Skeletal Injuries

Chapter contents

A) Sprains and strains

B) Injuries to bones and joints

C) A quick assessment for fractures and dislocations

D) Emergency management of fractures and dislocations

E) Management of fractures and dislocations when professional help is not available

F) General principles of management

G) Manipulations

H) Head and face
Chapter 9 - Skeletal Injuries

I) Neck and spine

J) Thorax

K) Pelvis

L) Hands, fingers and toes

M) Feet, wrists, ankles

N) Forearm fractures

O) Leg fractures

P) Arm and elbow fractures

Q) Fractures of the femur (thighbone)

R) Shoulder dislocations

S) Hip dislocations

T) Patella dislocation
A) Sprains and strains

Excessive stress on the skeletal soft tissues, i.e., muscles, tendons, etc., sometimes results in injury to those tissues. The terms sprain and strain are used pretty much interchangeably to describe a stress injury to the soft tissues of the skeletal structures of the body. These injuries occur when the muscle, tendon, or ligament is stretched too far, with too much force, by sudden and unexpected strain, or sometimes, from chronic, repeated excessive stress. Injuries—partial or complete tears—affect not only the muscles and tendons, but cause injury to, and disruption of, the nerves and blood vessels as well. Sometimes there is a complete tear or disruption of a muscle, tendon, or ligament. Occasionally, an injury may avulse (tear off) a small amount of bone at the attachment. Pain, swelling, and discoloration are the result. Most such injuries cause immediate pain, but sometimes one only notices the pain after the excitement of the event leading to it. Swelling and discoloration occur a little later as blood and lymph fluid accumulate in the tissue—all of which result in more inflammation and discomfort. It is not unusual for a day or two to pass before blood from the injury spreads from out into the skin where it is visible as discoloration.

1. Symptoms and findings

Sudden pain, during activity followed by pain at rest and upon movement suggests a sprain or a strain. One can usually distinguish a sprain or strain from a fracture (broken bone) by pressing on the bones around the injured area (when dealing with the long bones of the arms or legs, just pressing on the bone away from the injury will cause pain if a fracture is present). If the tenderness is greater in the space around the bones than on the bone itself, one may be pretty certain it is a sprain and a significant fracture is not present.
2. Treatment

Initial treatment includes rest, immobilization, and icing—begun as soon as possible—attempts to limit the amount of bleeding and swelling. Such cold treatments should be continued every 3–4 hours for the first 24–48 hours, after which warm applications may be started.

After icing for 20–30 minutes, wrap snugly with elastic wrap, and elevate the part.

Rest must continue until swelling resolves.

3. Indications for professional help

Professional help is indicated if there is suspicion of a fracture based on the above findings, an open wound with possible fracture, or if the joint is deformed or unstable.

Professional help is also indicated if the above measures fail to resolve the problem.

B) Injuries to bones and joints

Broken bones and dislocated joints may cause severe pain and life-threatening complications immediately following the injury, and life-long deformities and functional limitations thereafter. These potential problems may be reduced by prompt and appropriate care of the injuries. Injuries to the bones and joints that occur far from medical facilities require temporizing measures designed to stabilize the injured victim and to prevent complications, pending access to professional care. For those injuries occurring to persons where professional help is not available, one must do the best one can with the facilities available. This discussion is intended to provide basic information by which both of these needs may be met in the best possible way.
Any bone in the body can be fractured (broken) if sufficient force is applied. Likewise, any joint can be dislocated when conditions are met. An understanding of basic knowledge of bone and joint function will help one deal with these injuries when the need arises.

Bones come in all shapes and sizes. Some are long and skinny while others are short and flat. Bones are composed of a very hard, durable outer wall (the cortex), and a soft, marrow-filled center. Bones may break straight across, may break lengthwise in a spiral fashion, or be shattered into many pieces. They may remain enclosed by the skin and soft tissues (closed), or tear through these tissues and be exposed to the outside (compound or open). When bones break, bleeding from the marrow-filled center and from injury to the surrounding soft tissues often causes marked swelling and discomfort around small bones and shock from pain and blood loss when large bones—such as those of the thighs and pelvis—are involved.

