

INTRODUCTION

There is one fundamental rule to apply to these cases and that is **NOT** to let limb injuries, however dramatic in appearance, distract the clinician from less visible but life-threatening problems such as airway obstruction, compromised breathing, poor perfusion and spinal injury.

HISTORY

Obtain a history of how the injury was sustained, in particular factors indicating the forces involved.

ASSESSMENT

However dramatic limb injuries appear, **ALWAYS** exclude the presence of other **TIME CRITICAL** injuries by using the **PRIMARY SURVEY**.

Assess and correct deficits with:

- **AIRWAY**
- **BREATHING**
- **CIRCULATION**
- **DISABILITY** (mini neurological examination)

Evaluate whether the patient is **TIME CRITICAL** or **NON-TIME CRITICAL** following criteria as per **trauma emergencies guideline**.

In **TIME CRITICAL** patients, evidence suggests that haemorrhage control, spinal immobilisation if indicated (*refer to neck and back trauma guideline*) and rigid splinting are sufficient treatment of fractures for rapid evacuation to hospital. If a traction splint can be applied very quickly to a femoral shaft fracture, it will contribute to “circulation” care by considerably reducing further blood loss and pain en-route to hospital. However, if application of a traction splint will incur an unacceptable delay, use manual traction where sufficient personnel are available; remember that once traction is applied it should not be released.

LOAD AND GO to the nearest suitable receiving Hospital with a Hospital Alert Message / Information call.

En-route – continue patient **MANAGEMENT** (see below)

In **NON-TIME CRITICAL** patients, perform a more thorough patient assessment and secondary survey.

Specifically assess:

- sites of suspected fracture
- all four limbs for injury to long bones and joints as part of secondary survey

- expose suspected fracture sites in order to assess for swelling and deformity. Where possible avoid unnecessary pain stimulus.
- for intact circulation and nerve function (MSC x 4 – motor, sensation and circulation), distal to the fracture site.
- age of patient; consider greenstick fractures in children, and fractures of wrist and hip in the elderly
- for accompanying illnesses; some cancers can involve bones (e.g. breast, lung and prostate) and result in fractures from minor injuries. Osteoporosis (bone thinning) in elderly females in particular makes fractures more common.
- for pattern of fractures; fractures of the heel in a fall from a height may be accompanied by pelvic and spinal crush fractures. “Dashboard” injury to the knee may be accompanied by a fracture or dislocation of the hip. Humeral fractures from a side impact are associated with chest injuries.

Dislocations

These are very painful and are commonly found affecting the digits, elbow, shoulder and patella. Occasionally the hip may be dislocated where forces of injury are very high. Any dislocation that threatens the neurovascular status of a limb must be treated with some urgency. Such dislocations require prompt reduction.

Amputations

Most frequently involve digits, but can involve part of or whole limbs. Remember the first priority in managing amputated parts is to manage the patient who has sustained the amputation (start with ABCD). They are likely to be in considerable pain and distress so administer IV analgesia as early as possible (*refer to pain management guidelines*). Dressings moistened with water for injection or saline should be applied to the stump paying particular attention to haemorrhage control.

Management of the amputated part should include the removal of any gross contamination, then covering the part with a damp gauze or dressing, securing in a sealed plastic bag and placing the bag on ice. Re-implantation surgery may be possible so it is important that amputated parts are maintained and transported in the best condition possible. Body parts should not be placed in direct contact with ice as this can cause tissue damage; the aim is to keep the temperature low but not freezing.

Partial amputations

These may still result in a viable limb, providing there is minimal crushing damage and survival of some vascular and nerve structures. It is important to arrest any obvious haemorrhage and to immobilise the partially amputated limb in a position of normal anatomical alignment. Where possible dress the injured limb to prevent further contamination.

Pressure alone should be used to arrest haemorrhage if possible.

It is essential that these patients be removed to an appropriate receiving Hospital, ideally with both **ORTHOPAEDIC** and **PLASTIC** surgery facilities.

