EXTREMITY FRACTURE
CASE MANAGEMENT
GUIDELINES

Prepared for
The Workplace Health, Safety and Compensation Commission of New Brunswick

by

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1. FRACTURES: GENERAL OVERVIEW

ALSO KNOWN AS: Broken bone

WHAT IS A FRACTURE?

"Doctor, is it fractured or just broken?" Fractured means broken! It's that simple. However, every fracture has its own unique personality. Fractures occur when the force applied exceeds the breaking strength of the bone. Depending on the type and amount of force, the bone can be merely cracked, or it can literally explode!

Fractures are described in many ways: location (shaft, end, into joint); type (transverse, oblique, spiral, comminuted or impacted); complexity (hairline, simple, complex, non-displaced, displaced); configuration (angulation, alignment and apposition); stability (stable, unstable); and soft tissue involvement (closed, open, compound or contaminated).

Examples of fractures, in order of increasing severity:

Physicians have different ways of describing fractures. As a rule, the lower the energy involved, the simpler the fracture pattern (i.e., simple or mildly displaced), and the less severe the bony destruction and soft tissue injury. The lower the energy involved, the quicker a fracture will heal and the lower the probability of complications. Most simple fractures heal in 6-8 weeks.

High-energy fractures produce considerable bone destruction (i.e. comminuted or in several pieces) and soft tissue injury (i.e., ligaments, nerves, muscles) and even break through the skin (compound). They can be very difficult to treat, requiring extensive rehabilitation. Fractures involving joints (intra-articular) or at risk of moving during healing (unstable) are often treated surgically. Intra-articular fractures are at risk of arthritis.

WHAT IS ITS PERSONALITY?

As with people, every fracture has its own personality. However, depending upon location and type, fractures can be grouped into “personality types.” Some are “friendly” and heal predictably while others are “nasty” and develop certain complications with predictable regularity. The following text, when discussing the various fractures, will attempt to characterize their unique “personalities.”
HOW IS IT DIAGNOSED?

**History:** Most work-related injuries are traumatic and a result of a fall, twist or direct blow. Fractures can also be the result of bone weakness (pathological fracture) or repeated cyclical loading (stress fracture). Pathological fractures can occur with minimal force through the weakened area of bone such as with osteoporosis or tumor. Stress fractures occur in people who have chronic repetitive low-grade stressing of bones such as marching or running. The less energy required producing a fracture, the less patient discomfort. The ability to use an extremity does not exclude the possibility of fracture.

**Physical Exam:** Tenderness, swelling, and bruising are often present. A displaced fracture is usually associated with deformity. Low-energy fractures may be associated with mild discomfort and no deformity. High-energy fractures have the greatest risk of neurovascular, soft tissue or joint damage. A break in the skin over the fracture means that it is compound and therefore at risk of infection. The physician should also examine the joints adjacent to a fractured bone, since there may also be ligament or joint damage that requires specific treatment.

**Tests:** Routine x-rays are all that are usually necessary to diagnose and manage most fractures. X-rays should include the joint above and below the fracture. Certain fractures can be difficult to see on initial x-ray and therefore require a repeat x-ray in several weeks or special investigations such as a bone or CT scan, a tomogram or an MRI. One of the most sensitive tests for the presence of an occult recent fracture is the bone scan. It is not as useful as an x-ray to plan treatment. A bone scan is useful to determine whether a fracture is recent or old. Angiography or electromyography (EMG) is used to investigate vascular or nerve injury.

If the patient’s x-ray suggests a fracture but the symptoms are mild and not in keeping, it could be that the fracture is old or that the patient has a developmental deformity. A bone scan can help sort this out, since it will be “hot” if it is a recent fracture.

HOW IS IT TREATED?

**Low energy** fractures often require little treatment beyond initial rest, analgesics and "the tincture of time." If the fracture is stable and non-displaced, all that may be required is protection (cast or splint) along with measures to decrease swelling and pain (ice, elevation and analgesics) for 24-48 hours, followed by progressive mobilization with weight bearing as comfort permits. An appropriate rehabilitation program should be carried out as the fracture heals.

**Higher-energy** fractures can be associated with considerable bone, joint, or soft tissue damage. If ligaments, vessels or nerves are damaged they may also require treatment.

**Displaced or angulated** fractures may not be in an acceptable position. Angulation can often be corrected by manipulation under anesthesia. Displaced fractures can occasionally be treated with closed reduction under anesthesia followed by a cast, but more often require surgery.

**Unstable fractures** are at risk of shifting during healing and usually require surgery. Many fixation devices are used when operating upon fractures, and include screws, plates, intramedullary nails, wires, and external fixators. These devices are selected depending upon the type of fracture and preference of the surgeon.

Most displaced, unstable or joint fractures will require surgery.
Compound fractures have a break in the skin over the fracture and may be potentially infected. They require urgent operative treatment to explore and cleanse the wound. Antibiotics are usually required perioperatively.

GENERAL COMPLICATIONS

Complications are directly proportional to magnitude of energy, complexity of fracture, associated soft tissue injuries and multiple trauma. They can be classified as follows:

Cardio-respiratory Complications: The stronger the bone that is fractured, the higher the energy required and therefore the greater the risks of serious complications. Large bones such as the femur or tibia can be associated with the release of fatty material into the bloodstream at the time of fracture, which can result in a serious condition similar to pneumonia. This is called fat embolism or adult respiratory distress syndrome. It can necessitate intensive care unit admission and the patient being placed on a respirator. Cardio-respiratory complications are often seen in multiple trauma (i.e., several organs or systems injured).

Neuro-vascular Complications: Injury to nerves or blood vessels can be a very serious complication. Vessel injuries require emergency surgery or loss of the extremity (amputation) can result. Nerve injuries may require surgical intervention as well, and even with this can have long-term complications, including permanent loss of muscle function, protective sensation, joint stiffness or contractures. Neuro-vascular injuries can be devastating.

Compartment Syndromes: These occur when there has been a severe crushing of muscle that is enclosed in a tight fascial compartment (envelope around the muscle). The tight compartment does not permit the damaged muscle to swell and pressure increases to a degree that can cut off blood supply. This is an emergency situation that necessitates urgent surgery to release the compartments over the involved muscle. Otherwise the muscle will be permanently damaged. Toxins from the destroyed muscle can temporarily damage the kidneys. Compartment syndromes are most common in the calf and forearm. It is not common from them to occur in the thigh or upper arm.

Skin and Soft Tissue Complications: Severe skin injury can result in the need for skin grafting or other complex procedures. Torn ligaments around joints require surgical repair as well. Soft tissue injuries don’t usually show up on an x-ray but they can be devastating.

Infection: Infection of either bone (osteomyelitis), joint (septic joint), or soft tissue (wound infection) can occur with compound fractures or after surgery. Infection usually requires urgent surgical treatment and is a serious complication that can markedly delay healing. Bone infections can be a lifetime complication.

Deep Venous Thrombosis (DVT): Clots that occur in the deep veins of the leg are a serious and common complication following any injury that requires rest or immobilization. They are particularly common after lower extremity injuries.

The clots develop in response to inflammation of the vein’s lining. This inflammation can damage the small valves in the veins with resultant chronic leg swelling and pain (post phlebitic syndrome). If the clots break off and travel to the lungs they can cause a severe pneumatic like condition (pulmonary embolus) and even death! Suspected DVT requires a venogram or ultrasound to establish the diagnosis and treatment, necessitating the use of blood thinners (anti-coagulants) for a minimum of 3-6 months after. DVT can markedly slow recovery time, and patients on anticoagulants may require special work precautions.
Loss of Position/reduction: Fractures that have been successfully reduced may later shift position and require re-manipulation, or more commonly open reduction and internal fixation.

Malunion: This is healing of a fracture that is improperly positioned. This can be the result of loss of a position during healing (above) or the failure to achieve proper reduction initially. The types of malunion are shortening, rotation, and angulation.

Delayed Union and Non-union: Not all fractures heal in the usual predicted time. Because healing is a biological process many factors can interfere. This is a difficult complication to deal with, often requiring further operative procedures such as bone grafting, etc. Multiple trauma with multi-organ involvement, high-energy fractures with considerable soft tissue damage, or other factors that can challenge the normal healing process can result in delayed healing. The efficacy of electrical and electromagnetic stimulation for bone healing is controversial and therefore not commonly done in Canada. It is somewhat of a desperation measure after all else has failed. If requested, a second opinion would be justified.

Avascular Necrosis: This occurs when the blood supply to the bone has been cut off and the bone dies. This can occur at the time of the fracture from tearing of blood vessels or subsequent to surgery that damages the bone’s blood supply. Certain bones have a predilection to avascular necrosis due to the anatomy of their blood supply (scaphoid, lunate, and hip). It is a very serious complication that inevitably leads to arthritis.

Stiffness: Joint stiffness is always of concern especially with intra-articular fractures or those requiring prolonged immobilization during healing. "Cast disease" from being kept too long in a cast is a recognized cause of stiffness and should be avoided if possible. Early joint movement is always desirable.

Arthritis: Intra-articular fractures are prone to arthritis. Even if the joint was not fractured, osteoarthritis can occur from joint surface or ligament damage or if the joint had to be immobilized (i.e., casted) for a prolonged period. Fractures that don’t involve the joint (i.e., shaft fractures) or do not require prolonged immobilization are less prone to arthritis.

Deconditioning: Fracture healing can result in marked deconditioning. An important part of rehabilitation of the injured worker is to prevent deconditioning. Crutch and casts can result in disturbed biomechanics and produce knee, back or shoulder problems. These problems are more easily prevented than treated. Remember, every day in bed produces a 1% loss of muscle mass! Ten days in bed produces a 15% loss of aerobic capacity!

Pain Syndromes: Fractures with soft tissue injury can be associated with complex regional pain syndrome (CRPS) or reflex sympathetic dystrophy (RSD) and problems of chronic pain. These are not clearly understood conditions and treatment may require a multi-disciplinary approach (i.e. Pain Clinic). Occasionally complex regional pain syndromes can develop following even minor injuries. It is easier to prevent pain syndromes by early active rehabilitation and preventing the development of pain avoidance behavior than to treat it after it is fully established. The more quickly RDS is treated the better the prognosis. The main principle of treatment is active functional rehabilitation, though specific interventions are sometimes required.

Psychosocial and Non-accident Related Issues: Workplace, psychological, socio-economic, and family issues can greatly impact upon return to work. These factors are also known as “amber flag” issues! Other factors such as intercurrent illness, general debility, diabetes, poor nutrition, medications (e.g. steroids) and cigarette smoking can also interfere with bone healing.
WHAT IS THE EXPECTED OUTCOME?

Simple, uncomplicated fractures usually heal in six to eight weeks without sequelae. Those that are more complex, higher energy, or associated with complications will take correspondingly longer. In the sections to follow we will consider the different fractures describing their individual “personalities,” specific healing times, and complications.

About halfway through the expected disability duration time Case Managers should check with the attending physician and inquire if there are any treatment, rehabilitation, or workplace issues that the WHSCC can assist with or look into. This will also provide an opportunity to inquire as to whether there are any complications (see above) that may modify the disability duration for the particular fracture.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

Each fracture possesses its own set of restrictions and limitations depending upon its type, treatment, complications, and the patient’s work demands. These will be discussed individually under each fracture type.

Safety Issues: The effects of various appliances on dexterity and mobility have to be considered. Both immobilizing devices (splints, casts, etc.) and assistive devices (crutches and canes) can pose potential risks to the worker and colleagues. Analgesic medications can interfere with alertness.

Accommodations: Some workers may need rest periods and the opportunity to elevate the injured extremity. This may necessitate provision of a space with a cot or bed. Access to ice may be advisable. A gradual return-to-work program can be an important aid in integrating the injured worker back into the work force.

Ancillary: Patients with fractures frequently require physical and/or occupational therapy. Time off work may be required to attend physiotherapy sessions. Occupational therapy worksite site evaluations may be required.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

Every fracture has its own “personality” and this dictates the typical rehabilitation program. Unfortunately, there are many factors (complications, community, and personal resources, motivational issues, etc.) that can modify these programs. Physiotherapy is an important part of fracture rehabilitation. Occupational therapists typically deal with the rehabilitation of hand injuries and can carry out functional and workplace assessments.

From rehabilitation perspective the quicker a worker can be safely integrated back into the work place the more rapid the recovery. The personal, family and societal effects of taking someone out of the work place for a prolonged time can be immense.

WHO ARE THE APPROPRIATE SPECIALISTS FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

This can vary considerably depending on the community and specific specialist interests and training. In general the following are applicable:

Orthopedic surgeon: most fractures, except for complicated hand fractures and facial.
Plastic surgeon or orthopedic hand specialist: complicated hand fractures.
Plastic surgeon or oral surgeons: facial fractures.
WHAT FACTORS COULD AFFECT DISABILITY DURATION?

There are many factors, which include:
- Type, location and severity (i.e. personality) of the fracture
- Associated injuries (multiple trauma)
- Type of management
- Complications
- Workplace demands
- Work-related issues such as the availability of a gradual return-to-work program, etc, and
- Psychosocial issues (i.e. amber flags) that can arise in association with prolonged disability.

WHAT IS THE EXPECTED DISABILITY DURATION?

Disability durations are average times to permit specific levels of workplace demand and are specific to each fracture. They are averages for uncomplicated fractures and do not account for type of treatment, patient age, severity of injury, associated injuries, or workplace issues.

For this document they are derived from many sources including the experience of the Workplace Health, Safety and Compensation Commission of New Brunswick.

The job classifications of sedentary, light, medium, heavy and very heavy are of necessity somewhat arbitrary and have to be interpreted in light of the specific job demands made of the individual. A workplace assessment may sometimes be necessary to better understand the work situation.

The five job classifications listed are those of the US Department of Labor’s Dictionary of Occupational Titles and roughly correspond to:

**Sedentary Work**: Exerting up to 10 pounds of force occasionally and/or a negligible amount of force frequently.

**Light Work**: Exerting up to 20 pounds of force occasionally and/or up to 10 pounds of force frequently.

**Medium Work**: Exerting up to 50 pounds of force occasionally and/or up to 20 pounds of force frequently.

**Heavy Work**: Exerting up to 100 pounds of force occasionally and/or up to 50 pounds of force frequently.

**Very Heavy Work**: Exerting in excess of 100 pounds of force occasionally and/or up to 50 pounds of force frequently and/or in excess of 20 pounds of force constantly.