Broken bones do heal if all of the necessary conditions are met, though it does take time. For healing to occur, the broken parts must be brought close together, and for bones to heal without deformity, they must be held in proper alignment during the healing process. As a rule, broken bones in children are more “forgiving” than bones of adults. Though they may heal a little crooked, they usually straighten by themselves before healing is complete. Furthermore, a child's bones are normally much more flexible than the bones of an adult—a factor that often results in a “greenstick” type of fracture in which the bone bends like a green stick, but does not break apart.

Early immobilization of broken bones is necessary to slow down the bleeding of acute injuries—and for subsequent healing to occur.

Failure to heal may occur when infection is present (a common situation following open fractures), when the bone ends are not properly aligned, or are separated by muscle or other tissues.

Most fractures occur as a result of injury, but not all. People with osteoporosis, those who have tumors involving the bones, and a number of other abnormalities of the bones may cause them to break without trauma. Care of such fractures may require special treatments or procedures for management.
Joints are composed of well-lubricated cartilages covering the ends of the bones. Cartilage is softer than bone, a quality that gives a cushioning effect to the joint. Cartilage does not have blood vessels to feed it and provide it with oxygen; it depends upon the nutrients in the fluid surrounding the joint for its nutrition and oxygen. Exercise is necessary for this nutrient fluid to properly nourish the cartilage of the joint. Tough ligaments and the tendons of muscles controlling the movement of the joint hold the joint together. These strong supporting tissues may be stretched and torn when strained beyond capacity. In order for a dislocation to occur, the ligaments must be severely injured. Often, the boney socket of the joint is broken as well.

Strong bones and healthy joints depend upon a nutritious diet containing generous supplies of calcium, other minerals, and phyto-nutrients (nutrients obtained from plant foods), regular weight-bearing exercise balanced with appropriate periods of rest, ample sunshine for vitamin D, an abundance of water to drink, good supplies of oxygen in the blood, and avoidance of harmful drugs. These same ingredients are beneficial for healing injuries (Section VI, chapter 1 & 2 A).

1. Symptoms of fractures and dislocations

When one sustains a broken bone or a dislocated joint, there is seldom any question about it. Pain, swelling, and deformity usually tell the story. The indications are only slightly more difficult should the patient be unconscious. Swelling, deformity, and instability of the part, all point toward serious injury that may often be presumed to be a fracture or dislocation until proven otherwise by appropriate diagnostic studies.

C) A quick assessment

A quick check for fractures may be done in a conscious patient by pressing on a few strategic points; pressing on the sternum (breast bone) will usually cause pain at the site of broken ribs. Pressing on the pubic bone and/or compressing the pelvis together from the sides provides a quick check of the integrity of the pelvis. With the patient lying flat on the bed, gently jarring the heels with the palm of the hand will often cause pain if there is a fracture of the lower extremities or the back. Carefully placing the extremities through a range of motion will identify injuries involving those extremities. A note of caution is in order regarding the neck. DO NOT ever place the neck through a range of motion if a conscious patient has pain in the neck. It is
often best to assume that an unconscious trauma victim has an injured neck, and to protect it from movement until fracture has been ruled out. Neck movement may cause further damage of an injury involving the spinal cord with the possible consequence of total paralysis from the neck down.

D) Treatment of fractures and dislocations

1. Stabilize fractures pending transport

When initial assessment indicates the strong probability of a fracture or dislocation, the first order of business is to stabilize the site of injury so as to prevent movement of the injured parts as much as possible. Movement increases the amount of injured tissue and increases bleeding. Depending upon circumstances and available supplies, stability may be accomplished by rolled up blankets, clothing, or even sand or grass if that is all that is available. For the long bones, splints may be made from sticks, boards, etc., being careful to pad them well to avoid injuries by pressure, rubbing, etc. Pelvic fractures may be stabilized by wrapping snugly with sheets or buttressed with rolled up clothing. Suspected fractures of the neck may be stabilized with a collar made from materials at hand, or supported from the sides with towel rolls, etc.

