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DISEASES & CONDITIONS

Open Fractures

An open fracture, also called a compound 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.

An open fracture requires different treatment than a closed fracture, in which there is no open wound. This is because, once the skin is broken, bacteria from dirt and other contaminants can enter the wound and cause infection. For this reason, early treatment for an open fracture focuses on preventing infection at the site of the injury. The wound, tissues, and bone must be cleaned out in a surgical procedure as soon as possible. The fractured bone must also be stabilized to allow the wound to heal.

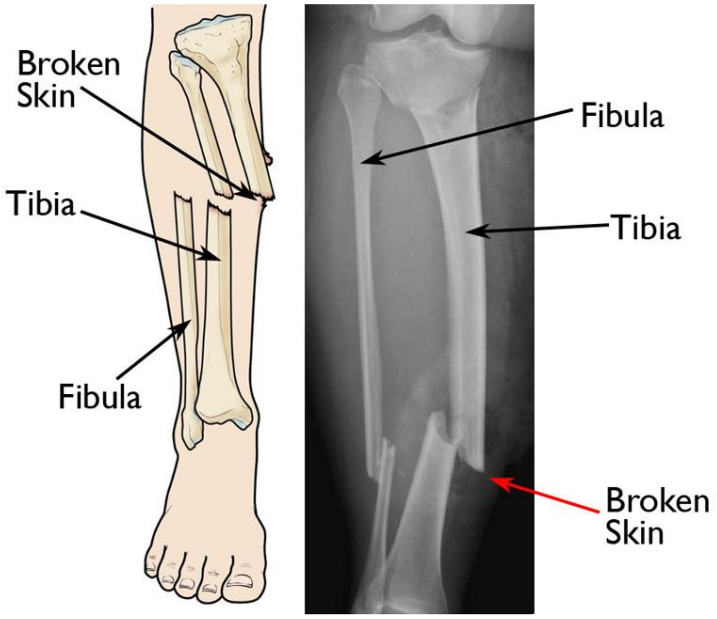

Illustration and x-ray show an open fracture. The broken end of the tibia (shinbone) has torn through the soft tissues and is protruding through the skin.

(Right) Reproduced from Egol KA, Gardner MJ, eds: Let's Discuss Management of Common Fractures. Rosemont, IL, American Academy of Orthopaedic Surgeons, 2016, pp. 135-152.

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 playing sports.

Description

Open fractures vary greatly in severity. In many high-energy injuries, there is obvious skin loss and the bone can be seen protruding through the wound. In other cases, the wound may be no larger than a puncture.

In either situation, the damage to the soft tissues around the bone—including muscles, tendons, nerves, veins, and arteries—can be extensive. For this reason, any acute fracture with an open wound in the area is considered to be an open fracture.

In this injury to the lower leg, the broken bones are not visible, but there is a small open wound over the fractures. Special care must be taken to prevent infection.

Reproduced and adapted from Zalavras CG, Marcus RE, Levin LS, Patzakis MJ: Management of open fractures and subsequent complications. Instructional Course Lecture 57. Rosemont, IL, American Academy of Orthopaedic Surgeons, 2008: pp. 51-63.

The severity of an open fracture depends upon several factors, including:

- The size and number of the fracture fragments
- The damage to surrounding soft tissues
- The location of the wound and whether the soft tissues in the area have good blood supply

Contamination

To some extent, the setting in which an open fracture occurs will affect the degree of contamination. Objects such as dirt, broken glass, grass, mud, and even the patient's own clothing can be driven into an open wound. Knowing the setting where your injury occurred can help your doctor determine the best course of treatment.

Infection

Open fractures pose an immediate risk of infection. In general, the greater the damage is to bone and soft tissues, the greater the risk of infection.

A bone infection can be difficult to treat. The patient may require long-term antibiotics and multiple surgical procedures. In extreme cases where the infection cannot be cured and the patient's life is threatened, amputation may even be necessary. For this reason, preventing infection is the focus of early treatment.

