Anatomy Quiz
Joint Immobilization for NAU NP Program
January 22nd 2010

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Name: _____

Orthopedic Assessment

Presented by Sherry A. Mace MS, FNPc

An orthopedic assessment should be performed in a consistent manner every time. This will get one accustomed to a routine and help prevent an incomplete exam. A good reference book can help decipher the exam findings later. I recommend the Atlas of Human Anatomy, second edition, by Frank H. Netter, M.D. I also recommend Essentials of Musculoskeletal Care published by the American Academy of Orthopedic Surgeons. This is an excellent orthopedic reference for the nurse practitioner. I used both of these books on a daily basis when I was practicing orthopedics full time.

Basic Exam

On every patient, in every clinic setting, and for every musculoskeletal complaint, the following basic components of the exam should be addressed.

General patient presentation (distress, grimacing, alert, crying, happy, etc)

Gait (antalgic, non-antalgic, wheelchair, cane, rotation of leg, etc)

Skin (intact, bruising, swelling, deforminty, etc)

Range of Motion of surrounding joints (dorsiflexion, volarflexion, rotation, etc. If unsure, measure every way you can move a joint and look up later.)

Strength testing (use 5/5 range, measure every muscle group in area, assess if pain with strength testing and where it is painful)

Neurologic testing (2 point discrimination, reflexes, gross sensation)

Vasacular testing (pulses, edema, hair growth, skin temp and color, etc.)

Fracture Principles

Clinical symptoms of a fracture are swelling, pain aggravated by movement, deformity and decrease function. Nondisplaced fractures may not exhibit obvious deformity. Stress fractures present with insidious onset and mild swelling, tenderness and pain with weight bearing.

A careful physical exam should assess for: localized tenderness (always correlate radiographically), swelling, skin integrity (any skin disruption should be treated as open), stability or pain in adjacent joints, function of nerves and vessels distal to site of injury. Document every one of these items, even if normal.

Radiographs identify acute fracture, usually. Stress fractures may not be visible until 1-4 weeks (due to bone resorption and/or periosteal reaction). Tomograms, CT and MRI are usually not necessary. To confirm diagnosis of a stress fracture, order a bone scan. *See enclosed tables for specific radiographic views.*

Treatment involves **RECOGNITION, REDUCTION, RETENTION AND REHAB.** One must first recognize a fracture. If in doubt, immobilize. Reduction of the fracture may be necessary. This can either be done closed or open. Consult with ortho prior to attempting to reduce unless you are VERY comfortable with this. Retention of the fracture or reduction is achieved with splinting, casting or internal fixation. Rehab is usually necessary because of the muscle atrophy and joint stiffness that results from immobilization.

Always keep this differential in mind:
Dislocation (marked deformity, abnormal joint alignment on X-ray)
Infection (no hx of trauma, fever, elevated ESR)
Sprain (normal radiographs)
Tumor (gradual onset, bone destruction on X-ray)

Fracture Classification

Location in bone	**Description**
Epiphyseal	End of bone, forming part of adjacent joint
Metaphyseal	Flared portion of bone at ends of shaft
Diaphyseal	Shaft of long bone

Orientation	**Description of Fracture**
Transverse	perpendicular to shaft
Oblique	angulated fracture line
Spiral	multiplanar and complex fracture line
Comminuted	more than two fracture fragments
Segmental	completely separate segment of bone bordered by fracture line
Intra-articular	crosses the articular cartilage and enters joint
Torus	buckle fracture of one cortex, often seen in children
Compression	impaction of bone, vertebrae or proximal tibia
Greenstick	incomplete fracture with angular deformity, seen in children
Pathologic	fracture through bone weakened by disease of tumor

Amount of displacement of fracture fragments	Description
Nondisplaced	fragments are in anatomic alignment
Displaced	fragments are no longer in anatomic alignment
Angulated	fragments are malaligned (measure angulation)
Bayoneted	distal fragment longitudinally overlaps the proximal frag
Distracted	distal fragment is separated from the proximal frag (gap)

Skin Integrity	Description
Closed	skin over and near fracture is intact
Open	skin over and near the fracture is lacerated OR abraded

Adverse Outcomes of Fractures

Any fracture can result in delayed or malunion. Limb function can be affected by nearby joint contracture, stiffness, limb shortening or malalignment. Osteomyelitis may develop if fracture is open. Nerve and/or vascular damage may occur with severe fractures. Compartment syndrome can evolve with excess swelling. Complex regional sympathetic dystrophy is rare.

