OPEN FRACTURE

An open fracture refers to osseous disruption in which a break in the skin and underlying soft tissue communicates directly with the fracture and its hematoma. A compound fracture refers to the same injury, but this term is archaic. Any wound occurring on the same limb segment as a fracture must be suspected to be a consequence of an open fracture until proven otherwise.

Soft tissue injuries in an open fracture may have three important consequences:

- Contamination of the wound and fracture by exposure to the external environment.
- Crushing, stripping, and devascularization that results in soft tissue compromise and increased susceptibility to infection.
- Destruction or loss of the soft tissue envelope may affect the method of fracture immobilization, compromise the contribution of the overlying soft tissues to fracture healing (e.g., contribution of osteoprogenitor cells), and result in loss of function from muscle, tendon, nerve, vascular, ligament, or skin damage.

CLINICAL EVALUATION

- Patient assessment involves ABCDE: airway, breathing, circulation, disability, and exposure.
- Initiate resuscitation and address life-threatening injuries.
- Evaluate injuries to the head, chest, abdomen, pelvis, and spine.
- Identify all injuries to the extremities.
- Assess the neurovascular status of injured limb(s).
- Assess skin and soft tissue damage: exploration of the wound in the emergency setting is not indicated if operative intervention is planned because it risks further contamination with limited capacity to provide useful information and may precipitate further hemorrhage.
    - Obvious foreign bodies that are easily accessible may be removed in the emergency room under sterile conditions.
    - Irrigation of wounds with sterile normal saline may be performed in the emergency room if a surgical delay is expected
    - Sterile injection of joints with saline may be undertaken to determine egress from wound sites to evaluate possible continuity.
- Identify skeletal injury; obtain necessary radiographs.

Classification of open fractures (Gustilo and Anderson)

Type	Wound	Level of Contamination	Soft Tissue Injury	Bone Injury
I	<1 cm long	Clean	Minimal	Simple, minimal comminution
II	>1 cm long	Moderate	Moderate, some muscle damage	Moderate comminution
III[a]				
A	Usually >10 cm long	High	Severe with crushing	Usually comminuted; soft tissue coverage of bone possible
B	Usually >10 cm long	High	Very severe loss of coverage; usually requires soft tissue reconstructive surgery	Bone coverage poor; variable, may be moderate to severe comminution
C	Usually >10 cm long	High	Very severe loss of coverage plus vascular injury requiring repair; may require soft tissue reconstructive surgery	Bone coverage poor; variable, may be moderate to severe comminution

[a]Segmental fractures, farm yard injuries, fractures occurring in a highly contaminated environment, shotgun wounds, or high-velocity gunshot wounds automatically result in classification as type III open fractures.
From Bucholz RW, Heckman JD, Court-Brown C, et al., eds. *Rockwood and Greenâ€™s Fractures in Adults*, 6th ed. Philadelphia: Lippincott Williams & Wilkins, 2006.

TREATMENT

Emergency Room Management
After initial trauma survey and resuscitation for life-threatening injuries (see Chapter 2):

- Perform a careful clinical and radiographic evaluation as outlined earlier.
- Wound hemorrhage should be addressed with direct pressure rather than limb tourniquets or blind clamping.
- Initiate parenteral antibiotic.
- Assess skin and soft tissue damage; place a saline-soaked sterile dressing on the wound.
- Perform provisional reduction of fracture and place a splint.
- Operative intervention: open fractures constitute orthopaedic emergencies, because intervention less than 8 hours after injury has been reported to result in a lower incidence of wound infection and osteomyelitis. The patient should undergo formal wound exploration, irrigation, and debridement before definitive fracture fixation, with the understanding that the wound may require multiple debridements.

Important

- Do not irrigate, debride, or probe the wound in the emergency room if immediate operative intervention is planned: this may further contaminate the tissues and force debris deeper into the wound. If a surgical delay is anticipated, gentle irrigation with normal saline may be performed. Only obvious foreign bodies that are easily accessible should be removed.

- Bone fragments should not be removed in the emergency room, no matter how seemingly nonviable they may be.