In the event that transport must be done by means other than by a fully equipped medical emergency vehicle and trained rescue crew, extra measures must be taken to protect the injured tissues during transport.

2. Assessing priority of treatment

(Section II, chapter 1—Emergency care ABC’s)

Once the site of a fracture has been identified either by careful physical assessment or by X-ray or other imaging studies, judgments must be made regarding the priority they should be given when compared to other injuries the patient may have. As a rule, once fractures have been temporarily stabilized, injuries threatening the life and mental status of the patient take precedence. It is, however, important to remember that the pelvis and thighs may be a source of
sufficient hidden blood loss to place a patient in deep shock—in which case these injuries become priority management concerns. Definitive management of fractures may usually be safely delayed until other more life-threatening injuries have been controlled.

3. Acute care

Resuscitation and pain management must be begun as soon as possible, in the field if possible, or at least as soon as arrival at a care center.

4. Indications for professional help

ALL fractures need the services of professional personnel and facilities for optimum results.

E) Management of fractures and dislocations when professional help is not available

In those places and under those conditions where professional help and modern medical facilities are not available, the following measures may be helpful for saving life and avoiding serious long-term disabilities. Not all injuries can be successfully treated under these circumstances, and outcome of treatable injuries may not be as satisfactory as when done by professional hands in a well-equipped facility.

*Initial resuscitation is a necessity (Section VII, chapter 4).*

*Manage other wounds (Section II, chapter 5).*

*Establish care center, whether in the home or other available facility (Section XI, chapter 1).*
F) General principles of management of fractures and dislocations

Carefully inspect and thoroughly cleanse any suspected open fractures. Open fractures (those that penetrate even a little through the skin) are at very high risk of infection and complications that will often end up in amputation. **They must be treated aggressively with cleansing (Section II, chapter 5) and available antibiotics.** If antibiotics are not available (or as supplementary options), **consider herbal modalities (Section VII, chapter 9, Y, 5, a).**

Where fractures are suspected, but a definite deformity is not present, nor fracture confirmed by X-rays, and when the injured bones are stable (do not move) when gently stressed, splints and supportive bandaging should usually be adequate.

When fractures are evident by obvious deformity or instability (movement of parts is evident) **treatment may usually be successfully managed with either careful immobilization with casting bandages or by traction (Section II, chapter 9, V and Section VIII, chapter 16).**

**Dislocations must be reduced as soon as possible after injury to limit long-term complications (Section II, chapter 9, R, S, T, U—dislocations).**

Some deformities must be manipulated back into place.

Local anesthetic, if available, may be injected into fracture sites about 15 minutes before attempted manipulation and reduction.

**Pain management can usually be readily accomplished by the wise application of natural means (Section VII, chapter 9, Y, 1, a) (Section III, chapter 1, F, and Section V, chapter 14).**
G) Manipulations

When bones are broken they must be straightened and if dislocated, must be replaced in the joint. Traction is almost always necessary to accomplish this since with injury, muscles contract forcefully causing injured bone ends to overlap. Successful reduction of these injuries requires fatiguing the muscles by gentle traction until they relax.

It is frequently necessary when attempting to reduce a broken bone to bend the fracture site even a bit more in order to engage the broken ends before straightening them. While one pulls traction with one hand, the other hand is used to attempt to align the broken ends. A second person is frequently needed to provide counter-traction.

Management of specific fractures and dislocations

(H) Head and face

Fractures of the skull may be evident by deep indentation (depressed fracture) of the bones or by the drainage of blood-tinged fluid from the ears or nose. Unless the depressed bone fragments can be easily elevated, nothing more than careful wound care is indicated. If leaking blood-tinged fluid is seen coming from the nose or ears—an indication of a fracture through the base of the skull—antibiotics are indicated in full dose until all leaking stops. (Do not attempt to “plug” the leak!)