MANAGEMENT¹⁻⁴

Follow Trauma Emergencies Guideline, remembering to:

- ensure **ABC**'s.
- arrest external haemorrhage through direct or indirect pressure and/or by raising the limb above heart level where appropriate
- administer high concentration oxygen (O₂) via a non-rebreathing mask, using the stoma in laryngectomy and other neck breathing patients, to ensure an oxygen saturation (SpO₂) of >95%, except for patients with chronic obstructive pulmonary disease (COPD) (*refer to COPD guideline*).

Fluid Therapy

Obtain IV access.

Current research shows little evidence to support the routine use of IV fluids in adult trauma patients. In circumstances such as penetrating chest and abdominal trauma, survival worsens with the routine use of IV fluids.⁵

Fluids may raise the blood pressure, cool the blood and dilute clotting factors, worsening haemorrhage. Therefore, current thinking is that fluids should only be given when major organ perfusion is impaired.

If there is visible external blood loss greater than 500mls, fluid replacement should be commenced with a 250ml bolus of crystalloid.

Central pulse **ABSENT**, radial pulse **ABSENT** is an absolute indication for urgent fluid. If the patient has a carotid pulse but no radial pulse then other clinical factors should also be considered before decision on fluid administration.

Central pulse **PRESENT**, radial pulse **ABSENT** is a relative indication for urgent fluid depending on other indications including tissue perfusion and blood loss.

Central pulse **PRESENT**, radial pulse **PRESENT DO NOT** commence fluid replacement,⁶ unless there are other signs of poor central tissue perfusion (e.g. altered mental state, cardiac rhythm disturbance).

Reassess vital signs prior to further fluid administration.

DO NOT delay at scene for fluid replacement; wherever possible cannulate and give fluid **EN-ROUTE TO HOSPITAL**.

Specifically consider:

- analgesia if the patient is in pain (*refer to pain management guideline*).^{7,8} There appears to be a general reluctance to administer IV analgesia for limb fractures (including neck of femur fractures) in the pre-hospital environment. Pain relief is an important intervention and should be considered as soon as ABCD's have been assessed and potentially life-threatening problems corrected. (*refer to pain management guidelines*).
- in **NON-TIME CRITICAL** patients, immobilise long bone fractures by appropriate splinting. (*see SPLINTAGE below*).

Splintage

The principles of splintage involve:

- arrest of external haemorrhage
- support of the injured area
- immobilisation of the joint above and below the fracture
- re-evaluation and recording of the circulatory and neurological (motor and sensory) function below the fracture **BEFORE** and **AFTER** splintage.^{9,10}

Always

Consider realignment of grossly deformed fractures into a position that is as close to normal anatomic alignment as possible. Where deformity is minor and both distal sensation and circulation are intact, then realignment may not be necessary.

Recognise the benefits of vacuum splints, especially if limbs need to be immobilised in an abnormal alignment.

Pad rigid splints to conform to anatomy.

Remove all jewellery from the affected limbs before swelling of the limb occurs.

Check for presence or absence of pulses and muscle function distal to injury after splintage.

Re-assess circulation by checking pulses pre- and post-application of splints. If pulse disappears during splintage then realign limb until pulse returns.

Splinting of Upper Limb¹¹

Patient self-splintage is often adequate and can be less painful than attempting to put the limb in a sling.

Fractures of the clavicle and upper limb may be supported in a triangular sling, if this alleviates pain.

Vacuum splints may be well suited to immobilising forearm fractures.

Splints such as short box splints may also be useful.

Splinting of Lower Limb

Ankle and tibial fractures, as well as those fractures around the knee, can be immobilised with either box splints or vacuum splints. Box splints may need padding to be effective in providing adequate immobilisation.

Femoral shaft fractures are best managed by traction splintage (see below). Isolated fractures of the tibia and fibula should **NOT** be immobilised using a traction splint.

Traction Splintage^{12,13}

A traction splint is a device for applying longitudinal traction to the femur, using the pelvis and the ankle as static points. Blood loss from femoral shaft fractures can be considerable, involving loss of 500 – 2000 millilitres in volume. If the fracture is open (compound), blood loss is increased.

Correct splintage technique using a traction splint will ease pain, reduce haemorrhage and damage to blood vessels and nerves, and also reduce the risk of embolisation to the brain and lungs of fat globules (fat embolus). It also minimises the risk of a closed fracture being converted to an open one.