Antibiotic Coverage for Open Fractures

Grade I, II: First-generation cephalosporin
Grade III: Add an aminoglycoside
Farm injuries: Add penicillin and an aminoglycoside
Tetanus prophylaxis should also be given in the emergency room (see later). The current dose of toxoid is 0.5 mL regardless of age; for immune globulin, the dose is 75 U for patients <5 years of age, 125 U for those 5 to 10 years old, and 250 U for those >10 years old. Both shots are administered intramuscularly, each from a different syringe and into a different site.

Irrigation and Debridement

Adequate irrigation and debridement are the most important steps in open fracture treatment:

- The wound should be extended proximally and distally to examine the zone of injury.
- The clinical utility of intraoperative cultures has been highly debated and remains controversial.
- Meticulous debridement should be performed, starting with the skin and subcutaneous fat.
    - Large skin flaps should not be developed because this further devitalizes tissues that receive vascular contributions from vessels arising vertically from fascial attachments.
    - A traumatic skin flap with a base-to-length ratio of 1:2 will frequently have a devitalized tip, particularly if it is distally based.
    - Tendons, unless severely damaged or contaminated, should be preserved.
    - Osseous fragments devoid of soft tissue may be discarded.
    - Extension into adjacent joints mandates exploration, irrigation, and debridement.
- The fracture surfaces should be exposed, with recreation of the injury mechanism.
- Pulsatile lavage irrigation, with or without antibiotic solution, should be performed. Some authors have demonstrated decreased infection rates with >10 L of irrigation under pulsatile lavage.
- Meticulous hemostasis should be maintained, because blood loss may already be significant and the generation of clot may contribute to dead space and nonviable tissue.
- Fasciotomy should be considered, especially in the forearm or leg.
- Historically, it has been advocated that traumatic wounds should not be closed. One should close the surgically extended part of the wound only. More recently, certain centers have been closing the open wound after debridement with close observation for signs or symptoms of sepsis.
- The wound, if left open, should be dressed with saline-soaked gauze, synthetic dressing, a vacuum assisted closure (VAC) sponge, or an antibiotic bead pouch.
- Serial debridement(s) should be performed every 24 to 48 hours as necessary until there is no evidence of necrotic soft tissue or bone.

COMPLICATIONS

- Infection: Open fractures may result in cellulitis or osteomyelitis, despite aggressive, serial debridements, copious lavage, appropriate antibiosis, and meticulous wound care. Gross

contamination at the time of injury is causative, although retained foreign bodies, soft tissue compromise, and multisystem injury are risk factors for infection.

- Compartment syndrome: This devastating complication results in severe loss of function, especially in tight fascial compartments including the forearm and leg. It may be avoided by a high index of suspicion with serial neurovascular examinations accompanied by compartment pressure monitoring, prompt recognition of impending compartment syndrome, and fascial release at the time of surgery.

CLOSE FRACTURE

Definition of fracture is a disruption in continuity of bone structures caused by direct or indirect injury to the bone. Closed fracture means the structures around the lesion are still intact.
4 R (prinsip penanganan fraktur)
Ada 4 hal yang harus diperhatikan, yaitu 4R:

1. Recognition
2. Reduction
3. Retaining
4. Rehabilitation

1. RECOGNITION
   Pada trauma ekstremitas perlu diketahui kelainan apa yang terjadi sebagai akibat cedera tersebut, baik jaringan lunak atau tulangnya. Dengan mengenali gejala dan tanda pada penggunaan fungsi jaringan yang terkena cedera. Fraktur merupakan akibat suatu kekerasan yang menimbulkan kerusakan tulang disertai jaringan lunak disekitarnya.
2. REDUCTION atau REPOSISI
   Reposisi adalah tindakan untuk mengembalikan jaringan atau frgamen tulang pada posisi semula. Tindakan ini diperlukan guna mengembalikan kepada bentuk semula sebaik mungkin, agar fungsi dapat kembali semaksimal mungkin.
3. RETAINING
   Retaining adalah tindakan imobilisasi atau fiksasi untuk mempertahankan hasil reposisi dan memberi istirahat pada spsame otot pada bagian yang sakit mencapai penyembuhan dengan baik. Imobilisasi yang tidak adekuat dapat memberikan dampak pada penyembuhan dan rehabilisasi.
4. REHABILITATION
   Rehabilitasi berarti mengembalikan kemampuan anggota gerak yang cedera untuk dapat berfungsi kembali. Falsafah lama mengenai rehabilitasi adalah suatu tindakan setelah tindakan kuratif dalam mengatasi kendala sequelle atau kecatatan, agar seseoarang dapat berfungsi kembali. Rehabilitasi menekan upaya pada fungsi dan akan lebih berhasil bila dilaksanakn sedini mungkin.