Referral

Never hesitate to call for opinion (know how to describe the fracture well prior to calling). Patients with open, unstable, irreducible, suspected compartment syndrome, nerve, vascular or muscle damage need further eval. Displaced fractures require further evaluation. Pediatric patients with fractures anywhere near a growth plate or around the elbow need further evaluation. Ankle fractures are tricky, request consult.

Unstable fractures include both bone, comminuted, oblique, spiral and intra-articular.

Pearls

Educate your patients well on cast care (neuro-vascular compromise) and always see them if there are concerns. Never be afraid to remove a cast. You can always re-apply it later. If concerned about swelling, don't be afraid to bi-valve a cast (saw the cast in half, re-apply and wrap w/ ace wrap). Don't keep joints immobilized longer than necessary; this will result in increased stiffness. Toddler fractures take 1 week per year of life to heal. Teens take 4-6 weeks. Adults take 6+ weeks. If worried about the retention of the fracture line, bring pt back every week and a few weeks and x-ray. It is necessary to x-ray unstable fractures every week.

Standard Radiographic Views

Hand	PA and lateral
Wrist	PA and lateral
Elbow/ Forearm	AP and lateral
Shoulder	AP of shoulder, GH joint and axillary
C-spine	AP and lateral
T-spine	AP and lateral
L-spine	AP and lateral
Pelvis	AP
Hip	AP and groin lateral or true lateral
Knee	age >40: wt bearing AP in full extension and 30` flexion age <40: standard AP, lat and bilateral axial views
Ankle	AP, lat and mortise
Foot	wt bearing AP and lat, supine oblique

Splinting

Splinting of fractures, dislocations or tendon ruptures often is required as part if initial emergency management. A well-applied splint reduces pain, bleeding and swelling by immobilizing the injured part. Splinting also helps prevent a number of problems: further damage by sharp edges of bone, laceration of skin, constriction of vessels by malaligned bone, and further contamination of open fracture.

Splinting is preferred whenever additional swelling is expected. This usually occurs in the first 2-3 days of all fractures and the majority of sprains. Splint when referral is planned. Splinting is often a definitive method of care (most finger and some toe fractures).

Acute casting may be necessary for the following reasons: fractures that require reduction, fractures involving two adjacent bones, spiral fractures, strong muscle forces (mid-shaft humerus), and fracture dislocations. (consider bi-valving cast)

General Principles

1) Remove clothing and inspect area thoroughly
2) Document pulse, cap refill and neurologic status distal to fracture
3) Cover all wounds w/ dry, sterile dressing. Notify receiving physician of all open wounds.
4) Immobilize joints above and below fracture site.
5) With joint injuries, immobilize bones above and below joint.
6) Pad all rigid splints to prevent local pressure
7) Support limb and injury site until splint has set
8) Align a limb severely deformed with constant gentle manual traction so that it can be incorporated into a splint.
9) If you encounter resistance to limb alignment when you apply traction, splint the limb in the position of the deformity.
10) When in doubt, splint.

Supplies

Prefabricated plastic, fabric or metal splints are used for very short periods of time. If the splint is to be used for more than a few hours, custom application of a well-padded plaster or fiberglass splint is preferred. Plaster is used more frequently because it is cheaper, more readily available, more versatile and more moldable.