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2. CLAVICLE FRACTURES

ALSO KNOWN AS: Broken collarbone

![Clavicle Diagram]

WHAT IS A CLAVICLE FRACTURE?

The clavicle (collarbone) is part of the mechanical linkage that secures the shoulder girdle to the chest. It is an "s"-shaped bone that runs from the sternum (chest plate) to the acromion of the shoulder. Most commonly it fractures as a result of a direct blow such as a fall on the shoulder, or outstretched hand, or an object falling directly on the shoulder. The usual location of the fracture is the outer middle one-third, which is an area of stress concentration. Clavicle fractures constitute approximately 5% of all body fractures.

Because the clavicle serves as mechanical linkage between the shoulder and chest, fractures of this structure typically affect the entire shoulder function during healing.

WHAT IS ITS PERSONALITY?

Typically, clavicle fractures are benign injuries that heal without sequelae. Occasionally, they can be slow healing. If patients are kept in slings for prolonged periods of time, they can develop shoulder stiffness (frozen shoulder). Barring complications or nerve injury, it is not usually a fracture that is a source of concern from a rehabilitation perspective.

HOW IS IT DIAGNOSED?

**History:** Usually there is a history of direct blow or fall on the shoulder. The patient will complain of pain and swelling in the area of the fracture and difficulty using the shoulder. If there has been nerve injury (not common) there may be complaints of arm numbness, weakness, or sensory loss. In the situation of high-energy multiple trauma, the clavicle has been known to puncture the lung (pneumothorax), which can cause difficulty breathing.

**Physical Exam:** There will be local tenderness, bruising, and swelling at the point of the fracture. The patient tends to protect the shoulder from movement.

**Tests:** Routine x-rays of the clavicle will usually establish the diagnosis. Ancillary investigations such as a MRI, a CT scan, etc., are rarely necessary. With severe trauma, a chest x-ray would be indicated to rule out a punctured lung (pneumothorax). In the extremely rare situation of neurovascular injury, angiography or electromyography (EMG) might be indicated.
DIFFERENTIAL DIAGNOSIS

Acromioclavicular and sternoclavicular joint strains: Strains of the joints of the two ends of the clavicle can present with pain and swelling which on physical examination can be confused with a clavicular fracture.

Acromioclavicular (AC) joint dislocation: AC joint dislocation is a separation of the joint at the outer end of the clavicle. This is the most commonly confused diagnosis because both injuries present with a lump along the course of the clavicle and depression of the shoulder girdle. Stress views of the AC joint will diagnose an AC dislocation.

Sternoclavicular joint dislocation: Separation of the joint at the proximal end of the clavicle is not common and requires specific treatment depending on the type of dislocation. Clinical findings and specific x-rays should easily sort out this injury.

HOW IS IT TREATED?

It rarely requires treatment beyond a sling or “figure 8 bandage” for about 3-4 weeks as discomfort dictates. Ice packs, rest, and analgesics are indicated in the acute inflammatory phase. If the shoulder is kept firmly immobilized in a sling too long (2-3 weeks), shoulder stiffness (frozen shoulder) can occur which can take some time to work out. As soon as comfort permits (5-7 days), gentle pendulum exercise should be encouraged to prevent shoulder stiffness.

Even if the fracture fragments are multiple (comminuted) or widely separated (displaced), most heal over a period of 6-8 weeks without residual problems.

Surgery is rarely indicated except in the situation of compound and non-union fractures or if there is concern that a spicule of bone is at risk of protruding through the skin. Occasionally if the fracture involves the AC joint, surgery is indicated.

COMPLICATIONS

Please refer to pages 2-4 for a list of general complications.

Serious complications are very uncommon. A “bump” at the site of fracture is common and usually gets smaller over a period of several years as the healing bone remodels.

Very high-energy injuries with multiple trauma or with compounding, neurovascular or chest injuries can be associated with long-term complications but the fracture itself usually heals uneventfully, without delay or non-union.

Post-traumatic osteoarthritis is very uncommon because the fracture usually does not involve a joint. Fractures near the distal end of the clavicle can result in post-traumatic acromioclavicular joint arthritis.

Transient shoulder stiffness can occur from being left in a sling too long.

WHAT IS THE EXPECTED OUTCOME?

These fractures predictably heal within 4-6 weeks without sequelae, provided none of the complications listed above occur.
POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS?

The major restriction imposed is due to discomfort and inability to use the shoulder for lifting, etc., during the healing phase. In non-dominant fractures, it would be possible to return to unilateral sedentary activities within 5-7 days if comfort permits. Usually bone union is sufficiently solid by two months to allow unrestricted lifting.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

The mainstay of rehabilitation for this injury is to encourage activities within the range of comfort as the fracture heals. This is done for the purpose of maintaining general fitness as well as preventing shoulder stiffness. The key to post injury rehabilitation is to be as active as comfort permits.

At about 3-4 weeks, uncomplicated fractures may require some specific physiotherapy instruction on shoulder range-of-motion, strengthening and rehabilitation, but otherwise no additional rehabilitation effort is usually required.

If frozen shoulder occurs, additional physiotherapy and consideration of injection of the subacromial bursa by the family physician may be appropriate.

Patients with complications, multiple trauma or neurovascular injury may require lesion-focused rehabilitation.

WHO ARE THE APPROPRIATE SPECIALISTS FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

Orthopedic surgeon. In the case of nerve injury neurologist and plastic surgeon.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

Multiple trauma, neurovascular injury, frozen shoulder, post-traumatic arthritis, delayed or non-union, hand dominance and job requirements.

WHAT IS THE EXPECTED DISABILITY DURATION?

**Clavicle (shaft):**

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<td>Medium Work</td>
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<td>Heavy Work</td>
<td>6 - 8 weeks</td>
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<tr>
<td>Very Heavy Work</td>
<td>6 - 8 weeks</td>
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**Clavicle (involving joint)** By report.
3. SCAPULAR FRACTURES

**ALSO KNOWN AS:** Broken shoulder blade

**WHAT IS A SCAPULAR FRACTURE?**

The scapula provides a flat glide surface between the ribs and the shoulder girdle. With its associated muscles it stabilizes the shoulder in positions of function. Fractures of the scapula are relatively uncommon but most frequently seen in patients aged 40-60. Because of its considerable muscle coverage and mobility, the scapula usually requires a high-energy direct blow to fracture.

**WHAT IS ITS PERSONALITY?**

Scapular injuries are usually relatively benign and heal without sequelae. However, because they are the result of high-energy direct blows, the treating physician should search for associated injuries (multiple rib fractures, pneumothorax, mediastinal injuries, vertebral, and extremity fractures).

Fractures involving the shoulder joint (intra-articular) usually require surgery.

**HOW IS IT DIAGNOSED?**

**History:** The patient will give a history of high-energy direct trauma to the back of the shoulder and will tend to hold the arm by the side protecting it from movement and complaining of pain behind the shoulder.

**Physical Exam:** The patient will be reluctant to move the shoulder and may display pseudoparalysis of the rotator cuff (inability to activate the cuff muscles due to bruising). There will be swelling, bruising, and tenderness over the fracture site.

**Tests:** Because of its shape and the fact that it is superimposed on other structures, fractures of the scapula can be difficult to see on routine shoulder or chest x-rays. Special x-ray views called trauma series are often necessary to fully appreciate the anatomy of these fractures. A CT scan may be useful if one is considering surgical intervention. Rarely is a MRI necessary.
DIFFERENTIAL DIAGNOSIS

Soft tissue bruising, rotator cuff tear, brachial plexus injury, or proximal humerus fracture.

HOW IS IT TREATED?

The vast majority of these fractures heal without sequelae. The primary treatment objective is patient comfort. This usually dictates the use of local ice, analgesics and rest for 24-48 hours followed by heat and gentle progressive shoulder mobilization (beginning with pendulum exercises) to prevent shoulder stiffness. A sling may be required for 7-14 days, removing it for gentle pendulums. The fracture usually heals uneventfully over a period of 6-8 weeks.

Considerable displacement of fragments is compatible with a good functional result and can therefore be accepted.

Surgical intervention may be required if the fracture involves the shoulder joint (glenoid).

COMPLICATIONS

Please refer to pages 2-4 for a list of general complications.

Complications are rare but arterial and brachial plexus injuries have been reported. Rarely, the fracture will heal with a bony prominence (malunion) that can irritate the underlying rib cage. This may necessitate surgical excision of the bony prominence.

WHAT IS THE EXPECTED OUTCOME?

Uneventful union and return to full function over a period of approximately 1-2 months (the full healing time of the fracture).

POSSIBLE WORK RESTRICTION AND MODIFICATIONS

Work restrictions are dictated principally by discomfort as the fracture heals, transient shoulder weakness and stiffness as a result of immobilization and deconditioning.

Light sedentary duties utilizing the uninjured extremity can begin as comfort permits, although heavy lifting should be avoided until the fracture has fully united (usually in 8-10 weeks).

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

Physiotherapy may be required for residual shoulder stiffness and strengthening.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

An orthopedic surgeon.
**WHAT FACTORS COULD AFFECT DISABILITY DURATION?**

Multiple trauma, neurovascular injury, stiffness, deconditioning, hand dominance, and job issues.

**WHAT IS THE EXPECTED DISABILITY DURATION?**

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*Go to Fractures: General Overview*
4. PROXIMAL HUMERUS FRACTURES

**ALSO KNOWN AS:** Broken shoulder

Proximal Humerus Fractures, in order of increasing severity:

![Impacted Neck Fracture (Stable)](image1)

![Comminuted 3 Part Fracture-dislocation](image2)

**WHAT IS A PROXIMAL HUMERUS FRACTURE?**

Fractures of the upper end of the humerus are common and account for approximately 5% of all fractures. Usually they are seen in elderly osteoporotic patients following a fall on the outstretched arm. These low-energy fractures heal with little problem beyond that of transient stiffness.

Unfortunately, the most serious proximal humerus fractures occur in the working population. These are high-energy injuries with considerable comminuting (multiple fractures) and therefore have the potential to be quite disabling.

The most commonly used classification for proximal humeral fractures is the “four segment classification” developed by Drs. Neer and Rockwood. This classification divides the fractures into groups according to the number of fragments (1-4), the amount of displacement and whether the fracture is associated with dislocation. The more severe the fracture (the more parts, the greater the displacement and if associated with dislocation), the worse the prognosis.

**WHAT IS ITS PERSONALITY?**

**Young vs. Elderly:** Low-energy impaction fractures that occur in the elderly are usually not a problem. When these fractures occur in young individuals, they are often the result of high-energy trauma with considerable comminution and require surgical intervention. Serious shoulder fractures can result in significant long-term stiffness, weakness and disability!

**HOW IS IT DIAGNOSED?**

**History:** The classical history is that of a fall on the outstretched arm or a direct blow to the shoulder. The patient usually complains of severe shoulder pain and is reluctant to move the arm. Swelling can be difficult to appreciate due to the overlying muscle bulk.
Physical Exam: The patient tends to hold the arm by the side with the shoulder girdle depressed and is reluctant to move the arm because of pain. Bruising rarely occurs until several days later, when it will often appear at the elbow! With neurological injury (severe fractures) the patient may demonstrate sensory and motor deficits in the extremity.

Tests: Routine shoulder x-rays (including trauma series of shoulder) are usually all that are necessary to establish the diagnosis and for treatment. Complex severe three-part and four-part fractures may require tomograms, a CT scan, or a MRI to fully delineate the extent of the injuries and to plan treatment.

If there has been neurovascular injury, angiography and/or electromyography (EMG) may be necessary.

DIFFERENTIAL DIAGNOSIS

This includes a simple soft tissue bruise, rotator cuff injury, acromioclavicular joint separation, or fractures of the clavicle or sternum.

HOW IS IT TREATED?

Non-displaced impacted stable fractures (80%) require only a sling during healing time (5-8 weeks), which can be removed for gentle pendulum exercises beginning as soon as comfort permits (usually 5-7 days). This is done to prevent stiffness, which is the most common complication after these fractures. As this type of fracture occurs through soft spongy (cancellous) bone, it heals with predictable regularity.

In young people surgery may be required if there are multiple displaced fragments or if associated with dislocation. The type of surgery would be either open reduction and internal fixation (ORIF) or prosthetic head replacement.

COMPLICATIONS

Please refer to pages 2-4 for a list of general complications.

Over 80% of these fractures will heal without complications. The most common complication is that of transient joint stiffness which is treated with physiotherapy and can be prevented by early gentle range-of-motion.

The comminuted multi-part fractures, either with or without dislocation, have a significant incidence of complications, including neurovascular injury, avascular necrosis (interference of blood supply), malunion, non-union, chronic stiffness and weakness. Fortunately, these are not common fractures.

WHAT IS THE EXPECTED OUTCOME?

Eighty percent heal without sequelae. The high-energy, multi-fragment displaced fractures associated with dislocation can have a variable outcome depending on the amount of soft tissue damage, the ability of the surgeon to restore the pre-operative anatomy and whether complications such as avascular necrosis, non-union, arthritis or shoulder stiffness from adhesions occur.
POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

Uncomplicated, impacted, stable, non-dominant fractures will allow the individual to return to one-handed work within 1 - 2 weeks. If pain medications are required, these can interfere with mentation.

The patient should avoid heavy lifting until bone healing is advanced (usually 8-10 weeks) and it can take several months before range-of-motion, strength and normal shoulder glide patterns have returned.

Severe four-part fractures or those associated with neurovascular injury have a high incidence of permanent work restriction, and patients are often unable to return to manual labour.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

Impacted stable fractures might require a short period (2-4 weeks) of physiotherapy for shoulder strengthening and ROM.

Fractures that require surgical open reduction (less than 10%) usually require swing and swathe immobilization for 2-3 weeks until early repair has occurred before beginning exercises. Typically these injuries will require a considerable period of physiotherapy rehabilitation to restore range-of-motion, strength and normal glide mechanics. This could take 6-8 months.

If prosthetic replacement is necessary (less than 3%) passive exercises can be started early (often within several days of surgery) but typically rehabilitation is slow to progress. Prosthetic replacement imposes considerable permanent impairment due to stiffness and difficulty doing overhead activities.

Almost all patients will require some type of physiotherapy either for instructions or for a supervised rehabilitation program.

If complications such as brachial plexus injury, non-union, malunion, and avascular necrosis occur, then rehabilitation can require several years.