Fractures of the nose may be straightened by gently pressing from the sides or by placing an instrument within the nose and lifting away from the face. Most other facial fractures are best managed by careful wound care without attempts to correct deformities. (These should be referred to specialty care facilities if at all possible, even if it takes a few days to get there.)

Fractures of the lower jaw with deformity may be manipulated into proper occlusion followed by placing wires between the upper and lower teeth to stabilize the lower bone (mandible) with the upper jaw (maxilla). This position must be maintained for about three months, during which feeding will need to be done with liquefied food.
I) Neck and spine

Most fractures of the spine will require bed rest on a firm but well padded surface until pain relief is adequate. When able to be up and about, corsets or other supports may be helpful. Physical therapy and hydrotherapy may also hasten recovery (Section III, chapter 11, F) (Section VII, chapters 6 and 7).

All suspected neck fractures—whether or not there is resulting paralysis of all or part of the body—must be stabilized. This may be done initially with sand bags to prevent movement, but long-term will require traction, if possible, or at least a carefully constructed collar that keeps the neck stable with very limited movement. If commercial collars are not available, one must be made from available materials and carefully padded to prevent ulcerations and injuries

(Note: Most completely paralyzed patients resulting from a fracture of the neck will not likely recover significant function. Good nursing care is recommended.) (Section VII, chapter 5).

J) Thorax

Rib fractures (Section II, chapter 7, C, D & G).

Most collarbone fractures can be adequately managed with a “figure of 8” bandage using elastic or another long bandage to loop around both shoulders and secured snugly in the back, as to hold the shoulders backward. Such bandages should be kept in place for about three weeks.

K) Pelvis

Stable pelvic fractures need only bed rest until bleeding is controlled and pain is managed.
Unstable pelvic fractures may be stabilized in a pelvic sling made of sheeting material, and maintained until fractures are stable. Many of these patients will need aggressive fluid administration and diligent nursing care (Section VII, chapter 4). (Section VII, chapter 5, CC).

L) Wrists, hands, fingers

1. Wrists

For discussion purposes here, the term wrist refers to the bones around the wrist joint, the ends of the ulna, radius, and the carpal bones. Most injuries of the wrist are limited to the ulna and radius, and they are often deformed.

If deformity is present, it may be reduced by using one hand to apply firm traction on the injured hand while using the fingers of the other hand to manipulate the deformed bones into place with an assistant providing counter-traction. Most of these deformities are toward the back of the hand, so they must be straightened by pulling and bending first slightly backward and then forward. Once manipulation is complete, position must be held with the wrist in slight flexion (forward bend) while applying a well-padded cast extending from the fingers to above the flexed elbow.

In the rare event of a forward deformity, the manipulation and casting will need to be reversed from the above description.

2. Hands

Broken hand-bones (metacarpals) are often contaminated by the microorganisms of the mouth of the person they hit. These wounds must be thoroughly cleansed and dressed open without attempts to close the wounds. Once the wounds are healing well without infection, or if no open wound is present, the broken bones may be straightened by pressure over the prominent area and the hand placed in a cast with the first finger joints all bent at about 45 degrees.
Fractures of the carpal bones are quite rare except for the navicular bone. When one has severe and persistent pain and tenderness over the navicular bone at the base of the thumb, treatment consists of a cast extending from the tip of the thumb to above the elbow. This must be continued for a minimum of 16 weeks and longer if pain persists.

3. Fingers

Most finger fractures and dislocations can be easily manipulated into place using gentle traction. A wooden or other splint may be applied to hold it in place for about 3 weeks.

M) Ankles, feet, toes

1. Ankles

Fractures to the ankles must be manipulated into the best possible position using traction and molding of the broken parts. A cast—extending from the toes to the knee—must be used to maintain the position. Weight-bearing must be avoided for a minimum of 6 weeks.