Materials	
Thumb/finger	1 or 2 rolls 4" cast padding (adults)
	1 or 2 rolls 3" cast padding (children)
	4"X15" splint, six thick (adults)
	3" roll folded into splint of approp length (children)
	2" or 3" elastic bandage
	Tepid water, gloves

Arm	2 or 3 rolls 4" cast padding (adults) 2 or 3 rolls 3" cast padding (children) 5"X30" splints six thick (adults) 4" roll folded to necessary length (children) 3" or 4" elastic bandage Tepid water, gloves
Wrist and Forearm	2 rolls 4" cast padding (adults) 2 rolls 3" cast padding (children) 5"X30" splints, six thick (adults) for sugar tong 4"X15" six thick (children) for simple dorsal or volar splint 2" or 3" elastic bandage Tepid water, gloves
Short leg splint	2 rolls of 4" or 5" wide cast padding 12 to 14 thick 5"X30" or 5"X45" plaster strips One 3" to 4" wide roll of plaster One roll of 4" wide elastic bandage Tepid water, gloves
Long leg splint	3 or 4 rolls of 6" wide cast padding 3 or 4 rolls of 5" or 6" wide plaster or 5"X45" splints One roll each of 4" and 6" wide elastic bandage Tepid water, gloves

Anatomic Positioning

Ankle and elbow- 90`
Wrist and hand- grasping position
Knee- 30` flexion

Procedure

Apply stockinet to extremity well above and below anticipated splint
Measure plaster for appropriate length and width- plaster goes above and below joints and must cover posteriorly the area of the break
Wet plaster in luke warm water (not too hot, splint will create heat as it sets)
Twist to remove water
Lay plaster out and smooth it out on a towel
Lay cotton padding on top of splatter splint (or it can be applied similar to an ace wrap to the extremity, padding the bony prominences more)
Place plaster splint in place, mold to extremity- avoid excess molding and avoid creating indentation
Now apply the ace wrap, hold splint and extremity in place till set

and can be more easily molded to the extremity; it is usually preferred. Caution: Many-layered "homemade" splints or thick commercial plaster splints can generate enough heat to burn the patient. See Table 1 for the materials needed for splinting. Store these materials in a dry cabinet or closet.

Table 1
Splinting Materials

Thumb/finger	Arm	Short leg splint
1 to 2 rolls 4" cast padding (adults) or 3" cast padding (children)	2 or 3 rolls 4" cast padding (adults) or 3" cast padding (children)	2 rolls of 4" to 5" wide cast padding
4" × 15" splints, six thicknesses (adults) or 3" roll folded into splint of appropriate length (children)	5" × 30" splints six thicknesses (adults) or 4" roll folded to necessary length (children)	12 to 14 thicknesses of 5" × 30" or 5" × 45" plaster strips
		One 3" to 4" wide roll of plaster
2" or 3" elastic bandage	3" or 4" elastic bandage	One roll of 4" wide elastic bandage
Tepid water (≈24°C)	Tepid water (≈24°C)	One bucket of tepid water
Nonsterile gloves	Nonsterile gloves	Nonsterile gloves
Wrist and forearm		**Long leg splint**
2 rolls 4" cast padding (adults) or 3" cast padding (children)		3 to 4 rolls of 6" wide cast padding
5" × 30" splints, six thicknesses (adults) for "sugar tong" or 4" × 15" six thicknesses splints (children) for simple dorsal or volar splint		3 to 4 rolls of 5" or 6" wide plaster or 5" × 45" plaster splints
		One roll each of 4" and 6" wide elastic bandages
2" or 3" elastic bandage		
Tepid water (≈24°C)		One bucket of tepid water
		Nonsterile gloves
Nonsterile gloves		

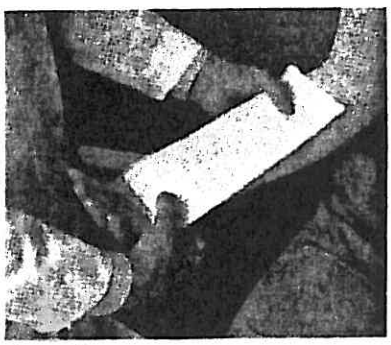


Figure 1
Begin in the palm and extend up the volar surface of the forearm to below the elbow.

Splinting the Upper Extremity

Fractures or Injuries of the Hand or Wrist

1. Position the patient supine or sitting and have an assistant hold the patient's thumb and/or index fingers.
2. Loosely wrap cast padding from the palm to the elbow, making sure that there are three layers of padding at any bony prominence.
3. Place a 4" × 15" preassembled splint in the palm and carry it up the volar aspect of the forearm to just below the elbow (Figure 1). If the injury involves the thumb, wrap it separately with 2" or 3" of cast padding.