WHO ARE THE APPROPRIATE SPECIALISTS FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

Uncomplicated: An orthopedic surgeon.
Complications: A vascular surgeon, neurosurgeon, neurologist, or physiatrist.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

The major medical factors relate to type of fracture and whether complications arise. Delayed union and stiffness are the most common causes of increased disability time. Job issues can also be a factor.
WHAT IS THE EXPECTED DISABILITY DURATION?
Proximal humerus (impacted stable):

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Proximal humerus (complex, i.e. multi-fragment or dislocated): By report.
5. SHAFT OF HUMERUS FRACTURES

ALSO KNOWN AS: Broken arm

WHAT IS A SHAFT OF HUMERUS FRACTURE?

The humerus is the largest bone in the upper extremity and connects the shoulder with the elbow. Most commonly, the fractures of the shaft of the humerus occur in response to torsional forces (spiral fractures) or direct blows to the arm (transverse, comminuted and butterfly).

WHAT IS ITS PERSONALITY?

Good personality! They are long bone fractures that do not involve the joint, therefore arthritis is uncommon and they usually heal without sequelae. Once a humeral shaft fracture has united, it will be as strong as prior to the original fracture.

The only catch is that fractures of the mid shaft can be associated with injuries to the radial nerve! These, however, usually recover.

HOW IS IT DIAGNOSED?

History: The patient presents with pain and perhaps deformity in the mid-upper arm, following trauma.

Physical Exam: Tenderness, bruising, and movement may be present at the fracture site. The patient holds the arm to the side of the body to prevent movement. If there has been injury to the nerve (most commonly the radial nerve), there may be sensory or motor loss distally.

Tests: These fractures are readily diagnosed with routine x-rays. Usually additional studies are not necessary unless there was neurovascular injury, in which case angiography or electromyography (EMG) would be indicated.
DIFFERENTIAL DIAGNOSIS

Soft tissue injury or bruise, biceps tendon rupture.

HOW IS IT TREATED?

Humeral shaft fractures are either treated with some type of immobilization device (cast hanging, sugar tong splint, brace) or surgically stabilized with a compression plate or intramedullary rod. This is determined by the surgeon’s preference. In young active people especially, there is a tendency to treat displaced long bone shaft fractures with surgical stabilization, because this allows more rapid mobilization and rehabilitation.

COMPLICATIONS

Please refer to pages 2-4 for a list of general complications.

The most common, potentially serious, complication associated with mid-shaft humeral fracture is radial nerve injury. This is usually a bruise or traction injury and recovers without specific treatment over 6-8 weeks.

Compound fractures (those where the bone has protruded through the skin) are usually surgically debrided, especially if there is nerve impairment.

In fractures treated nonsurgically, the most common complications are transient shoulder stiffness and delayed union or non-union. Non-union requires surgical intervention and bone grafting.

Because these fractures do not involve the joint, there is very little risk of osteoarthritis.

Malunion is not commonly a problem. As this is not a weight-bearing bone and the shoulder joint will accommodate for rotational malunion, the only significant malunion complication is angulatory deformity, which is principally cosmetic. Minor degrees of rotational malunion or shortening are well accepted.

WHAT IS THE EXPECTED OUTCOME?

The vast majority of humeral shaft fractures heal uneventfully without sequelae. Radial nerve injuries that don’t recover are a problem and can require extensive plastic surgery.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS?

These restrictions relate principally to the type of treatment undertaken. If the patient is treated with a cast or other immobilization device, then the arm is not functionally useful for about 6-12 weeks (until such time as the fracture has solidified). If surgical intervention and internal fixation has been carried out, then the arm can often be used to do gentle protected activities (i.e., writing, clerical work, etc.) within 3-4 weeks of the surgery.

If the injury involved the non-dominant extremity and there are no complications, sedentary single-arm activities should be possible within 7-14 days.

Occupational therapy worksite visits should be considered if workplace issues are of concern.
WHAT IS THE TYPICAL REHABILITATION PROGRAM?

To prevent stiffness, gentle shoulder pendulum exercises should be instituted as soon as possible. If the patient is treated with a cast or some other immobilization device, there may be little that can be offered from a physiotherapy prospective until the appliance has been removed. As soon as possible, gentle pendulums should be instituted.

If surgical stabilization has been carried out, the patient can usually be started on range-of-motion exercises for the shoulder, elbow, and forearm within 7-14 days, depending upon comfort. The patient should only do protected lifting or arm rotational activities until bony union has occurred, which can be 2-3 months.

Complications such as radial nerve injury require lesion-specific rehabilitation.

WHO ARE THE APPROPRIATE SPECIALISTS FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

An orthopedic surgeon, neurologist, or plastic surgeon for nerve injury.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

Multiple trauma, neurovascular injury, stiffness, deconditioning, hand dominance and job issues.

WHAT IS THE EXPECTED DISABILITY DURATION?

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Go to Fractures: General Overview
6. ELBOW FRACTURES

**ALSO KNOWN AS:** Broken elbow, radial head, olecranon, trochlear or capetellar fracture.

![Image of elbow anatomy]

**WHAT IS AN ELBOW FRACTURE?**

The elbow joint is the articulation between the upper arm (humerus) and the two forearm bones (radius and ulna). Fractures about the elbow can involve the distal humerus (capetellum, trochlea), head of neck of the radius, or the olecranon of the ulna. Movements about this joint are very complex, involving both flexion-extension as well as forearm rotation. As such, elbow joint fractures usually require accurate surgical repair. The exception to this is the mildly displaced radial head or neck fracture, which usually needs only a short period of time in a sling (4-5 days) followed by progressive mobilization as comfort and swelling permits. Elbows do not tolerate prolonged periods of immobilization.

**WHAT IS ITS PERSONALITY?**

**Distal humerus** fractures are not common but are usually high energy and have to be treated with a lot of respect! Intra-articular distal humerus fractures (unless non-displaced and stable) virtually all require open reduction and internal fixation. Highly comminuted fractures with massive joint destruction are devastating injuries that can produce permanent stiffness.

**Olecranon** fractures occur in response to a fall on the elbow or a violent contraction of the triceps muscle that literally pulls the bone apart. If displaced, they respond well to surgical intervention. Usually they are straightforward fractures to treat with good outcomes.

**Radial head and neck** fractures are commonly the result of a fall on the outstretched hand. Provided there are no large displaced fragments that might block movement, they usually heal without intervention or significant sequelae. If arthritis develops, it can be dealt with by a simple surgical head excision.

One of the personality traits of elbow injuries in general is that they tend to be associated with significant stiffness that can sometimes be slow to resolve. Early movement is an important part of successful treatment of elbow fractures!
HOW IS IT DIAGNOSED?

History: The typical history is that of a fall on the outstretched hand or a direct blow to the elbow. The presenting symptom is pain.

Physical Exam: Tenderness, swelling, bruising, and painful movement are the typical findings. Only severe elbow fractures are associated with neurovascular injuries, but when these are present there may be motor and sensory deficits in the distribution of the involved nerves.

Tests: Routine x-rays of the elbow are usually all that is required to establish the diagnosis. For complex fractures, tomograms or CT scans are necessary to aid the surgeon in planning the surgical approach. A MRI is rarely indicated.

DIFFERENTIAL DIAGNOSIS

Torn distal biceps tendon, soft tissue injury or bruise, dislocated elbow.

HOW IS IT TREATED?

Distal Humerus: If intra-articular and displaced, open reduction and internal fixation is the treatment of choice.

Olecranon: Unless non-displaced and stable, virtually all of these fractures are treated with open reduction and internal fixation, most commonly with tension band wiring.

Radial Head and Neck: Provided there are no fracture fragments that would interfere with forearm rotation, most radial head fractures can be treated with a sling for 7-10 days (to allow swelling to resolve) followed by progressive range-of-motion exercises as comfort permits.

As a rule of thumb, all elbow fractures should be treated as early as possible with range-of-motion therapy. This is the reason these intra-articular fractures are usually treated with open reduction and it is generally not advisable to treat elbow fractures with casts.

COMPLICATIONS

Please refer to pages 2-4 for a list of general complications.

The most common complication of elbow fractures (and elbow injuries in general) is stiffness. Virtually any elbow injury can cause significant stiffness. Frequently even with minor injuries to the elbow, the patient can lose the last few degrees of elbow extension and rotation, but rarely is this functionally significant.

High-energy, comminuted or compound elbow fractures can be associated with serious neurovascular consequences with resultant compartment syndromes, soft tissue loss, chronic stiffness, and osteoarthritis.

Fortunately the most common of elbow fractures (radial head or non-comminuted olecranon fractures) are of a fairly benign nature and respond predictably to conventional treatment modalities.
WHAT IS THE EXPECTED OUTCOME?

Non-displaced intra-articular, mildly displaced radial head and neck, and most olecranon fractures heal without complication and little long-term residual damage. Severe comminuted intra-articular fractures of the distal humerus are devastating injuries and can be associated with long-term morbidity as manifested by elbow stiffness and osteoarthritis.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

These are dictated principally by the restrictions imposed by one-arm activities during the healing of the fracture (which typically requires 8-12 weeks).

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

The mainstay of physiotherapy rehabilitation for elbow injuries is early institution of a gentle range-of-motion (flexion, extension, pronation, supination) with protection from excessive forces until the fractures have the opportunity to unite (6-8 weeks). As with all upper-extremity injuries, there is always a risk of frozen shoulder; therefore, gentle pendulum exercises should be instituted as soon as possible.

If neurovascular complications have ensued, then specific lesion-focused rehabilitation is required.

WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

An orthopedic surgeon.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

Compound, comminuted, high-energy fractures involving the distal humerus can be profoundly disabling. Other factors complications include such as neurovascular injury, stiffness, post-traumatic osteoarthritis, delayed union, dominance, and job issues.

WHAT IS THE EXPECTED DISABILITY DURATION?

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High-energy, comminuted, compound or complex fractures about the elbow would require individual consideration.
7. FOREARM FRACTURES

**ALSO KNOWN AS:** Broken lower arm, fractured radius and/or ulna, forearm fracture (isolated or both bones)

**Fractured Radius**

**Fractured Ulna**

**WHAT IS A FOREARM FRACTURE?**

The radius and ulna are the two long bones that make up the forearm and serve as a mechanical linkage between the elbow and the wrist. They have a very complex movement pattern as the forearm flexes, extends, and rotates about the elbow. Fractures of either the radius or ulna require anatomical reduction because minor degrees of angulatory or rotational deformities can cause permanent stiffness. It is for this reason that in adults these fractures are usually treated surgically.

**WHAT IS ITS PERSONALITY?**

Stable, hairline forearm fractures heal without complication and usually have an excellent outcome! However, as pointed out above, forearm movement is fairly complex and as such displaced fractures require a fairly precise reduction if one expects to avoid stiffness.

Forearm fractures tend to heal slowly, therefore delayed union can interfere with treatment ad early mobilization.

With shaft fractures the risk of osteoarthritis is low, since the joint is not involved.

**HOW IS IT DIAGNOSED?**

**History:** As with most upper extremity fractures, the typical history is either a fall on the outstretched hand or a direct blow to the forearm. The patient’s chief complaint will relate to pain.

**Physical Exam:** Deformity is quite common and is usually associated with swelling. High-energy, compound or severely comminuted fractures can be associated with considerable soft tissue injury that can result in compartment syndromes with neurovascular compromise.

**Tests:** Routine x-rays of the forearm are usually adequate for diagnosing and managing these fractures. Depending on the manner in which the force is applied, specific fracture patterns result.
DIFFERENTIAL DIAGNOSIS

Strain, soft tissue injury, crush injury. **Severe crush injuries even without fracture can be very serious**, requiring elevation and careful observation for fear of compartment syndromes (see general complications).

HOW IS IT TREATED?

If stable and non-displaced they can be treated with a cast. However delayed union is common with forearm shaft fractures and this can result in a prolonged period of cast immobilization with resultant stiffness. Most commonly, forearm fractures (unless hairline and stable) are treated with open reduction and internal fixation with plates or intramedullary devices to facilitate early rehabilitation.

COMPLICATIONS

*Please refer to pages 2-4 for a list of [general complications](#).*

**Stiffness** is the most common complication of forearm fractures. This is rarely a long-term problem provided anatomical reduction of the fracture has been achieved. Severely comminuted or compound fractures with bone loss may be impossible to restore anatomically, with resultant permanent stiffness.

**Delayed union and non-union** are common complications and can impede recovery or even require surgery with bone grafting. Occasionally union may be exceedingly difficult to achieve.

**Compartment syndromes** are the most dreaded complication of forearm fractures. This is the result of muscle injury with swelling occurring in the closed muscle compartments. It can result in permanent muscle damage. This complication can be associated with chronic pain syndrome and deformity (Volkmann’s contracture). Compartment syndromes are a surgical emergency necessitating urgent releases of the fascial envelop that surround the muscles.

WHAT IS THE EXPECTED OUTCOME?

Straightforward uncomplicated fractures of the forearm usually heal uneventfully without long-term sequelae. Frequently a second operation is required to remove the fixation device at about 6 months to a year after the original surgery.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

These are the usual restrictions imposed by one-arm activity. Following open reduction and internal fixation, patients can return to a sedentary job usually within 2 weeks of the fracture but have to protect the forearm from excessive rotational or bending forces for fear of disrupting the internal fixation devices and interfering with normal healing. Typically forearm fractures can be fairly slow uniting and can take up to 12-16 weeks before they are radiographically solid enough to withstand considerable forces.

Occupational therapy worksite visits should be considered if workplace issues are of concern.
WHAT IS THE TYPICAL REHABILITATION PROGRAM?

The patient is usually started on gentle forearm range-of-motion (flexion, extension, pronation, and supination) exercises as early as possible following surgery. This is dictated by the stability of the fracture, but usually can be started in 7-10 days, if comfort permits. As with elbow injuries, it is important to begin gentle range-of-motion physiotherapy as soon as it can be safely done without risking the surgical fixation.

Shoulder and hand range-of-motion exercises should be instituted early to prevent shoulder and finger stiffness.

WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

An orthopedic surgeon.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

Most commonly, delayed union and stiffness.

Other factors include: multiple trauma, neurovascular injury, stiffness, post-traumatic osteoarthritis, hand dominance, and job issues.

WHAT IS THE EXPECTED DISABILITY DURATION?

Radius or Ulna Shaft:

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Radius and Ulna Shaft (both bones of the forearm):

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8. WRIST FRACTURES

ALSO KNOWN AS: Distal radius fracture, Colles’ fracture

WHAT IS A DISTAL RADIUS FRACTURE?
Distal radius fractures are very common and occur as a result of a fall on the outstretched hand. The fracture can occur in the bone just above the wrist (extra-articular) or involve the joint itself (intra-articular). Where the fracture occurs is dependent upon the mechanical characteristics of the bone and tends to be dependent on age.