Reposisi / Reduksi

Sebagian besar fraktur tertutup ditangani secara konservatif. Reposisi fraktur dilakukan pada fraktur displace dalam waktu 12 jam setelah trauma. Apabila lebih dari 12 jam, maka terjadi pengembangan jaringan lunak sehingga reduksi atau reposisi menjadi sulit. Reduksi dan reposisi dilakukan dengan posisi yang adekuat dan kesegarisan (alignment) normal.
Ada 3 metode yang digunakan pada reduksi:

a. Manipulasi tertutup, biasanya dilakukan pada fraktur dengan displace yang minimal dan dapat kembali setelah reduksi. Reduksi dilakukan biasanya dengan pembiusan dan pemberian muscle relaxan
b. Traksi mekanik, digunakan pada fraktur dengan otot-otot yang tebal, untuk melawan tarikan otot agar ter-reduksi.
c. Reduksi terbuka dengan cara operasi, dilakukan pada fraktur yang gagal dengan reduksi tertutup, fraktur yang melibatkan intraartikuler atau fraktur dengan cedera neurovaskuler.

Retaining

Setelah dilakukan reposisi, maka posisi fraktur dipertahankan dengan cara-cara:

- Traksi
- Pemasangan gips plaster of paria
- Functional bracing
- Fiksasi internal dengan implant
- Fiksasi eksterna

Traksi dalam orthopaedi

Tujuan traksi dapat mempertahankan panjang ekstermitas, mempertahankan kesegarisan (alignment) maupun keseimbangan (stability) pada suatu patah tulang.

Jenis-jenis traksi:

- Skin traction (Traksi kulit)
- Skeletal traction (Traksi tulang)

DIAGNOSIS

Dalam menegakkan diagnosis akibat cedera perlu dilakukan:

1. Anamnesis tentang terjadinya trauma
2. Pemeriksaan fisik
    - Airway
    - Breathing
    - Circulation
    - Disability
    - Look
    - Feel
    - Move

Orthopaedic examination case

Immobilization

More complex management is often impractical in an entrapped casualty, and so extrication becomes a priority. This should be done with regard to spinal protection, usually using spinal boards or other rigid immobilization devices. Fractured limbs should be splinted in an anatomical position to preserve neuro -

vascular function. Analgesia may be necessary to extricate an injured casualty, and this can be achieved with inhalational or intravenous agents. The initial manoeuvre in the extrication process is manual immobilization of the cervical spine. This can be done from behind the casualty (typically in seated casualties entrapped in vehicles with a rescuer in the rear of the vehicle), or from the front and side if access is limited. A stiff cervical collar is sized and fitted at the earliest opportunity, but manual immobilization is still mandatory until the casualty can be placed on a spinal board.