Figure 2
Apply the splint along the volar aspect of the thumb, extending across the wrist to the proximal forearm.

4. Place the splint on the volar or radial aspect and fold the plaster around the thumb, extending across the wrist to the proximal forearm. Leave the dorsal or ulnar side open for swelling (Figure 2).
5. Wrap the cast padding loosely over the plaster, then wrap an elastic bandage loosely over the cast padding as you mold the splint.
6. Trim the palmar portion of the splint back to the distal palmar flexion crease, proximal to the metacarpophalangeal (MP) joint.

Fractures or Injuries of the Forearm and Elbow

1. With the patient sitting or supine, have an assistant support the patient's hand with the elbow flexed to 90°. If sitting, the patient should lean slightly to the affected side so that the elbow falls away from the body.
2. Loosely wrap cast padding from the palm to above the elbow, taking care to avoid creating a constriction in the antecubital fossa. Make sure that there are three layers of padding at any bony prominence, such as the wrist and elbow.
3. Begin the splint in the palm, carry it up the forearm to the elbow, around the posterior elbow, then distally on the extensor aspect of the forearm to the dorsum of the hand (sugar tong) (Figure 3). Use multiple 4" × 15" preassembled splints, or a 5" × 30" preassembled splint if that size is appropriate.
4. Wrap cast padding loosely over the plaster, then wrap an elastic bandage loosely over the cast padding as you mold the splint.
5. Trim the palmar portion of the splint back to the distal palmar flexion crease, proximal to the MP joint.

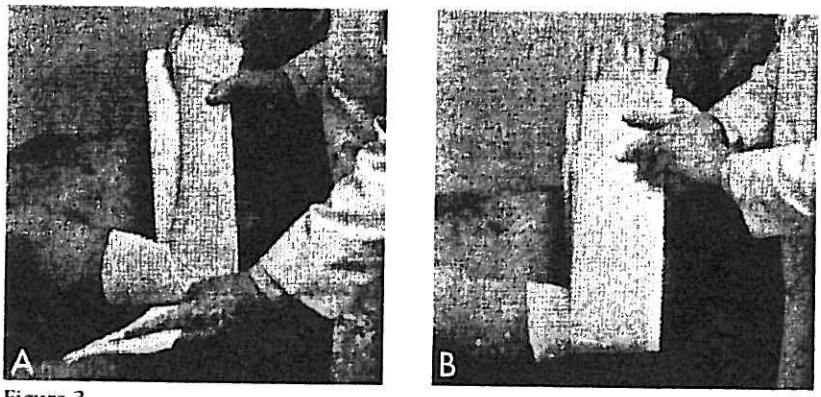


Figure 3
Splinting the elbow and forearm. A, Begin in the palm and extend proximally around the posterior elbow. B, Complete the splint distally on the extensor aspect of the forearm to the dorsum of the hand.

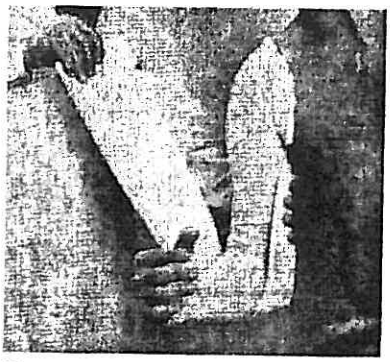


Figure 4
Begin the splint below the axilla, extending it under the elbow, then up the lateral aspect of the arm.

Fractures or Injuries Above the Elbow

1. With the patient sitting, have an assistant support the patient's hand with the elbow flexed to 90°. The patient should lean slightly to the affected side so that the elbow falls away from the body.
2. With an elbow injury, loosely wrap cast padding from the palm to the upper arm. Begin the splint below the axilla, carry it under the elbow, then up the lateral aspect of the arm (Figure 4).