Doctor Examination and Initial Treatment

Most patients with open fractures will go to the emergency room for initial treatment.

Physical Examination

In the emergency room, your doctor will do an initial evaluation and check for other injuries. He or she will want to know how your injury occurred and will ask about your medical history.

Your doctor will then examine the wound and fracture site, checking for damage to soft tissues, nerves, and circulation. When there is any wound in the same area as a broken bone, it is assumed that there is an open fracture.

Tests

Your doctor will order x-rays to help determine the extent of the fracture. X-rays will show the number of breaks in the bone, as well as the position and degree of separation (displacement) between the bony fragments.

If more information is needed, a computerized tomography (CT) scan or another type of imaging study may also be ordered.

Antibiotics and Tetanus

To help prevent infection, you will be given antibiotics as soon as possible in the emergency room. You will also be given a tetanus booster if you have not had one within the last five years.

Injury Stabilization

Your wound will be covered with sterile dressings. The doctor will then place your injured limb in a splint to keep the bones from moving until you are taken to surgery.

Treatment

Almost all open fractures are treated in the operating room. It is important to go to surgery as soon as possible so that your open wound can be cleaned out to help prevent infection. Depending on your specific injury, you will be given either regional or general anesthesia during this procedure.

Debridement and Irrigation

These are the first steps in controlling the risk for infection. In debridement, your doctor will remove all foreign and contaminated material—as well as damaged tissue—from the wound. If the wound is small, your doctor may need to extend it so that he or she can reach all of the affected areas of bone and soft tissue. The wound will then be washed out or irrigated with several liters of saline solution.

Once the wound has been cleaned, your doctor will evaluate the fracture and stabilize the bones. Open fractures are treated with either internal or external fixation.

Internal Fixation

In this procedure, your doctor places metal implants—such as plates, rods, or screws—on the surface of or inside the broken bone. The implants will maintain the position of the bone and hold it together while the fracture heals.

Internal fixation can be used to treat open fractures in which:

- The wound is clean,
- There is minimal skin or tissue damage, and
- The broken pieces of bone can be well aligned

It can be performed as an initial surgery or delayed if the soft tissues need to heal.

(Left) X-ray of compound fractures of tibia and fibula. **(Right)** A rod has been placed down the center of the tibia to hold the bone fragments in place.

Reproduced from Zalavras CG, Marcus RE, Levin LS, Patzakis MJ: Management of open fractures and subsequent complications. Instructional Course Lecture 57. Rosemont, IL, American Academy of Orthopaedic Surgeons, 2008: pp. 51-63.

After internal fixation, your injured limb will be immobilized in a sling cast or splint until the fracture heals. You will be given antibiotics for a period of time to help prevent infection. During the healing process, your doctor will check the wound to make sure there are no signs of infection.

External Fixation

If your wound and broken bones are not yet ready for a permanent implant, your doctor may apply external fixation to your injured limb. Most severe open fractures are first stabilized with external fixation.

In this operation, the doctor inserts metal screws or pins into the bone above and below the fracture site. The pins and screws project out of the skin where they are attached to metal or carbon fiber bars.

The external fixator has the advantage of stabilizing the broken bone while your doctor cares for the wound. In some cases, the wound may need further debridement or skin and tissue grafting to cover the injured bone. With an external fixator in place, the patient can often get out of bed and be mobile despite the open wound.

In most cases, an external fixator is kept in place only until it is safe to perform internal fixation. Sometimes, however, an external fixator is used to stabilize the bones until healing is complete. It is then removed during a second procedure when the fracture is healed.

In this severe open fracture, the doctor closes the wound with stitches after debridement and external fixation.

This patient's open fracture has been stabilized with external fixation and the wound has been partially closed with antibiotic beads.

Reproduced from Gum JL, Seligson D: Update on the management of open fractures. Orthopaedic Knowledge Online Journal 2012; 10(9). Accessed Dec. 2016.