WHAT IS ITS PERSONALITY?
Elderly: Good personality! In older patients, they usually occur through the soft spongy bone just above the wrist. They typically are treated with either closed reduction or cast immobilization and heal without sequelae. Because the joint is not involved arthritis is not common.

Young: Potentially difficult! In young people distal radius fractures are high-energy injuries and often intra-articular. Therefore, there is a greater risk of arthritis and they have to be treated with a great deal more respect. In the young (which is the age for most work injuries), the fracture tends to have a meaner personality!

HOW IS IT DIAGNOSED?
History: Fall on the outstretched hand. In the elderly, this can be a low-energy injury. In young people, considerable force is usually involved.

Physical Exam: There is typically a fairly profound deformity of the wrist (if displacement has occurred). Usually this is unassociated with neurovascular injury, though occasionally wrist swelling can interfere with median nerve function (acute carpal tunnel syndrome).

Tests: Routine wrist x-rays are usually adequate for diagnosing and managing this fracture.
DIFFERENTIAL DIAGNOSIS

Wrist dislocation or fracture-dislocation, fractured carpal bone, wrist sprain.

HOW IS IT TREATED?

The typical Colles' fracture in the elderly patient is extra-articular and can be easily treated with closed reduction, occasionally augmented with percutaneous (inserted through the skin) wire fixation. Typically these fractures go on to uneventful union over a period of 4-6 weeks.

In the young patient, distal radius fractures often involve the articular surface of the joint and therefore necessitate anatomical reduction. This may require open reduction and internal fixation or closed reduction augmented with percutaneous wire fixation.

COMPLICATIONS

Please refer to pages 2-4 for a list of general complications.

Stiffness and deformity (malunion) are the most common complications. In the elderly the fracture frequently heals with deformity but the stiffness usually works out and the functional outcome is often remarkably good. This may be a reflection of the lower demands in the older patient. Occasionally, because the radius will shorten relative to the ulna, the patient will develop symptoms due to the discrepancy between the lengths of the two bones. This may necessitate a shortening procedure for the ulna.

Arthritis: This fracture in the young is usually high energy and intraarticular so the risk of arthritis is higher.

Acute carpal tunnel syndrome can be a surgical emergency necessitating operation on the wrist and a release of the fibrous band passing in front of the wrist that can compromise the median nerve as it passes into the hand.

Compartment syndromes can occasionally occur with wrist fractures especially if there is an associated with forearm crush injury. This is a surgical emergency (see compartment syndromes), that can result in permanent damage to the muscles and nerves (Volkmann’s contracture).

Tendon rupture can occur if percutaneous pins are used to stabilize the fracture. This may require plastic surgery repair.

WHAT IS THE EXPECTED OUTCOME?

The vast majority of distal radius fractures heal uneventfully with no long-term sequelae. Major complications such as acute carpal tunnel syndrome or forearm compartment syndromes are rare but most common in the young.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

Because wrist fractures interfere with the function of the hand, rehabilitation can be somewhat slower than forearm or humerus fractures. The major limitation is that imposed by single-hand activities during healing. Typically, forearm fractures heal over a period of 6-8 weeks but heavy lifting is usually not possible before at least 2 months.
WHAT IS THE TYPICAL REHABILITATION PROGRAM?

Most wrist fractures are immobilized for 4-5 weeks in a cast or pressure dressing. During this time efforts should be made to maintain the range-of-motion of fingers, shoulder and elbow. Care should be taken to ensure that there is not excessive swelling of the fingers as a result of the hand being kept in a dependent position.

Percutaneously inserted pins usually have to be removed at a later date (2-3 months) because the pins can irritate tissues in their vicinity.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHO ARE THE APPROPRIATE SPECIALISTS FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

An orthopedic surgeon, or a plastic surgeon with expertise in wrist injuries.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

The greater the magnitude of energy, the slower the recovery.

The major factors that affect disability duration are involvement of the wrist joint and whether surgical intervention is necessary to restore the joint surfaces.

Because these are inter-articular fractures there is always a risk of post-traumatic osteoarthritis. However, minor degrees of wrist arthritis are often well tolerated with non-weight bearing (i.e., upper extremity) joints.

WHAT IS THE EXPECTED DISABILITY DURATION?

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9. CARPAL FRACTURES
(SCAPHOID, LUNATE, HAMATE, ETC.)

ALSO KNOWN AS: Broken “wrist” (erroneously)

WHAT IS A CARPAL FRACTURE?

Carpal fractures account for 6-10% of all fractures. The 8 carpal (wrist) bones articulate in a complex manner to permit the tremendous degree of movement through the wrist. These bones are the scaphoid, lunate, capitate, triquetrum, hamate, pisiform, trapezium, and trapezoid. They most commonly break from a fall on the outstretched hand in association with a bending or twisting force.

Scaphoid fractures are the most frequent and account for over 50% of carpal fractures. It can often not show up on the initial x-ray and sometimes will require casting on clinical suspicion alone and repeat x-ray in 10-14 days to confirm its presence.

Dislocations and fracture dislocations are the second most common injury, accounting for 15% of wrist injuries. The combination of dislocated wrist and lunate with fractured scaphoid is called a trans-scaphoid peri-lunar dislocation.

Lunate fractures are the second most common (10%) and are most commonly seen in association with wrist dislocations and is called a trans lunar wrist dislocation.

Other carpal bones fracture far less frequently (2-3%). The hamate accounts for less than 1% of carpal fractures but is frequently missed on x-ray.

One of the characteristics of many carpal fractures is their tendency to be associated with disruption of blood supply. This can cause the bone to die (avascular necrosis).

As with all fractures, these can be classified as stable or unstable, displaced or non-displaced, open or closed and can occur with or without dislocation.

WHAT IS ITS PERSONALITY?

Scaphoid: This fracture is commonly missed on initial examination and may not show up on x-ray for several weeks. It can be difficult to heal, and sometimes the blood supply is destroyed at the time of fracture with resultant avascular necrosis and arthritis. This can be a “sleeper” injury!
Hamate: This uncommon fracture often does not show easily on routine x-ray either. Tenderness over the hamate may be the only hint as to the presence of fracture. Special x-ray views may be necessary. Fortunately, hamate fractures usually heal without significant problems.

Lunate: This is usually a high-energy injury associated with dislocation and severe ligament damage and therefore increased risk of chronic carpal instability problems as well as avascular necrosis.

Others: These fractures usually heal uneventfully without sequelae.

HOW IS IT DIAGNOSED?

History: Fall onto the outstretched hand or severe twist, followed by immediate pain. Wrist pain and stiffness is the usual presentation.

Physical Exam: Reveals swelling and tenderness over the fracture. Range of motion is restricted by swelling and pain. With swelling there may be numbness and weakness in the distribution of the median nerve that passes through the wrist. If associated with wrist dislocation, the deformity can be profound and nerve injury common.

Tests: Routine x-ray of the wrist with scaphoid views. If there are specific areas of tenderness (for example, over the hamate), special views may be required. The scaphoid is most commonly missed. If there is tenderness over the scaphoid a cast or splint should be applied and repeat scaphoid x-rays obtained in 10 to 14 days. Occasionally a bone scan or tomograms will be ordered to confirm the diagnosis. A CT scan may be useful for fracture dislocations. Rarely is an MRI needed.

DIFFERENTIAL DIAGNOSIS

The most common differential diagnosis is that of a simple wrist strain or a fracture of the distal radius (Colles' fracture), both of which are more common.

HOW IS IT TREATED?

Undisplaced fractures can be treated with cast alone. Healing can be slow and for bones such as the scaphoid, union can take up to 3 months. The wrist is immobilized in a cast or splint and follow-up x-rays are needed to confirm healing and detect any displacement of the fracture. A removable wrist gauntlet splint makes hygiene much easier.

Displaced fractures usually require surgery with postoperative immobilization in a cast or splint. Hardware may need to be removed after healing has occurred.

If complications such as arthritis or avascular necrosis occur other operations such as bone grafting, excision of ununited fragments, fusions of various carpal bones or the entire wrist may be necessary.

COMPLICATIONS

Please refer to pages 2-4 for a list of general complications.

Wrist stiffness is the most common complication and is usually transient.
Avascular necrosis/Non-union: The severe complications for carpal fractures are delayed union, non-union and loss of blood supply (avascular necrosis) with subsequent carpal collapse and osteoarthritis. These occur most commonly with scaphoid and lunate injuries.

Neurovascular: The median nerve can be injured from dislocation, swelling (acute carpal tunnel syndrome), or healing with deformity and osteoarthritis. The ulnar nerve can be injured with hamate fractures.

A compartment syndrome can develop from swelling in cast. Compartment syndromes can occur in the forearm or the hand.

Shoulder stiffness (frozen shoulder) can occur if the arm is kept immobilized too long in a sling. This is an avoidable complication.

Complex regional pain syndrome (CRPS) is a serious complication with potential long-term disability. It may be associated with nerve injury at the time of fracture or can occur simply as a response to the injury itself.

Infection is possible with an open fracture or following surgery.

WHAT IS THE EXPECTED OUTCOME?

These fractures can be slow healing and may require prolonged immobilization in cast with resultant stiffness. Overall, however, over 90% of scaphoid fractures heal satisfactorily. Lunate fractures associated with dislocations can proceed to stiffness and chronic instability. The other carpals generally have a satisfactory outcome.

The time for recovery varies, depending upon the type of injury, particularly the time required for support and adequate healing of all tissues. Appropriate treatment with avoidance of residual deformity is important prognostically.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

Typically the wrist could be immobilized for 6-8 weeks but fractures such as the scaphoid can take 2-3 months to fully heal. The major restrictions are those imposed by one arm activity and the limitations of having to use a wrist splint or cast (occasionally for a prolonged period) followed by a fairly intensive physiotherapy program to work out stiffness. Until the fracture has healed the wrist has to be protected from excessive forces.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

Prior to cast or splint removal, arm elevation, general fitness, and efforts to prevent shoulder and elbow stiffness are emphasized. Physical and/or occupational therapy will usually be required as wrist stiffness and weakness are common.

WHO ARE THE APPROPRIATE SPECIALISTS FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

Initial management: An orthopedic surgeon, hand surgeon, plastic surgeon.
Rehabilitation: As above or a sports medicine specialist, or a physiatrist.
WHAT FACTORS COULD AFFECT DISABILITY DURATION?

The potential complications mentioned above will be the major factors influencing disability duration and of course the limitations imposed by the patient’s work. Disability duration is a function of the bone involved, work demands and hand dominance. Medium to very heavy work requires that the bone be radiographically healed and the limb rehabilitated.

WHAT IS THE EXPECTED DISABILITY DURATION?

**Scaphoid:**

<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum/Maximum</td>
</tr>
<tr>
<td>Sedentary Work</td>
<td>0 - 4 weeks</td>
</tr>
<tr>
<td>Light Work</td>
<td>2 - 8 weeks</td>
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<tr>
<td>Medium Work</td>
<td>4 - 10 weeks</td>
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<tr>
<td>Heavy Work</td>
<td>12 - 16 weeks</td>
</tr>
<tr>
<td>Very Heavy Work</td>
<td>12 - 16 weeks</td>
</tr>
</tbody>
</table>

**Carpal Bones (excluding scaphoid):**

<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum/Maximum</td>
</tr>
<tr>
<td>Sedentary Work</td>
<td>0 - 4 weeks</td>
</tr>
<tr>
<td>Light Work</td>
<td>1 - 8 weeks</td>
</tr>
<tr>
<td>Medium Work</td>
<td>1 - 8 weeks</td>
</tr>
<tr>
<td>Heavy Work</td>
<td>8 - 12 weeks</td>
</tr>
<tr>
<td>Very Heavy Work</td>
<td>8 - 12 weeks</td>
</tr>
</tbody>
</table>

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*Go to Fractures: General Overview*
10. METACARPAL FRACTURES

**ALSO KNOWN AS:** Broken hand, Bennett’s fracture, Rolando’s fracture

**WHAT IS A METACARPAL FRACTURE?**

The metacarpals are the long slender bones of the hand between the wrist (carpal bones) and fingers (phalanges). A fracture of the metacarpals can be the result of crush injuries, blunt trauma, twisting, or rotational forces, and can be associated with joint dislocations. Falling on the outstretched hand is the usual course.

Based upon the mechanism of injury and commonality, various types of fractures have acquired distinct names such as the Bennett and Rolando fractures of the thumb. Fractures of the distal 5th metacarpal are often called “street fighter” or “boxer’s” fractures and occur as a result of fistfights or falls on a closed fist.

**WHAT IS ITS PERSONALITY?**

Simple minimally displaced fractures are fairly benign, but if there is rotational malalignment, shortening or associated soft tissue and tendon injuries they have to be treated with a great deal of respect!

**HOW IS IT DIAGNOSED?**

**History:** There is usually a history of a direct blow or fall.

**Physical Exam:** Deformity, swelling, and local tenderness are typically present.

**Tests:** Routine x-rays of the hand are usually adequate for diagnosing and managing metacarpal fractures.

**DIFFERENTIAL DIAGNOSIS**

Contusion, strain, bruise and metacarpal/phalyngeal joint dislocation.

**HOW IS IT TREATED?**

Metacarpal fractures must heal in proper alignment and rotation if one is to expect to have a good outcome. This can be achieved by closed reduction or surgery but it is imperative that the anatomy be properly restored.
Provided alignment is satisfactory most fractures can be treated with splints, casts, or braces to maintain position.

Severe fractures with comminuting may require open reduction, screw/plate and or k-wire fixation.

Open reduction and internal fixation has the advantage of being able to achieve immediate stability and allows earlier rehabilitation of the hand. It can also be associated with extensive soft tissue scarring and stiffness. Because of the complexity of hand function, early restoration of movement is important.

**COMPLICATIONS**

Please refer to pages 2-4 for a list of general complications.

Concomitant soft tissue injury, malunion, and stiffness are the commonest complications associated with metacarpal fractures. Fractures involving the shafts and base of the metacarpal are often due to crush injuries and can be compound with significant soft tissue injury and infection. Soft tissue damage can cause massive swelling and scar formation.

Extensor and flexor tendon damage may occur or they may become adherent to damaged bone. The hand muscles may be damaged with resultant contractures.