2. Feet

Broken foot-bones (tarsals and metatarsals) are usually best treated with a cast applied to the foot and leg. Weight-bearing should be avoided until healing is complete. Six to twelve weeks is often required for extensive injuries.
Chapter 9 - Skeletal Injuries

3. Toes

Most toe fractures, after straightening them, can be taped to the other toes that function as splints. Place a small piece of cotton or cloth between the toes before taping them together.

N) Forearm fractures

Fractures of the forearm must be straightened and placed in a long arm cast (from fingers to armpit with elbow flexed at 90 degrees) for a minimum of 6 weeks (see L, 1 above).

O) Leg fractures

Fractures of the tibia, the large bone of the lower leg, must be carefully straightened and maintained in place with a cast extending from the toes to the knee with the ankle held as close to a right angle as tolerated. This may be accomplished with the patient lying on his back with both legs hanging over the edge of the table. The weight of the leg will reduce the amount of traction needed for manipulation, and the other, non-injured leg may serve as a comparison for length while reducing the fracture and applying the cast. Once the cast has hardened, the knee may be straightened and the cast extended to the groin area. The patient may be up with crutches as soon as able and may begin weight-bearing as tolerated. The cast must be left in place for at least 16 weeks.

P) Arm and elbow fractures

Most fractures of the humerus (the long bone of the upper arm) may be successfully treated with a plaster splint on the back of the arm (posterior) extending from the shoulder to the hand with the elbow bent at a right angle. The extremity is supported with a sling, so that the forearm lies across the front of the abdomen. This is maintained until the fracture is stable, following which the sling is maintained; but the splint may be removed to allow early movement of the elbow and shoulder. (If the patient is bed ridden for other injuries, mild traction may be used instead of the plaster splint.) (Section VIII, chapter 16).
Supracondylar fractures are fractures that occur immediately above the elbow at the far end of the humerus. These fractures are particularly dangerous to the circulation around the elbow, often causing life-long deformity and disability unless circulation is maintained throughout the treatment period. Treatment consists of applying traction to the forearm with one hand, bending the forearm and elbow slightly backward; then, while applying pressure over the broken bone just above the elbow, bending the elbow all the way forward. It is crucial to check the pulse at the wrist before doing the manipulation, and also again at the completion. If the pulse disappears while bending the elbow, straighten the elbow just enough to restore the pulse. Once this has been accomplished, apply a cast or posterior splint (back side of arm)—all the while being certain the pulse is present. If, in the event a pulse was not present to begin with, or disappears with any amount of bending, or if the fracture cannot be reduced with manipulation, the extremity must be placed in traction (Section VIII, chapter 16).

The patient must lie supine (on his/her back) in bed with the extremity suspended from above in such a manner that the arm is pointing directly toward the front of the patient and the forearm is directed across the chest. A sling may be used to suspend the forearm from an overhead frame with sufficient weights controlling the sling to gently stretch the fracture site. If sterile stainless steel Kirchners are available, one may be placed through the elbow bone (olecranon) to which to attach the traction in place of the sling. This position must be sustained for 3 weeks. Traction may then be removed and a long arm cast placed for another 3 weeks.

Q) Fractures of the thigh (femur)

In the absence of surgical facilities, fractures involving the femur—the long bone of the thigh—must generally be treated with traction. This is best accomplished with the use of a sterile stainless steel Kirshner wire placed through the tibia (leg bone) just below the knee to which the traction is attached. Lacking such hardware, skin traction will be necessary. Since the muscles of the thigh are very strong, it takes significant weight to overcome spasm and to allow the bone ends to line up and to heal (Section VIII, chapter 16). Without X-rays, one is dependent upon observation alone to align the bone ends and to apply the appropriate amount of traction weight.

The patient must be in bed, lying on his/her back. Traction must be directed toward the foot of the bed. One then attempts to align the extremity in a straight line with the patient’s body as determined by visualizing the patient and feeling the injured portion of the thigh. Tension on the traction must be adjusted by measuring the length of the extremity as compared with the non-injured limb. It is better to be slightly shorter during healing rather than longer in comparison to the opposite extremity. This position must be maintained for about 6 weeks until the fracture is stable, after which a long leg cast may be placed from the ankle to the groin, and
careful ambulation can begin.