By using traction to pull the thigh back from the spherical shape caused by muscle spasm to a cylindrical shape. There is compression of bleeding sites and this reduces blood loss considerably. It also reduces bone fragment movement, and reduces the other complications noted above.

Modern devices such as the Sager, Trac 3 and Donway splints are easy to apply and some now have quantifiable traction, measured on a scale in pounds. The correct amount of traction is best judged by the injured leg being the same length as the un-injured limb.

Ankle, lower leg, knee or pelvic fractures on the same side as the femoral fracture limit the use of a traction splint.

It has been suggested that a fracture of the tibia in the same limb as a femoral shaft fracture may be immobilised using a traction splint, with the traction reduced to about 10lbs so as not to over-displace the tibial fracture. However there is little evidence to support this treatment.

Open fractures

Where fractures are open, bone ends should be irrigated with normal saline and a sterile dressing applied as soon as practicable. Infection following an open fracture can have serious consequences for the future viability and long-term function of the limb. Any gross displacement from normal alignment must, where possible, be corrected, and splints applied. It is important to point out any wounds that were the result of an open fracture to the receiving emergency department staff, especially if bony fragments have now receded.

Neck of Femur fractures

These occur most commonly in the elderly population and are one of the most common limb injuries encountered in the pre-hospital environment. Typical presentation includes shortening and external rotation of the leg on the injured side with pain in the hip and referred pain in the knee. The circumstances of the injury must be taken into account – often the elderly person has been on the floor for some time, which increases the possibility of hypothermia, dehydration, pressure sores and chest infection, so careful monitoring of vital signs is essential. Immobilisation is best achieved by strapping the injured leg to the normal one with foam padding between the limbs. Extra padding with blankets and strapping around the hips and pelvis can be used to provide additional support whilst moving the patient. Appropriate analgesia should be given (*refer to pain management guidelines*).

Additional Information

Fractures may be closed or open. Comminuted fractures involve shattering of the fracture site into multiple fragments. Nerves and blood vessels are placed at risk from sharp bony fragments, especially in very displaced fractures, hence the need to return fractured limbs to normal alignment as rapidly as possible. Fractures around the elbow and knee are especially likely to injure arteries and nerves.

Another potential complication of limb fractures is **compartment syndrome**. Increased pressure within muscular compartments of the fractured limb compromise the circulation causing ischaemia with potentially catastrophic consequences for the limb. The five 'P's of ischaemia are:

1. Pain	out of proportion to the apparent injury, often in the muscle and may not ease with splinting/analgesia
2. Pallor	due to compromised blood flow to limb
3. Paresthesia	changes in sensation and loss of movement
4. Pulselessness	(loss of peripheral pulses) – grave late sign as swelling increases causing complete occlusion of circulation
5. Perishing cold	the limb is cold to the touch

If compartment syndrome is suspected management is as previously described but with increased urgency and a hospital alert as the patient may require immediate surgery.

In the field, it is frequently impossible to differentiate between ligament sprain and a fracture. Immobilisation should be performed, and **ASSUME** a fracture is present until x-ray or expert medical opinion advises otherwise.

In non-time critical patients, full splinting with suitable analgesia (see **Pain Management Guideline**) is essential. In **TIME CRITICAL** patients, however, splintage is often restricted to securing fractured limbs to a longboard or scoop, to allow for rapid evacuation from the scene and immediate hospital transportation.

Always ensure hospital staff are shown any skin wound relating to a fracture and that they appreciate that the underlying fracture was initially an open one. Remember that by applying traction visible bone ends (open fracture) may disappear.

Key Points – Limb Trauma

- **DO NOT** become distracted, by the appearance of limb trauma, from assessing less visible but life-threatening problems, such as airway obstruction, compromised breathing, poor perfusion and spinal injury.
- Limb trauma can cause life-threatening haemorrhage.
- Assess for intact circulation and nerve function distal to the fracture site.
- Any dislocation that threatens the neurovascular status of a limb must be treated with urgency.
- Splintage is fundamental to prevention of further blood loss.
- Limb injuries can be painful and good analgesia should be initiated early.

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METHODOLOGY

Refer to methodology section.