Rotational malalignment is one of the most important fracture complications, and efforts should be made by the treating physician to prevent this.

Finger stiffness is a common complication and is usually transient, though long term and permanent loss of full range of motion does occur.

 Reflex Sympathetic Dystrophy (RSD) can occur as a result of soft tissue and/or nerve damage.

**WHAT IS THE EXPECTED OUTCOME?**

Uncomplicated fractures heal uneventfully over a period of 4-6 weeks. Complications will delay recovery.

**POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS**

The major work restriction relates to restricted use of the hand on the involved side. Rest and elevation may be necessary for several weeks. The patient may require time off from work for occupational or physical therapy treatments if hand stiffness is a problem (complex fractures).

Occupational therapy worksite visits should be considered if workplace issues are of concern.

**WHAT IS THE TYPICAL REHABILITATION PROGRAM?**

Non-displaced or minimally displaced stable metacarpal fractures require no specific rehabilitation provided there is no finger stiffness or functional impairment. More complex fractures or those associated with complications will invariably require either physiotherapy or occupational therapy rehabilitation to help restore proper hand function.
WHO ARE THE APPROPRIATE SPECIALISTS FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

A plastic surgeon or an orthopedic hand surgeon.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

Hand dominance, work requirements, severity of fracture, and the presence or absence of complications.

WHAT IS THE EXPECTED DISABILITY DURATION?

<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum/Maximum</td>
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<tr>
<td>Sedentary Work</td>
<td>0 - 2 weeks</td>
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<td>Light Work</td>
<td>2 - 4 weeks</td>
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<td>Heavy Work</td>
<td>6 - 12 weeks</td>
</tr>
<tr>
<td>Very Heavy Work</td>
<td>6 - 12 weeks</td>
</tr>
</tbody>
</table>

Phalyngeal fractures will usually require about 4 weeks to adequately heal and before being subjected to strenuous use.
11. FINGER AND THUMB FRACTURES

ALSO KNOWN AS: Broken fingers, fractured phalanges

WHAT IS A FINGER OR THUMB FRACTURE?

The bones of the finger (phalanges) are three in number: proximal, middle and distal. Each finger has three phalanges connected by joints (inter-phalyngeal joints), with the exception of the thumb, which is shorter and has only two phalanges.

Fractures can occur as a result of a direct blow, bending, rotation or a crush injury. Dislocation and or open wounds can accompany fractures of the phalanges. Fractures of the ends of the bones may involve the nail beds that can complicate management.

Finger fractures are classified by their location (proximal, middle or distal phalanx) and the type of fracture (displaced, comminuted, spiral, etc.).

WHAT IS ITS PERSONALITY?

Small but mighty! Displaced phalyngeal fractures can be nasty! The phalanges become progressively smaller in size and diameter as they proceed distally. Their small size and the complex inter-relationship between the tendons that control fine finger function can make these fractures very difficult both to operate upon and to rehabilitate. They have to be treated with a great deal of respect!

In contrast, simple hairline, non-displaced, stable fractures of the phalanges heal uneventfully with buddy taping or splinting for a period of 3-4 weeks.

HOW IS IT DIAGNOSED?

History: A history of hand trauma is invariably present.

Physical Exam: Tenderness, swelling, deformity, and bruising characterize phalyngeal fractures.

Tests: Routine x-rays of the hand or phalanges are usually all that is required for diagnosing and management.
DIFFERENTIAL DIAGNOSIS

Dislocation, extensor tendon avulsion, volar plate ligament injuries, and soft tissue contusion or strain.

HOW IS IT TREATED?

Correction of lateral angulation or rotational deformity of the fingers and thumb are essential; with emphasis on achieving as anatomical reduction as possible given the nature of the injury. Occasionally this necessitates surgical intervention, especially if the fracture is unstable or involves the joint surface. Complex phalyngeal fractures should be dealt with by a specialist in hand surgery.

COMPLICATIONS

Please refer to pages 2-4 for a list of [general complications](#).

Maltreated or under-treated fractures of the phalanges may result in long-term loss of function and post-traumatic osteoarthritis. Complications associated with phalanges include malunion, delayed union, non-union, tendon rupture, infection, adhesions, and stiffness.

WHAT IS THE EXPECTED OUTCOME?

Uncomplicated fractures are usually associated with excellent restoration of function and uneventful healing. Permanent disability can occur if complications are encountered or rotation and alignment are not obtained and maintained during healing of the fracture.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

The work restrictions are dictated by hand dominance, and the restrictions are imposed by unilateral hand function until such time as the fracture has healed and the hand rehabilitated.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

Occupational therapy or physiotherapy may be required for assistance in restoration of hand function.

WHO ARE THE APPROPRIATE SPECIALISTS FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

A plastic surgeon or orthopedic hand surgeon.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

Hand dominance, complications, complexity of injury and work requirements.
**WHAT IS THE EXPECTED DISABILITY DURATION?**

**Phalanges (uncomplicated):**

<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
</tr>
</thead>
<tbody>
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<td>Medium Work</td>
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<td>Heavy Work</td>
<td>4 - 8 weeks</td>
</tr>
<tr>
<td>Very Heavy Work</td>
<td>4 - 8 weeks</td>
</tr>
</tbody>
</table>

**Phalanges (complicated):** By report.

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[Go to Fractures: General Overview]
12. HIP FRACTURES

**ALSO KNOWN AS:** Broken hip

**WHAT IS A HIP FRACTURE?**

The hip is a ball and socket joint that connects the femur (the largest bone in the body) to the pelvis. Fractures of the hip typically occur in three locations: through the neck (subcapital), through the bone between the neck and the shaft of the femur (intertrochanteric), and through the upper shaft (subtrochanteric). Each of these fracture locations has a specific treatment and prognosis.

**WHAT IS ITS PERSONALITY?**

*Subcapital* hip fractures in the elderly are very common and treated successfully either with pinning or partial hip replacement. However, these fractures in the young can be a more sinister process. Young patients have strong bone and therefore an immense amount of energy is required to produce a fracture. This can destroy the blood supply to the ball, with resultant avascular necrosis (the ball dies).

*Intertrochanteric* hip fractures in the elderly usually heal quite readily and typically are not associated with arthritis. However, in the young they can be high energy, very high-energy and slow healing. Typically they are better fractures to treat than subcapital or intertrochanteric in young people.

*Subtrochanteric* fractures are a common hip fracture pattern in the young. This is also a high-energy injury (typically a result of motor vehicle accidents or falls from heights) that can be very difficult to heal (delayed union).

**HOW IS IT DIAGNOSED?**

**History:** Fall on the hip or sudden twisting movement. The patient complains of groin pain and an inability to bear weight.

**Physical Exam:** On examination, the hip is painful to movement. The leg is usually externally shortened and painful to movement. If the fracture is outside the capsule the leg may be shortened.

**Tests:** X-rays are usually sufficient to establish the diagnosis. Occasionally non-displaced subcapital fractures require special investigations such as bone scan or tomograms to diagnose the fracture. Rarely would a CT scan or an MRI be necessary.
DIFFERENTIAL DIAGNOSIS

Bruised hip, fractured pelvis, fractured femur.

HOW IS IT TREATED?

**Subcapital Fracture:** These fractures are treated with internal fixation in the form of a screw side plate or replacement of the broken ball (hemi-arthroplasty).

**Elderly:** A minimally displaced subcapital fracture in the elderly can be successfully treated with a screw fixation with a fairly high probability of healing. If the ball of the hip has been completely displaced from the shaft then the replacement of the ball (hemi-arthroplasty) or total hip replacement is the operative treatment of choice.

**Young:** These are high-energy injuries with a significant risk of avascular necrosis. However, most surgeons feel that in the young it is still preferable to try to carry out an open reduction and internal fixation. Although the risks of avascular necrosis and non-union are high, they feel it is worth taking if it avoids joint replacement in a young patient. It is preferable to do surgery as soon as possible to reduce the risks of avascular necrosis.

**Intertrochanteric Fracture:** These fractures are uncommon in the young but are treated with a screw fixation device. Though the risk of avascular necrosis is higher than in the elderly, most fractures heal uneventfully.

**Subtrochanteric Fracture:** These high-energy fractures are treated with a rigid intramedullary nail with a side screw placed up into the neck of the femur.

COMPLICATIONS

*Please refer to pages 2-4 for a list of [general complications](#).*

**Subcapital Fracture:** The major complication associated with subcapital fractures is that of avascular necrosis and non-union with loss of reduction. This leads to arthritis.

**Intertrochanteric Fracture:** These fractures usually heal without problems but there can be shortening or rotation of the leg during the healing process (malunion).

**Subtrochanteric Fracture:** These fractures through the strongest bone in the body are the result of high-energy forces with considerable soft tissue injury. Delayed healing and non-union may require bone grafting. These fractures can also malunite with shortening and rotation.

A common complication with all lower extremity fractures (especially those involving the large bones) is deep venous thrombosis and the risk of pulmonary embolism. Most patients with hip fractures are treated prophylactically with blood thinners (anticoagulants) to reduce this risk.

**Infection** can be a complication after surgery and prophylactic antibiotics reduce its risk.

WHAT IS THE EXPECTED OUTCOME?

Provided avascular necrosis or the other complications listed above don’t occur, most hip fractures recover without sequelae. In spite of the fact that these fractures occur in the proximity of the joint, osteoarthritis is not common provided avascular necrosis does not occur.
The ultimate outcome of avascular necrosis is usually artificial hip replacement. In a young individual, this is an unfortunate occurrence due to the high probability of loosening and subsequent revision surgeries later in life.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

The major restrictions are those imposed by the patient having to use some type of walking appliance (crutch, cane) and have restricted weight bearing until union has occurred (8-12 weeks). Occasionally if rigid internal fixation is achieved, the patient will be able to start partial or even full weight bearing 2-3 days after surgery. Most commonly, however, patients have to restrict weight bearing to some degree until bony union has occurred.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

Postoperatively, patients are usually discharged from hospital in 5-7 days (when able to ambulate comfortably and safely). They require physiotherapy instructions on ambulation and will usually require a fitness program to maintain general muscle tone. After the fractures have healed, patients may require further physiotherapy for gait training and strengthening.

WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

An orthopedic surgeon.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

Delayed union, non-union, avascular necrosis and wound complications associated with the surgery.

WHAT IS THE EXPECTED DISABILITY DURATION?

Hip, head, neck including subtrochanteric region:

<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum/Maximum</td>
</tr>
<tr>
<td>Sedentary Work</td>
<td>4 - 12 weeks</td>
</tr>
<tr>
<td>Light Work</td>
<td>8 - 16 weeks</td>
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<td>Medium Work</td>
<td>8 - 16 weeks</td>
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<td>Heavy Work</td>
<td>12 - 24 weeks</td>
</tr>
<tr>
<td>Very Heavy Work</td>
<td>By report</td>
</tr>
</tbody>
</table>

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Go to Fractures: General Overview
13. SHAFT OF FEMUR FRACTURES

**ALSO KNOWN AS:** Broken leg, femur, or thigh

![Mid Shaft Fracture Diagram]

**WHAT IS A FEMORAL SHAFT FRACTURE?**

The femur is the largest and strongest bone in the body. Femoral fractures in the young working individual occur either through pathological bone (osteoporosis, tumor, other bone pathology) or as a result of high-energy injuries. Because it requires tremendous energy to fracture a normal femur, these fractures are often highly comminuted (many pieces) and can be compound (associated with the bone protruding through the skin).

**WHAT IS ITS PERSONALITY?**

The fact that a patient has sustained a femoral fracture usually implies a high-energy accident and therefore is often associated with multiple trauma. One should look for other injuries, including other fractures. An isolated non-compound femoral fracture with appropriate treatment and no complications usually heals without sequelae.

**HOW IS IT DIAGNOSED?**

**History:** High-energy accident (motor vehicle accident, fall from heights, etc.).

**Physical Exam:** Pain localized to the thigh, swelling, and deformity. The leg distal to the fracture is frequently externally rotated and shortened.

**Tests:** Routine x-ray for diagnosis and management. Rarely is a CT scan or an MRI necessary.

Because of associated multiple trauma, numerous other investigations may need to be carried out.

**DIFFERENTIAL DIAGNOSIS**

Soft tissue bruise, quadriceps hematoma, fractured hip.
HOW IS IT TREATED?

Most femoral shaft fractures are treated with closed intramedullary nailing or less commonly with open reduction and internal fixation (nail or compression plating).

COMPLICATIONS

Because of the high-energy nature of these injuries, virtually all of the complications listed in the general complications section (pages 2-4) are possible.

The cardio-respiratory complication is that of fat embolism or adult respiratory distress syndrome. This is manifested by an inflammation of the lung that can be very serious and even necessitate the patient be placed on a ventilator. Resuscitative measures can be taken to try to reduce the risks of this complication.

Neurovascular complications are remarkably less common than one would expect considering the magnitude of energy involved with these fractures. When they do occur they are serious.

Infection is a potential complication following any surgical procedure (the risk is less with closed intramedullary nailing) and is a particular concern in the case of compound fractures.

Deep venous thrombosis is a significant risk and can be associated with pulmonary embolism.

Delayed union and non-union, though significant risk factors are lower in patients who have closed intramedullary-nailing procedures. Screw and plate fixation of the femur is associated with an increased incidence of delayed healing, non-union and occasionally avascular necrosis involving segments of femoral shaft.

Osteoarthritis: Provided the fracture does not involve the hip or knee, osteoarthritis is not a common sequelae. For femoral fractures with dashboard injuries, the kneecap or ligaments can be damaged as a result of the blow.

Trochanteric bursitis: Patients treated with intramedullary nailing will often develop an irritation (bursitis) of the tendons at the site of the insertion of the nail (trochanteric bursitis). This aching on the outside of the thigh just below the hip usually disappears when the intramedullary nail is removed 1-2 years later.

WHAT IS THE EXPECTED OUTCOME?

Though high-energy femoral fractures are associated with multiple trauma and potentially life threatening injuries, they usually go on to uneventful recovery provided complications do not occur.

After healing, provided the patient has not been left with significant shortening or rotational deformity, the outcome is usually very gratifying. Arthritis (other than perhaps to the kneecap) is not common.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

The major restrictions are from restricted weight bearing and the need for crutches or a cane during healing. In certain situations where strong internal fixation has been achieved, it is possible for the patient to begin partial or full weight bearing within 4-7 days of the surgery. Most commonly, however, the patients are instructed to restrict weight bearing to
some degree until there is evidence of bony union. Femoral fractures typically take from 12-16 weeks to heal.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

**WHAT IS THE TYPICAL REHABILITATION PROGRAM?**

The patient will require physiotherapy instructions on gait training as well as a general fitness program to prevent deconditioning. Hip stiffness is rarely a problem, though occasionally patients will be aware of aching in the area of insertion of the intramedullary nail (just below and on the outside of the hip). This discomfort resolves when the intramedullary nail is removed, usually 1-2 years following the surgery.