A possible alternative for a fracture of the mid-portion of the femur is to remove the patient from traction when the swelling has subsided and place a long leg cast for early ambulation. Weight bearing is a stimulant to healing, but it is not without risk. The cast must be maintained for three months or more.

Most fractures to the hip occur in elderly persons or those with osteoporosis. These are ideally treated very soon after injury with surgery. Traction may occasionally be successful in management, but frail and elderly people do not tolerate this treatment well and survival is problematic.

Dislocations of major joints

R) Shoulder dislocation

Most dislocations of the shoulder are anterior (toward the front) and occur when an arm—outstretched to the side—is forced backwards. When present, the shoulder will be deformed with the ball of the shoulder located in front of its normal location in the joint, and the patient will be unable to bring the elbow to his side.

Posterior dislocations usually occur during a grand mal seizure (convulsion or fit). Rather than a bulge in front of the shoulder, there will be an indentation here, and the patient will be unable to lift the arm to the side or turn it outward.

Treatment of these dislocations may be accomplished by laying the patient (face down) on a table with the involved arm hanging over the edge. While in this position, a bucket is attached to the arm—using appropriate dressings—and water is then poured into the bucket, thus slowly increasing the weight until the dislocated bone slips into place. Once reduced, the arm is placed in a sling with the forearm lying across the chest and with the arm wrapped to the side of the chest. This position is maintained for 4-6 weeks before the sling is removed and shoulder motion begun. (The longer time is for the younger, more active individuals.)
Posterior dislocations may be reduced in the same way, but must be held by a cast with the elbow out to the side and the forearm rotated outward. This requires a cast extending around the chest and out to the wrist of the involved arm.

S) Hip dislocations

As with shoulders, hips may be dislocated toward the front (anterior), or toward the back (posterior). These injuries must be reduced as soon as possible.

Anterior dislocations may be suspected when the thigh is held out to the side away from the body, and the knee is turned away toward the outside. Reduction is accomplished while the patient is lying on his/her back. Strong traction is applied, pulling the extremity out and away from the body until muscle spasm has been overcome. Then, while continuing traction, move the thigh inward toward the other leg while bending the hip at the groin and turning the knee inward. (As with all reductions, an assistant is required to provide counter traction while one is doing the manipulation.) The patient is then placed in traction with the extremity straight and the knee rotated slightly inward (Section VIII, chapter 16). This is maintained for 4 weeks, followed by another 4 weeks on crutches before full weight-bearing.

Posterior dislocations are suspected when the thigh is bent (flexed at the groin), held in toward the other leg and the knee turned inward. Reduction is accomplished by laying the patient face down on the table (or bed) with the involved extremity hanging down over the edge. Then, with the knee bent at right angles, traction is applied downward to overcome muscle spasm. Once this has been accomplished, gently bring the thigh outward, away from the body while turning the knee outward. A noticeable “click” will often be noted when the reduction occurs. Traction is applied with the extremity positioned slightly outward, and the knee turned slightly outward for 4–6 weeks followed by the use of crutches without weight bearing for another 6 weeks.

Other dislocations

T) Patella (knee cap)
Dislocations of the kneecap usually reduce spontaneously, but when they do not, may be manipulated back into place when the knee is straight. Following reduction, the extremity is placed in a cast with the knee held in full extension (fully straightened). Quadriceps exercises are then used to strengthen the support around the knee in an effort to prevent a chronic, recurrent problem. (Quadriceps exercises may be done by sitting on a bench high enough from the ground to prevent the foot from touching. Attach weights—sand, water, or other adjustable substances—to the foot. Exercise the leg by repeatedly straightening the extremity 10–20 times. Begin with minimal weight and progressively increase it—do not try to rush. Repeat the routine several times daily. Be faithful with the exercise.)