Further immobilization and extrication may be impossible until wreckage has been cleared enough to enable an extrication device to be positioned under the casualty. Managing wreckage is a specialist skill that is the province of the Fire and Rescue crews; however, the pre-hospital doctor should be familiar with the techniques used to advise how extrication can be managed without causing additional injury to the casualty. Common manoeuvres in road vehicle wreckage are removal of glass and doors, a dashboard roll to lift the dashboard off trapped limbs, and removal of the roof by cutting through the A, B and C pillars. The seat can then be carefully flattened, and a long spinal board slid under the casualty from the rear of the vehicle, minimizing movement of the spinal column. If a casualty is deteriorating fast, the rescue crews should be advised and a rapid extrication carried out. Limb fractures and dislocations should be reduced and the limb returned, if possible, to its anatomical position with gentle traction and straightening. This may require analgesia. Note that some injuries such as posterior hip dislocations may prevent an anatomical alignment, and the limb must not be forced. The limb should then be splinted with traction, gutter or vacuum splints as appropriate. This reduces pain and haemorrhage, and minimizes neurovascular damage. Femoral traction splints such as the Thomas are effective for mid-shaft femur fractures, providing the pelvic ring is intact. The traction reduces the fracture, and the fusiform compression of the fracture haematoma reduces further bleeding. A unilateral, closed, femoral fracture can cause a 1.5 L blood loss – 30 per cent of the adult blood volume and enough to cause significant shock without other injury. Open-book pelvic fractures cause uncontrollable retroperitoneal bleeding. Blood loss can be minimized by stabilizing and reducing the fracture using specialist, pelvic compression devices or a rolled sheet around the pelvis and twisted above. Analgesia may be necessary to extricate an injured casualty. This can be administered by inhalation with Entonox, a 50:50 mixture of nitrous oxide and oxygen, delivered via a breath-actuated regulator valve and mask or mouthpiece. Parenteral analgesics should only be given intravenously, and titrated cautiously against effect. Other routes of administration are very unpredictable, especially in shocked casualties. Pure opioid agonists such as morphine, diamorphine and fentanyl are most effective, but it should be noted that there is a wide variation in response between individuals, and care should be taken not to cause respiratory depression by overdosage. Partial opioid agonists such as nalbuphine are used, but have a degree of narcotic antagonism that can make further administration of opioids unpredictable. Ketamine is a very useful drug that is a powerful analgesic in doses of 0.5 mg/kg intravenously, and a general anaesthetic in doses of 2– 4 mg/kg. The advantage of ketamine is that it does not cause respiratory depression, and the casualty's airway is more predictably maintained. Doses and administration times of all drugs given should be noted.

Immobilisasi adalah cara mengistirahatkan bagian yang cedera dengan pembidaian (splinting). Immobilisasi dilakukan dengan syarat mengunci 2 sendi, bagian proximal dan distal dari tulang fraktur.

Tujuannya adalah:

- Mengurangi rasa sakit
- Mencegah kerusakan lebih lanjut
- Mengurangi dan menghentikan perdarahan
- Memudahkan transportasi

Pembuatan x ray sebaiknya dilakukan sesudah pembidaian.

Transportasi

Delayed or prolonged transfer to hospital is associated with poor outcomes, and every effort should be made to minimize the on-scene times for injured casualties. There is a balance between 'scoop and run' and 'stay and play' management. The airway must be secured, and life-threatening chest injuries (e.g. tension pneumothorax) and catastrophic, external haemorrhage dealt with before transfer commences. Prolonged attempts at complex management on scene are disadvantageous, and should be limited to life-saving interventions where possible. The appropriate method of transport should be chosen, with helicopters offering some advantage for long-distance transfers or rescue from remote and rough terrain. Police escorts can be used to aid ambulance progress, and a balance sought between speed of transfer and violent movement of the casualty and attendants. The appropriate destination hospital should be chosen for the casualty's likely injuries, and this may mean bypassing a small unit that does not have the appropriate facilities. Wherever possible, the receiving medical team should be directly advised of the estimated time of arrival (ETA) and the identified injuries, enabling an appropriate trauma team to be standing by. During the transfer, the casualty's vital signs should be monitored clinically and with available equipment. Conscious casualties should be constantly assessed by speaking to them, and a decrease in conscious level detected early. ECG and pulse should be continuously monitored, blood pressure measured with a non-invasive blood pressure (NIBP) monitor, and oxygen saturations measured if peripheral perfusion allows. EtCO2 monitors are useful for gauging adequacy of ventilation in intubated and ventilated casualties. The casualty's airway must be maintained at all times, and oxygenation and ventilation maintained. Oxygen saturations should be maintained above 95 per cent if possible, and ventilated casualties have their EtCO2 maintained at a low normal level (4.0–4.5 kPa). Haemorrhage is controlled with direct pressure, and Hartmann's solution titrated intravenously to maintain a palpable radial pulse. If the patient deteriorates *en route*, the medical attendant must decide whether to attempt resuscitation whilst on the move, stop and resuscitate or make a run for the nearest hospital. This decision will depend on the nature of the intervention required and the ETA at the hospital. Contemporaneous records are almost impossible to maintain during a transfer, but electronic equipment can usually download a paper or electronic record. If not, notes should be made as soon as possible after arrival at the hospital. On arrival, the medical attendant should remain part of the resuscitation team until an effective handover can be made.