Typically, femoral fractures heal over a period of 12-16 weeks, at which time the patient can resume full activities. Gait training and strengthening is often a necessary part of the rehabilitation.

**WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?**

An orthopedic surgeon.

**WHAT FACTORS COULD AFFECT DISABILITY DURATION?**

Multiple trauma, neurovascular injury, delayed union, non-union, infection, DVT, and stiffness.

**WHAT IS THE EXPECTED DISABILITY DURATION?**

**Femoral (shaft):**

<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy Minimum/Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary Work</td>
<td>4 - 12 weeks</td>
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<tr>
<td>Light Work</td>
<td>12 - 16 weeks</td>
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<tr>
<td>Medium Work</td>
<td>12 - 16 weeks</td>
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<td>Heavy Work</td>
<td>12 - 16 weeks</td>
</tr>
<tr>
<td>Very Heavy Work</td>
<td>20 - 26 weeks</td>
</tr>
</tbody>
</table>

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*Go to Fractures: General Overview*
14. KNEE FRACTURES

ALSO KNOWN AS: Distal femoral fracture, proximal tibial fracture, tibial plateau fracture, transcondylar fracture femur, fractured patella

WHAT IS A KNEE FRACTURE?

The knee joint consists of the distal femur, patella and tibia. Fractures in this area are usually high-energy fractures necessitating a considerable amount of force.

WHAT IS ITS PERSONALITY?

Knee fractures often have associated ligament injuries. The knee depends greatly on its surrounding ligaments for stability and proper function. Therefore the knee can produce surprises even after the fractures have healed!

Intra-articular fractures require anatomical reduction if one hopes to avoid osteoarthritis. This is especially important about the knee, as it is a major weight-bearing joint. Therefore, these fractures have to be treated with a great deal of respect.

HOW IS IT DIAGNOSED?

History: Usually there is a history of high-energy injury (motor vehicle accident, fall from heights, etc.), often with a direct blow to the knee (dashboard injury).

Physical Exam: The major physical findings relate to swelling, bruising, and deformity. Though uncommon, there can be neurovascular injury with resultant physical findings related to disturbance of blood or nerve supply to the distal leg.

Tests: Most fractures about the knee are diagnosed with routine x-rays. Occasionally tomograms or CT scans are necessary to better delineate their complexity and to plan surgical approaches. Rarely is an MRI necessary.

DIFFERENTIAL DIAGNOSIS?

Torn ligaments, dislocated knee, soft tissue injury and knee strain.
HOW IS IT TREATED?

Occasionally hairline or non-displaced fractures can be treated with a simple knee immobilizer, cast or splint for a period of 2-3 weeks, followed by gentle range-of-motion exercises as union starts to occur over the next 2-3 weeks. These fractures are usually healed by 6-8 weeks in total.

Because the knee is a major weight-bearing joint and fractures in this area usually involve the joint surface, it is important that the joint be anatomically reconstructed. This usually necessitates surgical intervention.

Surgical management of displaced distal femoral and tibial plateau fractures usually involves the use of screws and side plates often in combination with bone grafting.

Patella fractures, unless hairline and stable, are treated with open reduction and internal fixation using a combination of wire and pins (“tension band wiring”). Severe comminuted patella fractures may require its removal (patellectomy).

COMPLICATIONS

Please refer to pages 2-4 for a list of general complications.

Fractures about the knee are often associated with severe ligament tears (cruciates and collaterals). As such, following healing of the fracture, the patient can often be left with ligamentous instability problems for which further surgical intervention may be necessary. If possible, ligaments are repaired at the time of the initial surgery (though this is not always possible).

The complication is post-traumatic osteoarthritis. This can occur in response to the initial joint damage or inability for the joint to be reconstructed surgically due to massive joint destruction.

Because of the lack of soft tissue and muscle coverage over the knee, compounding (penetration of the skin by the bone) is not uncommon with fractures in this area. Complications of compound fractures include infection, delayed union, non-union and osteoarthritis.

Deep venous thrombosis is commonly associated with fractures involving the major bones of the lower extremity, especially those requiring prolonged periods of bed rest.

WHAT IS THE EXPECTED OUTCOME?

Low-energy injuries with little joint damage and those for which the surgeon is able to restore structural integrity usually do very well.

Highly comminuted high-energy fractures with considerable ligament injury do not fare well and often require multiple operations. Arthritis, instability or stiffness can be a problem for these patients.

Institution of early knee range-of-motion therapy is important to a good outcome (unless one has to protect a ligament repair).
POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

The principal work restrictions relate to the need for mobilization devices such as crutches, a cane or a wheelchair, depending upon the restrictions dictated by the personality of the fracture.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

Non-displaced or hairline fractures: Typically the patient is placed in a knee immobilizer for several weeks with restricted weight bearing and started on a gentle range-of-motion program as soon as risks of displacement have passed (usually 2-3 weeks). Usually as soon as bony union has occurred, unrestricted activities are permitted. Physiotherapy may be needed for range-of-motion, strength, and gait training.

Displaced, comminuted fractures: Intra-articular knee fractures have to protect from full weight bearing post operatively for 8-10 weeks until sufficiently healed.

As with most intra-articular fractures, the mainstay of post-operative rehabilitation is early range-of-motion exercises (as soon as this can be safely started) and delayed weight bearing until union has occurred. Typically these fractures will be started on a range-of-motion program within 1-2 weeks of the surgery but weight bearing will have to be delayed for 8-12 weeks.

Comminuted high-energy fractures involving the knee joint usually require extensive physiotherapy to prevent knee stiffness.

Patella fractures can usually be started on weight bearing shortly after surgery (2-3 days). Excessive knee bending and active leg lifts are avoided during patella healing. Patients have to avoid activities that could cause sudden contraction of the quadriceps musculature for fear of pulling the bone fragments apart.

Ligament repairs have to be protected from excessive bending and torsional forces until they have healed. In this situation the rehabilitation program is tailored the surgical findings and interventions.

WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

An orthopedic surgeon.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

Severity of fracture and associated joint/ligament destruction are the major factors that could affect disability duration. Knee stiffness, weakness and instability are common and frequently require a considerable rehabilitation. The risks of osteoarthritis can be significant. Multiple trauma, vascular injuries, post-traumatic osteoarthritis, delayed union and job issues can also be factors.

Untreated ligament injuries may have to be treated after bone healing but before the patient is able to return to work.
### Intra-articular fractures of knee, distal femur and tibia:

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<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
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<tr>
<td></td>
<td>Minimum/Maximum</td>
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<tr>
<td>Sedentary Work</td>
<td>4 - 12 weeks</td>
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<tr>
<td>Very Heavy Work</td>
<td>By report</td>
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### Patella displaced with surgical reduction:

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<td>Minimum/Maximum</td>
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<td>8 - 12 weeks</td>
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<tr>
<td>Very Heavy Work</td>
<td>8 - 12 weeks</td>
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[Go to Fractures: General Overview](#)
15. TIBIA / FIBULA FRACTURES (SHAFT)

**ALSO KNOWN AS:** Broken calf, broken shin bone, tib-fib fracture

![Diagram: Spiral Fracture of Fibula and Comminuted Fracture of Femur]

**WHAT IS A TIBIA/FIBULA FRACTURE?**

The tibia and fibula are the two calf bones that link the knee and ankle. Of these two structures, the tibia is the major weight-bearing structure supporting approximately 80% of the weight. Fractures involving both the tibia and fibula are commonly the result of a combination of compression, torsional and bending forces. Isolated fibular fractures are most commonly the result of a direct blow to the lateral side of the calf.

Because of the absence of soft tissue coverage about the calf and the fact that the tibia is one of the stronger bones in the body (second only to the femur), tremendous energy is necessary to break the tibia. As such, high-energy tib-fib fractures can be associated with tremendous soft tissue destruction and its sequelae.

**WHAT IS ITS PERSONALITY?**

Isolated fibular fractures are fairly straightforward and usually heal without sequelae and no need for intervention. Low energy tibia shaft fractures are also fairly straightforward and heal without sequelae. High energy tib-fib shaft fractures are associated with considerable soft tissue damage and are often compound (protrusion of bone through skin) with a resultant tendency toward infection, delayed union and non-union. **High energy tib-fib fractures can be nasty!**

**HOW IS IT DIAGNOSED?**

**History:** The patient will usually present with a history of significant trauma to the calf area. In the case of a fibular fracture, there may be a direct blow.

**Physical Exam:** There is usually considerable swelling and pain over the fracture and not uncommonly (approximately 10% of the time) there is compounding (breaks in the skin) over the fracture.

One has to very carefully assess the neurovascular status of the foot as well as the status of the muscles about the calf to rule out the possibility of compartment syndrome or neurovascular injury.

**Tests:** Routine x-rays are usually adequate for diagnosis, planning treatment and monitoring these fractures.
DIFFERENTIAL DIAGNOSIS

Gastroc soleus hematoma, pulled plantaris tendon, soft tissue bruise, or contusion.

HOW IS IT TREATED?

Fractured shaft of fibula: These fractures usually heal without any treatment beyond that which is necessary for comfort. Neither weight restriction nor a cast is required, though some patients insist on a cast for comfort (it frankly is often more of a hindrance than an aid!). Elevation and cold packs are required for about 48 hours followed by gradual mobilization with application of gentle heat, etc. Rarely is surgical intervention necessary, unless the fracture involves a joint.

Stable fractured tib-fib: Non-displaced stable tib-fib fractures require cast or brace immobilization for 4-6 weeks until union has occurred.

Unstable comminuted tib-fib fractures require surgical intervention. Most commonly internal fixation is in the form of closed intramedullary nailing, though depending on the fracture configuration and experience of the surgeon, compression plate fixation may be utilized.

Intramedullary nailing is frequently done with locking screws proximally and distally to prevent shortening and rotational deformity during healing. Not uncommonly, these locking screws have to be removed between 6-12 weeks following the surgery to accelerate union (dynamizing).

Usually the fixation devices (nail or plate) are removed after 6-12 months, since they tend to irritate the soft tissues about the knee.

COMPLICATIONS

Please refer to pages 2-4 for a list of general complications.

Compartment syndromes: Compartment syndromes are the most feared complication associated with tib-fib fractures. This occurs in response to trauma to the muscles with resultant swelling inside the tight muscle compartments. This devastating complication can result in muscles destruction. This condition is associated with profound pain and is a surgical emergency. The two areas of the extremities for which there is the greatest fear of compartment syndromes are fractures involving the forearm and those involved in the calf.

Delayed union and non-union are the most common complications associated with tib-fib fractures and may necessitate repeat surgery and bone grafting.

Compounding and soft tissue damage are common complications. Due to the absence of significant soft tissue protection about the calf, fractures in this area can be associated with significant damage for which skin grafting and other procedures may be necessary.

Fat embolism and adult respiratory distress syndrome can occur with high-energy tib-fib fractures. This is due to the release of fat and other substances into the blood at the time of fracture, which can then move to the lungs and other parts of the body. It produces an inflammatory reaction in the lungs similar to pneumonia.

Deep venous thrombosis is not an uncommon complication of tib-fib fractures or isolated fibular fractures. Virtually any injuries about the leg can be associated with deep venous thrombosis.
Arthritis is a low risk, as shaft fractures do not involve the joint.

**WHAT IS THE EXPECTED OUTCOME?**

Fibular shaft fractures usually heal uneventfully without sequelae.

Uncomplicated low energy tib-fib fractures usually heal uneventfully over a period of 8-12 weeks. Those treated in casts tend to heal slightly quicker than fractures that are nailed with intramedullary devices, but the intramedullary devices permit more rapid rehabilitation of the knee and other joints. Baring complications, most tib-fib shaft fractures heal without sequelae.

The complications of high energy fractures listed above can dramatically affect outcome.

In young active individuals, it is usually necessary to remove the fixation devices at some time in the future.

**POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS**

If the fracture is sufficiently stable or has been surgically stabilized sufficiently well to permit weight bearing, then the restrictions are purely those dictated by discomfort and the need for a crutch, cane or other appliance.

Sometimes these fractures require protective weight bearing for a period of up to 12 weeks to allow bone healing (in which case workplace modifications have to allow for this).

Occupational therapy worksite visits should be considered if workplace issues are of concern.

**WHAT IS THE TYPICAL REHABILITATION PROGRAM?**

Patients treated with cast immobilization will require physiotherapy for gait training. Emphasis should be on range-of-motion of the knee and ankle joints. Knee stiffness is not uncommon, especially if the patient has had to be placed in a full leg cast or brace for a substantial period of time.

Following surgery, instructions on gait training and general strengthening may be necessary.

**WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?**

An orthopedic surgeon.

**WHAT FACTORS COULD AFFECT DISABILITY DURATION?**

The complications mentioned above are the major factors that could interfere with disability duration. Delayed union is probably the most common cause of delay.

Multiple trauma, neurovascular injury, stiffness, delayed union or job related issues could all affect disability duration.
**WHAT IS THE EXPECTED DISABILITY DURATION?**

**Tibia (shaft):**

<table>
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<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
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<td></td>
<td>Minimum/Maximum</td>
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<tr>
<td>Sedentary Work</td>
<td>4 - 6 weeks</td>
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<td>Light Work</td>
<td>8 - 12 weeks</td>
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<td>Medium Work</td>
<td>14 - 16 weeks</td>
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<td>Heavy Work</td>
<td>20 - 26 weeks</td>
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<tr>
<td>Very Heavy Work</td>
<td>By report</td>
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**Fibula (shaft):**

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<td></td>
<td>Minimum/Maximum</td>
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<tr>
<td>Sedentary Work</td>
<td>1 - 2 weeks</td>
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<tr>
<td>Light Work</td>
<td>1 - 2 weeks</td>
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<td>Medium Work</td>
<td>6 weeks</td>
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<td>6 weeks</td>
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<td>Very Heavy Work</td>
<td>6 weeks</td>
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*Go to Fractures: General Overview*
16. ANKLE FRACTURES

ALSO KNOWN AS: Broken ankle, medial/lateral/posterior/bimalleolar/trimalleolar fractures

WHAT IS AN ANKLE FRACTURE?