3. For unstable humeral fractures, continue the splint over the top of the shoulder, cover the plaster with a layer of cast padding, and then loosely wrap the entire arm with an elastic bandage (elephant ear splint) (Figure 5).
4. For lower humeral fractures or elbow injuries, end the splint below the lateral shoulder, cover the plaster with a layer of cast padding, and then loosely wrap the entire arm with an elastic bandage (coaptation splint). Provide the patient with a strap sling that loops around the wrist, then around the neck, and back to the wrist (Figure 6). The sling should be long enough to allow the elbow to be maintained at 90°.
5. Ensure that the sling has padding at the neck and wrist; these straps do not slide at night and can be adjusted for different arm lengths.

Figure 5
For lower humeral or elbow fractures, end the splint below the lateral shoulder.

Figure 6
Proper positioning of a sling to maintain the elbow at 90°.

PATIENT INSTRUCTIONS

Patients should be advised to protect the splint for 24 hours, until the plaster cures and hardens (fiberglass splints harden faster than plaster splints). A splinted arm should not be placed on any plastic covered surfaces (including pillows) until the plaster has cooled. Patients also should be reminded to watch for changes in skin color (circulation), sensation, and motion in the hand.

SPLINTING THE LOWER EXTREMITY

LONG LEG SPLINT

1. For unstable fractures of the leg or ankle, a long leg splint with the knee flexed 30° and the ankle 90° should be used.
2. With the patient supine, move his or her buttocks to the edge of the table, allowing the entire leg to hang suspended with an assistant holding the patient's forefoot. Ask the patient to allow the heel to sink so that the foot will be maintained at 90° during splinting.

3. Use either a stirrup-type splint or a long posterior splint. For a stirrup splint, have an assistant hold the patient's forefoot as you wrap the leg with three layers of 6" cast padding. Place extra padding over the kneecap and lateral knee (fibular head).
4. Begin the 5" × 45" plaster splint (10 to 12 thicknesses) on the lateral aspect of the thigh, extend it down the lateral aspect of the leg, under the heel, and then back up the medial side (Figure 7).
5. Start a second splint medially, and extend it beneath the foot and up the lateral side.
6. Apply a layer of cast padding over the plaster, and wrap a 5" or 6" elastic bandage over the padding as you mold the splint.
7. Ensure that the knee is positioned in 25° to 30° of flexion and the foot is positioned at 90° to the tibia (Figure 8).

Avoid folds in the plaster over the area of the peroneal nerve below the lateral knee (fibular head) or around the ankle. Preassembled foam padded splints are convenient, but use them with caution as they may develop folds or ridges in critical areas.

Use tepid or cool—never hot—water when applying the splint. The heat generated by the reaction of the plaster, if coupled with the use of hot water, can seriously burn the skin. For the same reason, place the leg on a cloth (not plastic) pillow and leave it uncovered for about 10 minutes following application to allow better convection of the heat.

Hold the splint in place with a loosely applied elastic bandage or bias-cut stockinet, rolled on with almost no tension. As the splint hardens, maintain the ankle at 90°. Mold or support the splint with the flat of the hand—only while it hardens—to avoid causing dents. Dents not only make the splint uncomfortable, but can cause cast sores or peroneal nerve palsy and foot drop.

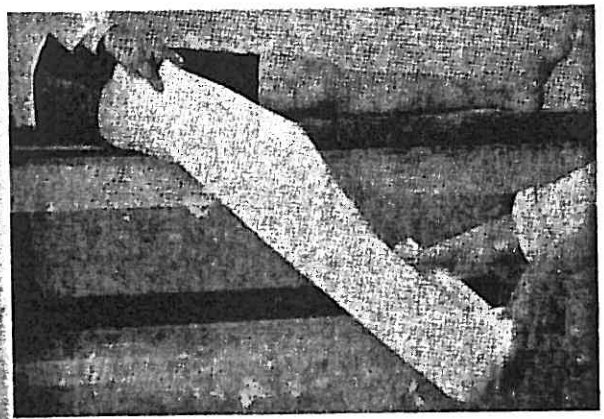


Figure 7
Begin the splint on the lateral aspect of the thigh, extending it down the lateral aspect of the leg, under the heel, and then back up the medial side.