Treatment of More Complex Wounds

Some open fractures have large wounds with extensive skin and soft tissue loss. These wounds are often too large to be closed. In this situation, the doctor will temporarily cover the wound to help decrease the risk of infection and promote healing.

This open fracture is too large to be closed with stitches.

There are many types of dressings that can be used for temporary coverage but, in many cases, a semipermeable dressing is used to seal the wound until it can be permanently closed. Antibiotic beads are often placed into the wound before sealing to provide a high concentration of antibiotics directly to the injury.

Antibiotic beads may be used to help prevent infection during temporary wound coverage.

Reproduced from Zalavras CG, Marcus RE, Levin LS, Patzakis MJ: Management of open fractures and subsequent complications. Instructional Course Lecture 57. Rosemont, IL, American Academy of Orthopaedic Surgeons, 2008: pp. 51-63.

After a period of time, a permanent technique will be used to close the wound. Permanent techniques for wound coverage include:

- **Skin graft.** If there is skin loss only, a piece of skin can be taken from another part of the body and used to cover the wound.
- **Local flap.** Muscle tissue from a nearby area in the same limb can be rotated into the wound to cover the defect. A skin graft may then be placed over the flap.
- **Free flap.** Tissue can be transferred from another part of the body, usually the back or abdomen. A free flap procedure is often done with a microvascular surgeon who can establish blood circulation to the flap.

(Top) This patient's open fracture has been stabilized with external fixation. To cover the large open wound, a flap of skin will be taken from his opposite calf (arrows). **(Bottom)** Here, the flap has been applied to the wound.

Reproduced from Levin LS (ed): Complications in Orthopaedics: Open Fractures. Rosemont, IL. American Academy of Orthopaedic Surgeons, 2010. pp. 71-87.

Complications of Open Fractures

Infection

This is the most common complication of open fractures. Infection is the result of bacteria entering the wound at the time of the injury.

Infection can occur early on during healing or much later after both the wound and fracture have healed. A bone infection can become chronic (osteomyelitis) and lead to further surgeries.

This patient has developed a bone infection after internal fixation for an open fracture.

Reproduced from Levin LS (ed): Complications in Orthopaedics: Open Fractures. Rosemont, IL. American Academy of Orthopaedic Surgeons, 2010. pp. 71-87.

Nonunion

Some open fractures may have difficulty healing because of damage to the blood supply around the bone at the time of injury. If the bone does not heal, further surgery, including bone grafting to the fracture site and repeat internal fixation, may be necessary.

Compartment Syndrome

This painful condition develops when the injured arm or leg swells and pressure builds within the muscles. When this happens, immediate surgery to relieve the pressure is required. If left untreated, compartment syndrome can lead to permanent tissue damage and loss of function.

Recovery

Return to Activity

How long it takes to return to your daily activities will vary, depending upon the type of fracture and the severity of your injury. Some fractures may take longer to heal. For example, fractures in the lower leg, where the tibia is right under the skin, will take longer to heal than fractures in the thigh or upper arm where there is good soft tissue coverage. Patients with medical conditions such as diabetes or peripheral vascular disease may also experience slower healing.

It is common to have stiffness, discomfort, and weakness for several months after an injury. Your doctor will talk with you about your concerns and expectations. He or she will also discuss the impact your injury may have on the activities of daily living, including your work, family responsibilities, and recreational activities.

Physical Therapy

Successful treatment of an open fracture depends a great deal on your cooperation. Performing specific exercises both during and after the healing process is essential to help restore muscle strength, joint motion, and flexibility. Your doctor or a physical therapist will provide you with a rehabilitation exercise plan.

Research

Doctors continue to search for new approaches to the treatment of these challenging fractures. Some of the current studies are investigating:

- The closing of wounds associated with open fractures
- The timing of debridement (how quickly it needs to be done)
- The timing of soft tissue coverage for wounds that cannot be closed on their own
- The use of devices coated with antibiotics

Last Reviewed

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