The ankle is a complex hinge joint that usually fractures in response to a twisting injury. The fracture usually involves a combination of three bones: the lateral malleolus (fibula), medial malleolus, or the posterior malleolus (tibial plafond).

WHAT IS ITS PERSONALITY?

Uncomplicated ankle fractures heal with no sequelae, provided there has been no joint damage and the fracture can be anatomically reduced. The most common problem is transient joint stiffness.

HOW IS IT DIAGNOSED?

History: Twisted ankle occasionally associated with a fall. Elderly and osteoporotic individuals fracture easily.

Physical Exam: Swelling, bruising, pain on movement and tenderness are the most common presentation. Deformity is usually not present unless the ankle is subluxated (partially dislocated) or dislocated. Tenderness over the fracture is a consistent finding.

It is important to also examine the ankle ligaments because they can be torn as well and render the ankle unstable even if the x-ray suggests a stable, non-displaced fracture. Neuro-vascular examination of the foot should be included though damage to these structures is not common.

Tests: Routine x-rays (including oblique views to ensure that the ankle is not subluxated) are all that is usually required for diagnosis and treatment. Occasionally stress x-rays will be ordered. Rarely are a CT scan or an MRI necessary.

DIFFERENTIAL DIAGNOSIS

Ankle sprains, Achilles tendon tears, fractures of the talus, fractured tibial plafond or os calcis. Careful physical examination and x-rays will usually rule these out.
Tibial plafond fractures are high-energy injuries that occur through the distal tibia. They are often severe intra-articular fractures that can cause profound joint damage and are often result in stiffness, arthritis and permanent partial disability. A tibial plafond fracture is sometimes called an ankle fracture, but strictly speaking it is not!

**HOW IS IT TREATED?**

The type of treatment depends on which bones are fractured, where they fractured and whether there are associated ligament injuries. Treatment options include cast or splint protection if **stable and non-displaced** or reduction/stabilization of the fracture if **unstable or displaced**, either by closed or surgical means.

A simple rule is that if the fracture involves only one bone, is non-displaced and does not involve a torn ligament, it is stable. Stable fractures only require protection for 5-6 weeks until they heal. If there is not a great deal of soft tissue swelling they can be treated in a few days with a splint/pressure dressing followed by a removable Air Cast brace or pressure dressing. This makes mobilization and hygiene much easier than having a cast. X-rays should be obtained at 1 and 3 weeks to insure that the fracture is stable and a final x-ray at 6 weeks.

All other fractures require surgery either to restore the anatomy or confer stability until healing is advanced. Open reduction and internal fixation (ORIF) is required and surgical repair of ligament tears may also be necessary. One of the advantages of open reduction is that it usually permits earlier ankle mobilization.

Fractures with separation (**diastasis**) of the tibia and fibula usually require a screw placed between the bones. This precludes weight bearing until the diastasis has healed (6-8 weeks) and the screw removed at a second operation.

**COMPLICATIONS**

*Please refer to pages 2-4 for a list of general complications.*

**Stiffness** is the complication to ankle fractures and can take several months to resolve. Early mobilization can prevent this if it doesn't compromise treatment.

**Arthritis** is possible if sufficient damage has occurred to the joint or if the joint has healed in an improper position (malunion).

**Reflex Sympathetic Dystrophy** (usually minor) can occur with ankle fractures, especially if protected in a cast with no weight bearing for long periods. This usually resolves with active rehabilitation.

**WHAT IS THE EXPECTED OUTCOME?**

The vast majority of ankle fractures heal uneventfully, especially if they heal in perfect position. However, variable degrees of stiffness are common for 3-6 months post injury.

If there has been joint damage, post-traumatic arthritis may develop, or with ligament injuries there may be complaints of recurrent ankle sprains (not common).
POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

These may include limited or no weight bearing using crutches, canes, or other appliances for 3-6 weeks, and limited standing, stair climbing or walking. Sedentary work can resume as soon as comfort permits and the patient is able to tolerate sitting with the ankle dependent for the required time periods. Return to heavy-demand jobs depends upon the rate of bone healing and comfort. Return has to be tailored to patient tolerance and work demands. Rest periods with elevation of the ankle may be necessary.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

Physical therapy should be instituted for range-of-motion (ROM) and general soft tissue care as soon as the patient’s immobilization device can be safely removed for therapeutic sessions. Gait training, ankle range of movement and soft tissue management will speed recovery. After bone healing a short period of PT (2-3 sessions) is often helpful for soft tissue and ligament rehabilitation.

WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

An orthopedic surgeon.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

Single malleolus fractures heal more rapidly than bimalleolar or trimalleolar fractures. Those associated with dislocations, considerable soft tissue injury, disruption of the ligaments between the distal tibia and fibula (diastasis) or joint damage are the slowest to recover. Post-traumatic arthritis may not show up on x-ray for months or even years.

If there was diastasis and a screw placed across it, weight bearing has to be delayed until the screw is removed at 4-8 weeks. The need for restricted weight bearing and a second surgery will impede recovery.

Severity, type of fracture, treatment, concomitant ligament injury, prolonged immobilization and job requirements all affect the return-to-work date.

WHAT IS THE EXPECTED DISABILITY DURATION?

Unimalleolar (lateral or medial malleolus, stable):

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<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
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<td></td>
<td>Minimum/Maximum</td>
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<tr>
<td>Sedentary Work</td>
<td>1 - 4 weeks</td>
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<td>1 - 4 weeks</td>
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<td>Medium Work</td>
<td>8 - 10 weeks</td>
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<td>Heavy Work</td>
<td>8 - 10 weeks</td>
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<td>Very Heavy Work</td>
<td>8 - 10 weeks</td>
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Bimalleolar and trimalleolar (requiring surgery):

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<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
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<td>Sedentary Work</td>
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<td>Very Heavy Work</td>
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Trimalleolar with diastasis (often requiring two operations):

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<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
<th>Minimum/Maximum</th>
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<td>Light Work</td>
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<td>Very Heavy Work</td>
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<td>12 - 24 weeks</td>
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[Go to Fractures: General Overview]
17. TALUS FRACTURES

**ALSO KNOWN AS:** Aviator's astragalus

**WHAT IS A TALUS FRACTURE?**

The talus is one of the most important bones of the foot because it supports and distributes the body's force above it. It allows motion between the tibia and the foot and between the heel and the middle part of the foot. Fractures of the talus are the second most common tarsal bone fracture (after os calcis).

**WHAT IS ITS PERSONALITY?**

Potentially nasty! A talus fracture can be a devastating injury principally because it has a very tenuous blood supply (risk of avascular necrosis) and is a major weight-bearing bone! The complication of avascular necrosis can be catastrophic!

**HOW IS IT DIAGNOSED?**

**History:** The usual mechanism of fracture is that of a sudden dorsiflexion force through the mid portion of the foot. The neck of the talus is forced against the front of the ankle joint, which acts as a fulcrum resulting in fracture. The name "Aviator's astragalus" was coined because the rudder bar commonly caused this fracture during airplane crashes. More frequently today this is seen in motorcycle accidents.

**Physical Exam:** The patients complain of intense pain in the foot and ankle, the severity of which depends upon the time between the accident and when examined. Usually there is quite marked swelling and tenderness over the site of fracture, and in high-energy accidents there may be a violation of the skin (compounding). If dislocated there is gross deformity and the overlying skin can be severely stretched or damaged.

**Tests:** Routine x-rays of the foot and ankle usually are sufficient for diagnosing, planning treatment and managing the fracture. Occasionally tomograms or a CT scan are utilized to plan surgery. An MRI should not be necessary.

**DIFFERENTIAL DIAGNOSIS**

Fractured ankle or os calcis (heel), mid-tarsal fracture, severe ankle or foot strain and isolated subtalar dislocation.

**HOW IS IT TREATED?**

Non-displaced fractures can be treated with cast immobilization for 8-10 weeks.
Displaced fractures require either closed reduction or more commonly open reduction with internal fixation. This is most commonly accomplished with screw fixation.

**COMPLICATIONS**

*Please refer to pages 2-4 for a list of general complications.*

Soft tissue injuries are the most feared immediate complication. These are often high-energy injuries with considerable damage to soft tissues. Not uncommonly, they are compound or even associated with dislocation of the talus. As such, soft tissue problems can be a major concern.

Avascular necrosis (loss of blood supply) is one of the most serious long-term complications of talar fractures (especially in association with dislocation). This can require multiple surgical procedures to ultimately achieve healing.

Stiffness and arthritis are common complications.

**WHAT IS THE EXPECTED OUTCOME?**

Non-displaced or minimally displaced talus fractures usually have a favorable prognosis. If the fracture is associated with dislocation, the prognosis is poor, with a 20% incidence of avascular necrosis, and 75% of the patients eventually develop subtalar arthritis.

**POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS**

The work restrictions and modifications are dictated by the possible need for restricted weight bearing or ambulation with cast or crutches.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

**WHAT IS THE TYPICAL REHABILITATION PROGRAM?**

Non-displaced fractures usually heal uneventfully but will require physiotherapy for gait training and for general fitness. Once union has occurred, there is often a tremendous amount of stiffness about the foot for which extensive physiotherapy may be necessary to mobilize the various joints.

Displaced talus fractures can be very slow recovering, with potential for avascular necrosis from disruption of blood supply.

**WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?**

An orthopedic surgeon.

**WHAT FACTORS COULD AFFECT DISABILITY DURATION?**

Delayed union or non-union is the most common factor affecting disability duration. Stiffness, osteoarthritis and foot pain are other factors that could interfere with return to work. Avascular necrosis can be a devastating complication!

Multiple trauma, neurovascular injury, post-traumatic osteoarthritis and job issues could all affect disability duration.
### WHAT IS THE EXPECTED DISABILITY DURATION?

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<tr>
<th>Job Classification</th>
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<td>By report</td>
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<tr>
<td>Very Heavy Work</td>
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*Go to Fractures: General Overview*
18. HEEL FRACTURES

ALSO KNOWN AS: Calcaneus fracture, os calcis fracture

WHAT IS A HEEL FRACTURE?

The heel bone is the largest bone in the foot and fractures typically occur with fall from heights (off roofs or staging) landing on the heel. The bone above the calcaneus (the talus) is driven down into the joint of the calcaneus like a battering ram, shattering it! Because the energy is also transmitted up into the lumbar spine, heel fractures are frequently associated with vertebral compression fractures.

Calcaneus fractures are classified by their location, whether they involve the joint, and the amount of displacement.

WHAT IS ITS PERSONALITY?

Nasty! These fractures occur through a major weight-bearing joint and are usually associated with considerable joint damage. They can swell up very rapidly and be complicated by major soft tissue injury, compartment syndromes, skin blistering or breakdown. Even among specialists there are considerable differences in opinions about management and no universally accepted method of treatment.

This fracture can be the end of a manual laborer’s career!

HOW IS IT DIAGNOSED?

History: Individuals will describe a traumatic event such as a fall or jump onto the heel. It can initially be suspected as being an ankle fracture but differs in that there is usually a history of direct impact rather than the twisting force that produces ankle fractures. There will be marked pain and the patient will not bear weight through the heel.

Individuals should be questioned about back pain, as there can be spinal compression fractures caused by the impact.

Physical Exam: Heel fractures are high-energy injuries and can be associated with rapid and profound swelling. There is the potential for neurovascular complications as a result of swelling in the tight muscle compartments of the foot (compartment syndrome). Because of the risk of neurovascular injuries, these structures must be evaluated carefully. Examination of the spine is necessary to rule out vertebral fractures.

Tests: Because these fractures are so much less common than ankle fractures they are not always thought of and if not greatly displaced can be missed on the initial x-ray. Usually routine x-rays of the foot and ankle make the diagnosis, but special tests such as a CT scan.
or tomograms are often used to assess the extent of damage and to plan treatment. A MRI is not usually needed.

DIFFERENTIAL DIAGNOSIS

Severe ankle sprain or fracture can be confused with heel fractures. The location of the bruising **under the heel** (not around the ankle) in conjunction with the heel tenderness helps to clinically differentiate it from an ankle injury.

HOW IS IT TREATED?

As soon as the diagnosis is established, it is important to quickly apply a soft compressive dressing and elevate the foot to support the soft tissues and prevent further swelling. The foot has to be carefully monitored for neurovascular complications (compartment syndrome).

There is no unanimity of opinion about treatment. They are difficult fractures to treat and are associated with a high incidence of complications, chronic heel pain and stiffness. Treatment with cast alone can produce tremendous stiffness but so can overly aggressive surgery!

Surgery is usually recommended if the fracture is displaced and involves the joint. A cast or pressure dressing usually follows surgery. There is a trend towards early postoperative mobilization but non-weight-bearing status is usually recommended until the fracture heals.

Occasionally the fracture is treated with cast alone followed by aggressive physiotherapy after healing has occurred.

In general for displaced fractures, there is a tendency towards: 1. Early surgical intervention; 2. Early post-operative movement to prevent stiffness; 3. Delayed weight bearing for 6-8 weeks to allow healing.

COMPLICATIONS

*Please refer to pages 2-4 for a list of [general complications](#)*

Because these are usually high-energy injuries involving a major weight-bearing joint, complications are common: soft tissue damage, **compartment syndromes**, osteoarthritis, and joint stiffness. Vertebral compression fractures can also be associated with heel fractures.

WHAT IS THE PREDICTED OUTCOME?

Fractures that do not involve the joint surface and are not displaced (less than 25% incidence) usually heal without long-term complication, but it can take considerable time for stiffness and pain to resolve. However, many go on to long-term aching and pain and ultimately require a surgical subtalar fusion.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

Though this injury can mark the end of a labourer’s career, a remarkably high percentage (over 50%) return to work within 6-12 months. Work restrictions and accommodations would include no weight bearing during healing (6-8 weeks), which may involve the use of crutches, a walker, or a wheelchair. These restrictions will interfere with mobility and the ability to climb stairs, stand for long periods of time, and ambulate long distances. The
ability to maneuver in small or congested areas may also be affected. Frequent rest periods and the ability to elevate the foot may initially be necessary.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

**WHAT IS THE TYPICAL REHABILITATION PROGRAM?**

Physiotherapy should be started as soon as the treating physician feels the fracture is stable. The emphasis is on soft tissue rehabilitation and gentle subtalar ROM but avoiding weight bearing until the fracture has healed. Orthotics may be required after the swelling has resolved.

**WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?**

An orthopedic surgeon.