U) Radial head dislocation

Radial head dislocation occurs commonly to small children when an adult jerks or pulls on the arm forcefully to prevent a fall or for other reasons. When a dislocation is present, the child holds the elbow bent with the hand turned inward and does not use the arm. Reduction is accomplished by grasping the hand like as in a handshake; hold the elbow with the other hand, and gently rotate the child's hand outward until you feel a slight “click” at the elbow. Do not ever force. If this maneuver does not work and a “click” is not felt or heard, gently rotate the hand inward—again feeling for the click. Once reduced, the child will use the arm normally in a few hours. This will provide immediate relief of pain. A sling is sometimes recommended for a few days to prevent recurrence.

V) Casts and splints

Casts and splints are necessary for stabilizing injured and broken bones and soft tissues while healing occurs. (A cast is typically placed all around the extremity, whereas a splint covers only one side and is held in place by wrap-around bandages.) Splints are often used for temporary support of an acute injury while awaiting transport and definitive care; for certain injuries that require maintaining a certain position, but where some movement is tolerated, and when it is necessary to have visible access to the injured part. Splints may be made from the same materials that are used to make casts, or in an emergency, they may be made from sticks, rags, or other hings at hand. PVC piping works well.

Modern casts are made of plaster of paris or fiberglass. Both of these materials are available
commercially packaged, ready to dip in water, and to roll on to make the cast. In the event that commercially prepared materials are not available, plaster of paris may be mixed with water to make a paste and spread on long strips of gauze for wrapping the injured parts.

The following points should be noted when considering applying splints or casts:

Following reduction of the fracture, the position of the bones must be maintained while the cast is applied and until it sets and becomes solid.

Casts are not applied directly to the skin, but must be applied over thick, soft cloth material that will allow the skin to breathe. Allow for some swelling of the tissues, and protect bony prominences from pressure injuries. Commercial products are made for this purpose, but these may be made from available materials if need be.

Following placement of the cast, careful observation of circulation is mandatory since soft tissue swelling under the cast may occlude blood-flow to the extremity. For this purpose, fingernails and toenails are generally left uncovered as to be able to check for blood-flow. To check for blood-flow, gently press on the nail. The nail-bed will blanch from pink to white. Upon releasing the pressure, the nail will quickly return to its pink color. Increasing pain under the cast or swollen, blue fingers indicate the need to release the cast pressure by loosening the wrap around a splint, or splitting a cast.

**Note:** Though not ideal, if commercial casting materials are not available, careful splinting with available materials and lots of soft padding over bony prominences may be used to keep the extremity straight and stable with minimal movement of the broken parts.

1. Applying the splint or cast

Whether using a splint or cast, a nice, soft layer of padding must be wrapped around the extremity first.
Splints are made by using multiple layers of casting material of the appropriate length to immobilize the injured area. The material is dipped into warm water and thoroughly moistened, laid on several layers of soft material, and then applied to the desired area. The splint is then held in place with a roll of gauze or an elastic bandage. The proper position is assured and the position held until the splint has set. Be certain the splint is well padded on both ends. **Note:** Plaster comes in strips of cloth impregnated with plaster of Paris. In order to have a strong cast, the layers must be constantly "worked" (rubbed) while applying so as to spread the plaster uniformly through the gauze.

Casts are managed in a similar fashion except that the casting material takes the place of the splint and elastic wrap, and the plaster-filled gauze wrapped around and around the extremity until it is multiple layers thick. **Note:** Do not wrap too tightly. Leave room under the cast for some swelling. If the cast is being applied to a very swollen extremity, it may be exchanged for a tighter one a few days later when the swelling has subsided.

Increasing pain after application of a cast usually means the cast is too tight and needs splitting!

Casts may be cut and or removed by using a specially-made vibrating "saw," or with a heavy scissors or a knife.

When a "walking cast" is desired, one can build a wooden or rubber block into the foot of the cast using multiple layers of plaster. This must be allowed to harden well before bearing weight.

**W) Traction (See Section VIII, chapter 16)**