ◆ Minimizing motion of fragments also decreases further damage, pain and permits mobilization of joints.

# Wound Closure

TO CLOSE OR NOT TO CLOSE



# Wound closure and coverage

- ◆ Wounds without skin loss: tension free primary closure after thorough debridement.
- ◆ Contraindications for primary closure
  - Delayed presentation >12 hrs.
  - Delayed administration of antibiotics >12 hrs.
  - Deep seated contamination
  - Immunocompromised
  - NV injury
  - Inability to achieve tension free suture
  - High risk of anaerobic contamination like farm yard injuries.
- ◆ Wounds with skin loss: healing by secondary intention. Delayed primary closure, SSG, free flaps.



A small, uncontaminated wound in a Grade I or II fracture may (after debridement) be sutured, provided this can be done without tension. In the more severe grades of injury, fracture stabilization and wound cover using split-skin grafts, local or distant flaps is ideal, provided both orthopaedic and plastic surgeons are satisfied that the wound is clean and viable after debridement.

\* Type I - II - III can be closed primarily  
if there is no contamination

IF NOT the fracture is stabilized by external fixation and then left open and dressed with an impervious dressing.

Stabilizing the limb in open fractures **External fixation** is a useful method of holding the fracture while the wound remains accessible. If necessary this can be replaced by **internal fixation**, provided the wound is clean and covered, and the interval between the two procedures is less than 7 days.

I, II, III<sub>a</sub> → internal fixation

III<sub>b,c</sub> → external fixation

## Post-op

- Limb is elevated
- Circulation carefully monitored
- Antibiotic cover continued; swab samples will dictate whether a diff. antibiotic is needed
- If wound has been left open, inspect in 2-3 days. Delayed primary suture is then often safe or, if there has been much skin loss, plastic surgery for grafting may be necessary