**WHAT FACTORS COULD AFFECT DISABILITY DURATION?**

Disability is affected by fracture type, joint surface destruction, treatment, complications, and length of weight-bearing restrictions. Stiffness and chronic pain can be a problem.

**WHAT IS THE EXPECTED DISABILITY DURATION?**

**Undisplaced:**

<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum/Maximum</td>
</tr>
<tr>
<td>Sedentary Work</td>
<td>3 - 6 weeks</td>
</tr>
<tr>
<td>Light Work</td>
<td>8 - 12 weeks</td>
</tr>
<tr>
<td>Medium Work</td>
<td>8 - 12 weeks</td>
</tr>
<tr>
<td>Heavy Work</td>
<td>By report</td>
</tr>
<tr>
<td>Very Heavy Work</td>
<td>By report</td>
</tr>
</tbody>
</table>

**Displaced:**

<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum/Maximum</td>
</tr>
<tr>
<td>Sedentary Work</td>
<td>6 - 12 weeks</td>
</tr>
<tr>
<td>Light Work</td>
<td>6 - 12 weeks</td>
</tr>
<tr>
<td>Medium Work</td>
<td>By report</td>
</tr>
<tr>
<td>Heavy Work</td>
<td>By report</td>
</tr>
<tr>
<td>Very Heavy Work</td>
<td>By report</td>
</tr>
</tbody>
</table>

Heavy work is sometimes not compatible with this fracture and disability may be permanent.

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[Go to Fractures: General Overview](#)
19. TARSAL FRACTURES (CUBOID, CUNEIFORM, NAVICULAR)

**ALSO KNOWN AS:** Fractured mid foot, fractured foot

**WHAT IS A TARSAL FRACTURE?**

The bones of the middle foot consist of the cuboid, three cuneiforms, and the navicular. Fractures in this area usually occur in association with dislocation. The mid foot is a fairly rigid structure, and as such when injuries occur the forces are transmitted across all of the bones with resultant multiple fractures. Mid-foot fractures are often associated with fractures of the other foot bones.

Navicular fractures are most commonly the result of forced flexion and rotation of the foot.

Cuboid and cuneiform fractures are often the result of crushing injuries and therefore associated with significant soft tissue damage.

**WHAT IS ITS PERSONALITY?**

These can be nasty fractures. Due to the rigidity of the mid foot area, fractures in this area are often high-energy, multiple, intra-articular and associated with complications. Because of the scant soft tissue protection over the mid foot area, compounding and skin damage are common.

**HOW IS IT DIAGNOSED?**

**History:** The patient will complain of severe pain and swelling with an inability to bear weight.

**Physical Exam:** Local tenderness with swelling and deformity are frequently present.

**Tests:** Routine x-rays of the foot are usually adequate for diagnosis but often a CT scan or tomograms are needed for planning treatment.
DIFFERENTIAL DIAGNOSIS

Fractures of other bones about the foot and ankle; soft tissue injury or sprain.

HOW IS IT TREATED?

Stable and non-displaced fractures require splint or cast immobilization for 6-8 weeks.

Unstable, comminuted, displaced fractures and fracture-dislocations are usually treated surgically. Internal fixation is often required.

Compound fractures are all treated surgically.

COMPLICATIONS

Please refer to pages 2-4 for a list of general complications.

Stiffness and post-traumatic osteoarthritis is the most common complication associated with mid-foot fractures. Compartment syndromes of the foot can occur in response to a high-energy injury. Avascular necrosis can occur if there has been interference with blood supply to the various bones, though this is an uncommon complication.

WHAT IS THE EXPECTED OUTCOME?

The outcome depends upon the severity of the fracture, treatment and the complications. Non- and minimally-displaced fractures usually heal uneventfully but foot pain may persist for a number of months. Residual mid-foot osteoarthritis is not uncommon with these injuries.

POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS

Weight bearing is usually restricted for 4-6 weeks until such time as the union has started to occur. The major restrictions are those dictated by the need for appliances such as crutches, canes, a walker, or a wheelchair, and by rehabilitation to the foot after healing.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

WHAT IS THE TYPICAL REHABILITATION PROGRAM?

The patient will require instructions on gait training, and following the removal of pressure dressings, splints or casts, considerable physiotherapy will be necessary to restore mobility in the mid-foot area. Frequently orthotics are necessary to support the mid foot. These are very slow injuries to recover!

WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

An orthopedic surgeon.
WHAT FACTORS COULD AFFECT THE DISABILITY DURATION?

Because mid-foot fractures are often not isolated injuries, the disability period may depend on the treatment dictated by the other injuries. Other factors would include the type of fracture, complications, response to treatment, ability to modify work, and other work-related issues.

WHAT IS THE EXPECTED DISABILITY DURATION?

Tarsal bones (excluding talus and os calcis):

<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy Minimum/Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary Work</td>
<td>3 - 6 weeks</td>
</tr>
<tr>
<td>Light Work</td>
<td>8 - 10 weeks</td>
</tr>
<tr>
<td>Medium Work</td>
<td>8 - 16 weeks</td>
</tr>
<tr>
<td>Heavy Work</td>
<td>8 - 16 weeks</td>
</tr>
<tr>
<td>Very Heavy Work</td>
<td>8 - 16 weeks</td>
</tr>
</tbody>
</table>

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Go to Fractures: General Overview
20. METATARSAL FRACTURES

**ALSO KNOWN AS:** Fractured foot or forefoot, Jone’s fracture, Lisfranc fracture-dislocation, transmetatarsal fracture-dislocation

**WHAT IS A METATARSAL FRACTURE?**

The forefoot consists of five metatarsals and their associated phalanges (toes).

Metatarsal fractures are usually the result of heavy objects having been dropped on the foot. They are common injuries and often occur as a result of industrial accidents such as a wheel rolling over the foot. They are often associated with toe fractures.

Base of the 5th metatarsal fracture (Jone’s fracture) is an avulsion fracture as a result of a fragment of bone being pulled off by one of the calf muscles (peroneus brevis). This usually occurs if the patient steps into a hole forcibly turning the foot inward (twisting the foot and ankle).

Stress fractures occur most commonly through the 2nd or 3rd metatarsal shaft. Stress fractures are also known as “march fractures” because they frequently occur in military recruits who are not used to prolonged periods of marching. There is usually a history of some change in activity from that to which the individual is accustomed.

**WHAT IS ITS PERSONALITY?**

Simple metatarsal fractures are fairly straightforward and heal uneventfully without long-term sequelae. If associated with severe crush injuries and compounding or multiple fractures, they can be more difficult to deal with. If joints are involved there can be post-traumatic osteoarthritis.

**HOW IS IT DIAGNOSED?**

**History:** The patients will often complain of a heavy object falling across the foot or a severe twisting type of injury. In the case of stress fracture, the individual may relate an unaccustomed change in activity level.

**Physical Exam:** The foot will frequently be swollen and tender over the area of fracture. With severe injuries there may be soft tissue damage. In the case of stress fractures, there may
be little evidence of pathology beyond that of local tenderness or pain on applying force through the mid-foot area.

**Tests**: Traumatic fractures are usually diagnosed with routine x-rays. A bone scan may be necessary to diagnose an occult stress fracture.

**DIFFERENTIAL DIAGNOSIS**

Crush injury or soft tissue strain.

**HOW IS IT TREATED?**

The treatment may range from compression dressing or cast to open reduction and internal fixation, depending upon the severity of the injury.

Simple, minimally-displaced, uncomplicated metatarsal fractures require ice and elevation for 48 hours followed by progressive mobilization as comfort dictates. Rarely is a cast necessary because patients are often more comfortable if they merely wear a comfortable shoe or sneaker. Though casts can be more of a nuisance than the actual fracture, some patients insist on them or else they feel inadequately treated! The vast majority of these fractures go on to uneventful union over a period of 4-8 weeks without sequelae.

Complex injuries may require surgery with open reduction and internal fixation.

For severe injuries of a crushing nature, elevation and observation may be necessary for 48-72 hours to ensure that compartment syndrome does not develop.

**COMPPLICATIONS**

*Please refer to pages 2-4 for a list of [general complications](#).*

The vast majority of metatarsal fractures heal without complication. In the case of severe crush injuries, one has to be concerned about the possibility of compartment syndrome or soft tissue damage. Associated compound fractures or dislocations add to the complexity of management and can increase morbidity. Post-traumatic osteoarthritis and foot stiffness can be a long-term complication of severe complex forefoot injuries.

**WHAT IS THE EXPECTED OUTCOME?**

The vast majority of metatarsal fractures heal uneventfully with no long-term sequelae. Healing usually occurs within 6-8 weeks. Complicated fractures or those associated with complications will take longer and have a less predictable outcome.

**POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS**

In uncomplicated fractures, weight bearing is only restricted by discomfort. Typically the patient will be quite sore on weight bearing for up to 2-3, weeks with symptoms progressively resolving over a period of 4-6 weeks. Restrictions relate to the individuals ability to stand for prolonged periods of time, walk distances, or climb stairs. Crutches or a cane will sometimes be required for several weeks.

Complex fractures or those associated with complications require greater work restrictions.

Occupational therapy worksite visits should be considered if workplace issues are of concern.
WHAT IS THE TYPICAL REHABILITATION PROGRAM?

Uncomplicated fractures will heal uneventfully over a period of 4-6 weeks. Weight-bearing restrictions are dictated by discomfort alone. Physiotherapy may not be needed, since recovery is usually rapid.

More complex fractures or fracture dislocations will require more intensive physiotherapy especially for treatment of foot stiffness and gait training. More complex fractures may require orthotics management.

WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?

An orthopedic surgeon.

WHAT FACTORS COULD AFFECT DISABILITY DURATION?

The major factor affecting disability duration will be the complexity of the fracture and complications.

WHAT IS THE EXPECTED DISABILITY DURATION?

<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Return-to-Work Expectancy Minimum/Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary Work</td>
<td>0 - 1 week</td>
</tr>
<tr>
<td>Light Work</td>
<td>0 - 3 weeks</td>
</tr>
<tr>
<td>Medium Work</td>
<td>8 - 12 weeks</td>
</tr>
<tr>
<td>Heavy Work</td>
<td>8 - 12 weeks</td>
</tr>
<tr>
<td>Very Heavy Work</td>
<td>8 - 12 weeks</td>
</tr>
</tbody>
</table>
21. TOE FRACTURES

**ALSO KNOWN AS:** Fracture of toes, fractured digits

**WHAT IS A TOE FRACTURE?**

Fractures of the toes are most commonly the result of direct trauma (i.e., dropping a heavy object on the toe or stubbing the toe). Steel-toed boots have greatly reduced the incidence of toe fractures.

**WHAT IS ITS PERSONALITY?**

Usually toe fractures are fairly benign injuries. Most are very simple to treat and heal without sequelae. Fractures involving the great toe have to be treated with greater respect and occasionally require surgery.

**HOW IS IT DIAGNOSED?**

**History:** The patient will often complain of direct trauma such as a heavy object falling on the toe or having stubbed the toe.

**Physical Exam:** There is swelling and bruising about the fractured digit and occasionally deformity.

**Tests:** Routine x-rays of the foot or toes will usually reveal the associated fracture.

**DIFFERENTIAL DIAGNOSIS**

Contusions, bruises, and dislocations.

**HOW IS IT TREATED?**

**Great Toe:** A non-displaced or hairline fracture requires no treatment beyond reassurance and wearing a comfortable shoe or sneaker. Splinting is occasionally needed. If there were joint involvement or significant deformity one would consider surgical intervention.

**Lesser Toes:** Non-displaced fractures involving the 2\textsuperscript{nd} to 5\textsuperscript{th} toes require no specific treatment beyond that for comfort and perhaps taping to the adjacent toe (buddy taping).
for 3-4 weeks to prevent it from getting caught in clothing or sheets and being displaced. Displaced fractures may require closed reduction to correct deformity followed by buddy taping. Even fractures that enter the joints rarely need surgical intervention.

**COMPLICATIONS**

*Please refer to pages 2-4 for a list of [general complications](#).*

The major complications relate to soft tissue injuries. Compound fractures have to be treated with respect and usually require surgical debridement. Provided there are no injuries to adjacent areas of the foot or lower extremity, serious complications are uncommon. Toe fractures in diabetics have to be observed carefully because of the risk of infection, difficulties with wound healing and potential skin breakdown due to diabetic small vessel disease.

**WHAT IS THE EXPECTED OUTCOME?**

The vast majority of phalangeal fractures heal uneventfully without long-term sequelae.

**POSSIBLE WORK RESTRICTIONS AND MODIFICATIONS**

These are principally dictated by discomfort. Rarely do toe fractures require immobilization beyond that of buddy taping. Patients are often more comfortable if they wear an oversized shoe or a comfortable sneaker for a week or two. Sneakers can pose a risk of injury if the patient is an industrial worker. Rarely are appliances needed beyond that of perhaps a cane for 7-10 days.

Occupational therapy worksite visits should be considered if workplace issues are of concern.

**WHAT IS THE TYPICAL REHABILITATION PROGRAM?**

Typically toe fractures heal uneventfully over a period of 3-4 weeks. Compounding or intra-articular great toe fractures that require surgical intervention may take several weeks longer.

Rarely is physiotherapy necessary beyond that perhaps for instructions on gait training and general fitness.

**WHO IS THE APPROPRIATE SPECIALIST FOR TREATMENT, REFERRAL OR INDEPENDENT EXAMINATION?**

An orthopedic surgeon.

**WHAT FACTORS COULD AFFECT DISABILITY DURATION?**

The major factor would relate to the inconvenience of having to wear a sneaker or other accommodating shoe until such time as the fracture has united. Complications from soft tissue injury or infection can affect disability duration.

**WHAT IS THE EXPECTED DISABILITY DURATION?**

Toes – Lesser:
### Job Classification | Return-to-Work Expectancy | Minimum/Maximum
---|---|---
Sedentary Work | 0 weeks |  
Light Work | 0 - 1 week |  
Medium Work | 2 - 3 weeks |  
Heavy Work | 2 - 3 weeks |  
Very Heavy Work | 2 - 3 weeks |  

**Toes – Great:**

### Job Classification | Return-to-Work Expectancy | Minimum/Maximum
---|---|---
Sedentary Work | 0 weeks |  
Light Work | 1 - 2 weeks |  
Medium Work | 2 - 3 weeks |  
Heavy Work | 3 - 5 weeks |  
Very Heavy Work | 3 - 5 weeks |  

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