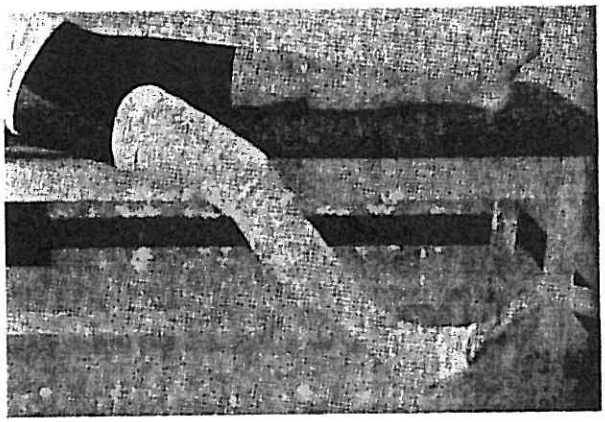


Figure 8
Maintain the knee in 25° to 30° of bend, maintaining the ankle at 90°.

Short Leg Splint

1. With the patient sitting, have an assistant hold the forefoot to maintain the ankle at 90°, wrap the foot, ankle, and leg loosely with three thicknesses of cast padding.

2. Use either 5" × 45" cast padding or fashion a splint with 4" or 5" rolls folded to length.
3. Begin the splint laterally, three fingerbreadths below the knee flexion crease, and extend it down and wrap it under the heel and then up the medial side of the leg (Figure 9).
4. Apply the splint like a stirrup, extending material under the foot, covering the heel and arch.
5. Place a single layer of cast padding over the splint, and loosely wrap a 4" elastic bandage to secure the splint as you mold it to the extremity.
6. Maintain the ankle at 90° as the splint hardens (Figure 10).

An additional splint may be placed posteriorly if needed. Leave the plaster open in front and/or back for swelling, so the patient can unwrap the elastic bandage and spread the splint if needed.

Figure 9
Begin the splint laterally, three fingerbreadths below the knee flexion crease, and extend it down and wrap it under the heel and then up the medial side of the leg.

Figure 10
Maintain the angle of the ankle at 90° as the splint hardens.

Patient Instructions

Patients should be advised to keep their injured leg elevated to the level of their heart as much as possible. Sitting in a reclining chair with a pillow beneath the leg is useful for this. In addition, ice bags should be kept on the injured leg as much as possible for the next 2 to 3 days to reduce pain and minimize swelling.