Aplikasi gips pada cedera ekstremitas

Gips dapat digunakan dalam kasus:

- Imobilisasi fraktur
- Imobilisasi penyakit tulang dan sendi
- Koreksi dan pencegahan deformitas muskuloskelatal

Tujuan pengobatan fraktur adalah proses penyembuhan dapat berjalan dengan baik, mengembalikan fungsi dari bagian tubuh yang cedera dalam jangka waktu secepat mungkin tanpa menimbulkan komplikasi dan mencegah terjadinya kecacatan.

Bahan dan alat

Pada dasarnya untuk memasang dan melepaskan sebuah balutan gips dibutuhkan material sebagai berikut:

1. Padding
   Tujuan pemakaian padding adalah untuk melindungi kulit dari bahan gips sehingga mencegah gatal atau terbentuknya ulkus akibat penekanan (pressure sore)
2. Gips

Macam padding:

a. Tubular stockinette
b. Padding softband

3. Alat-alat
    a. Ruangan pemasangan gips
    b. Alat
        - Apron untuk melindungi pasien dan operaot
        - Pemotong cincin (jika ada pasien yang menggunakan cincin)
        - Gunting padding dan gunting gips
        - Mesin pemotong gips
        - Distraktor gips
        - Spidol tahan air
        - Baskom yang cukup besar sehingga dapat mencukupi seluruh gulungan gips
        - Armsling (kain penggendong)
        - Turnit dari besi/plastik untuk pemasangan walking cast
    c. Pesonil
    d. Pencatatan rekam medis

JENIS-JENIS SPLINTING DENGAN GIPS

A. Dorsal forearm splint
   Indikasi : luka atau cedera pada volar pergelangan tangan, Proses infeksi daerah pergelangan tangan.
   Bahan : stokinette tubula bandage ukuran lengan dewasa stabilongette ukuran lebar 12cm, padding bandage ukuran lebar 15cm, verban elastis ukuran 8 / 10cm.
B. Voral forearm splint
   Indikasi : luka akibat cidera pada dorsal pergelangan, Proses infeksi daerah dorsal pergelangan tangan
   Bahan : stokinette tubula bandage ukuran lengan dewasa stabilongette ukuran lebar 12cm, padding bandage ukuran lebar 15cm, verban elastis ukuran 8 / 10cm.
C. Upper arm splint
   Indikasi : luka atau cedera pada elbow, splinting sementara fraktur antebrachii
   Bahan : stabilongette ukuran lebar 12cm, padding bandage ukuran lebar 15cm, verban elastis ukuran 8 / 10cm.
D. Dorsal lower leg splint
   Indikasi : cedera ankle. Splinting sementara, fraktur ankle, dan metacarpal
   Bahan : verban elastis bandage 10cm, padding bandage ukuran lebar 20cm, stabilongette ukuran lebar 15cm.
E. Dorsal high splint
   Indikasi : cedera lutut
   Bahan : verban elastis bandage 10cm, padding bandage ukuran lebar 20cm, stabilongette ukuran lebar 15cm.

Komplikasi pemasangan gips

Sesudah pemasangan gips, harus dilakukan observasi terutama gips sirkular karena dapat menimbulkan komplikasi yang cukup fatal. Pada pemasangan gips baik berupa stab ataupun gips sirkuler dapat menimbulkan komplikasi berupa:

1. Sindroma kompartemen

2. Cedera neuroskuler
3. Ulkus (pressure sore)
4. Cedera saraf
5. Iritasi dan kerusakan kulit
6. Induksi dan gas gangrene
7. Fracture disease
8. Loosering
9. Alergi terhadap gips