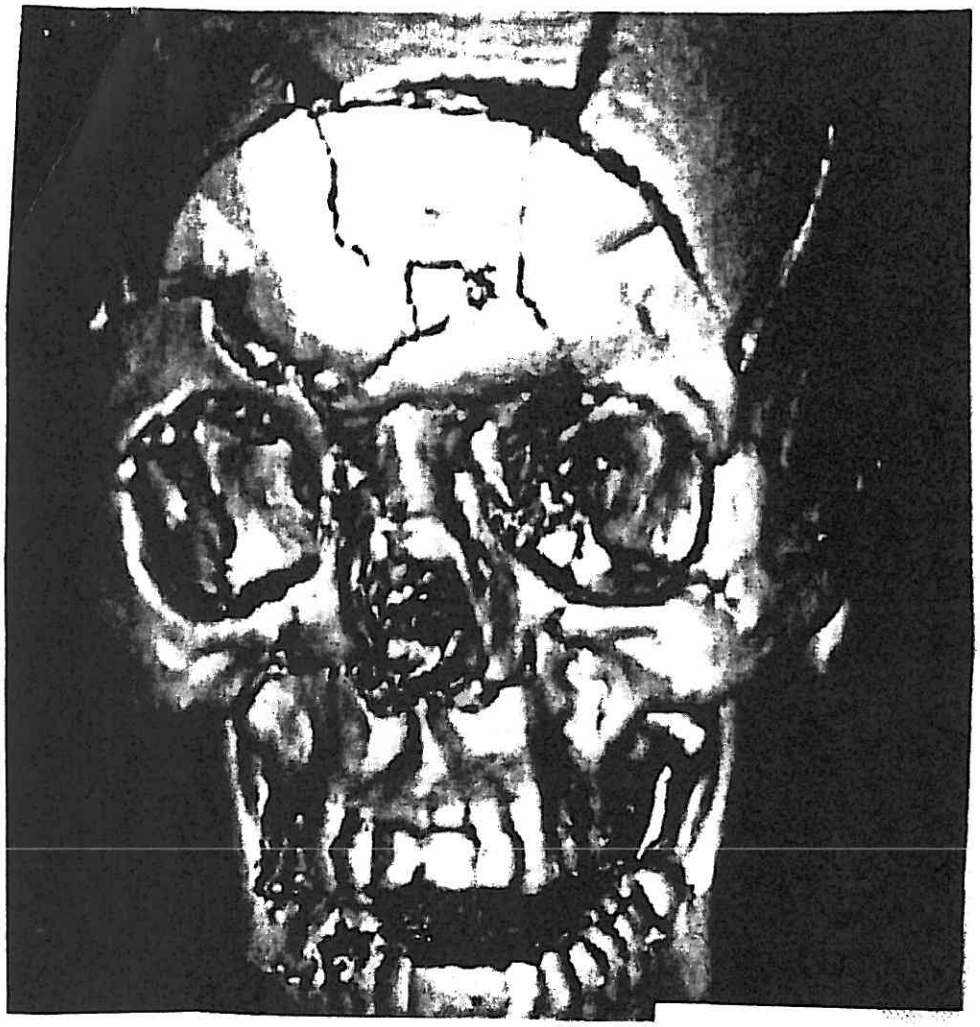
If the pain becomes a lot worse, the foot begins to feel numb or like it is "going to sleep," or the patient cannot move his or her toes up and down, the splint should be loosened by unwrapping the elastic bandage and tearing the padding down the front of the leg. If the leg does not feel better in 20 to 30 minutes, the patient should be advised to call the doctor because problems with circulation to the leg may be developing, which can have serious consequences.

The splint must be kept dry. Patients should be advised to place a plastic bag or commercially available cast cover over their leg, prop their leg on the side of the tub, and fill the tub around them, keeping the splinted leg out of the water. They should not shower.

Patients should be advised to contact the physician if they notice any places where the splint feels as though it is chafing or digging into the skin. Patients also should be reminded to watch for changes in skin color (circulation), sensation, and motion in the foot.

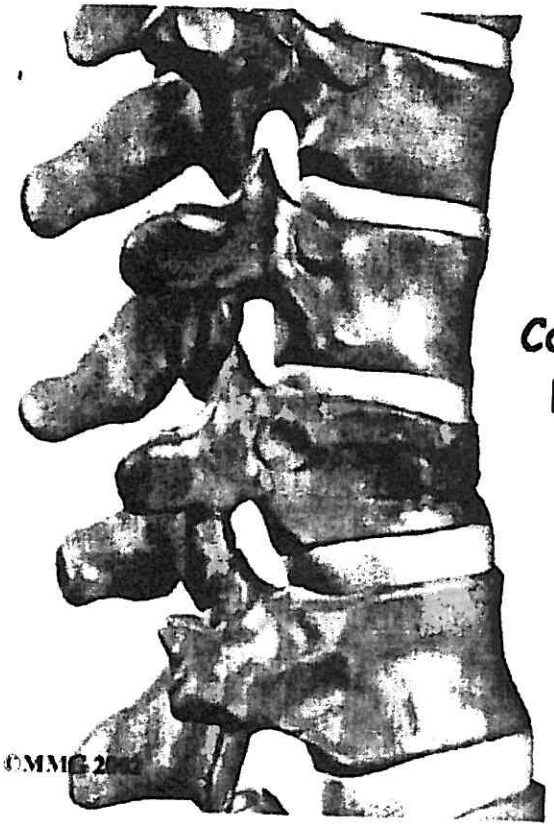
Adverse Outcomes of Treatment

Compartment syndrome, burns, and pressure sores can occur in splints of both the upper and lower extremities. Plantar flexion contractures of the ankle can develop if the ankle is splinted for prolonged periods with the ankle plantar flexed beyond the neutral position.



Fracture Examples

Courtesy of Google.



Compression Fracture

Types of Fractures