Orthopaedic Clerkship Mini Text

Laurence E. Dahners MD

This “Minitext” is intended to provide a basic overview of orthopaedic surgery that can be digested during a clerkship that is only a few weeks long. As such it focuses on common conditions, following the premise that if you know the 3-5 most common conditions in an area of the body you can recognize and often treat 80% of your patients. Urgent conditions and rare conditions with devastating outcomes are also addressed so that you will have the basic knowledge necessary to recognize and address patients in danger. It is important to recognize that this is in no way comprehensive or in depth. Rather it is intended to serve only as a general introduction, including knowledge most nonorthopaedic physicians should have (there are several five volume textbooks that *still* are unable to comprehensively cover all orthopaedic knowledge).

Organization

Fractures and dislocations
Generalized conditions (osteoarthritis, joint replacement, pediatrics, tumors)
Localized conditions by anatomic areas

Fractures and dislocations (Trauma)

General principles

Open vs closed
Most closed fractures (95%) heal quite well. An open fracture (called "compound" in the past) is one in which the skin is open and thus exposes the fracture to contamination. In general this denotes a more severe injury with a greater risk of infection. The increased injury to the soft tissue and periosteum usually means that the fracture will heal more slowly than a closed fracture. Open fractures should have URGENT treatment with IV antibiotics (cephazolin at least, with an aminoglycoside if there is much contamination). This should be followed by operative irrigation and debridement preferably with operative stabilization using internal or external fixation to stop the bone fragments from moving around and producing additional trauma.

Simple vs comminuted
A "simple" fracture is one where the bone is broken into only two pieces whereas a "comminuted" fracture is broken into multiple pieces. As a dinner plate thrown at the floor breaks into many pieces so does comminution indicate that more energy was delivered and a more severe injury has resulted, not only to the bone but to the surrounding soft tissue as well.

Cortical vs cancellous
Cortical or diaphyseal bone heals more slowly than cancellous bone.

Adult vs child
Children's fractures heal much more quickly than adults. This tapers off somewhat as the child ages but drops off rapidly after the physes close and is probably related to the drop off in growth hormone levels as GH is a potent stimulator of fracture healing. In addition, children have the ability to "correct" malalignment of fractures during growth. They do this better near rapidly growing physes, correcting angular deformities (in the plane of the joint motion better than out of that plane) better than rotational deformities.
Children and the elderly have relatively weak metaphyseal bone (due to recent formation and the physis in children and osteoporosis in the elderly). Thus they are more likely to have periarticular fractures while young adults with stronger bones in these areas are relatively more likely to sustain ligament injuries (sprains).

Articular vs nonarticular
A fracture involving the articular surface will produce osteoarthritis. This will be much more severe if it is not perfectly reduced. Therefore articular fractures have a poorer prognosis and more often require operative reduction to obtain the best possible result.

General diagnosis

Pain, tenderness to palpation (especially point tenderness at the fracture site), deformity, swelling and x-ray. If the bone is completely discontinuous the patient will be unable to move the distal part about but it is a myth that a fracture will completely render the patient unable to move.

Description
Fracture angulation should be described by the direction of the apex of the angulation but is often described by the direction of the distal fragment. Thus a Colles fracture has "apex volar angulation" but is often described as "dorsally angulated." Dislocations are described by the direction of displacement of the distal bone; thus shoulder dislocations are usually "anterior" because the humeral head is usually anterior to the glenoid.

Splints and casts
Splints are noncircumferential, held in place with an elastic bandage and used initially to allow swelling without circulatory embarrassment. After a few weeks the splint is removed and a cast is placed. Casts are circumferential and much more durable.

Reduction and fixation
"Reduction" refers to the putting of parts back where they belong as in the reduction of a dislocation or a displaced fracture. The reduced part may then be pinned (if a splint or cast will not suffice), which is called a "closed reduction and internal fixation (CRIF). If an incision was made to reduce the fracture it is treated "open" (ORIF). Sometimes the fracture is reduced and held with an external fixator (CREF or OREF) consisting of pins into the bone proximally and distally to the fracture held with an external frame of rods and joints.

Stress fractures
These are fractures caused by repetitive high stress (a new sport or marching in the military) that fatigues the bone. The patient complains of pain over the site, with tenderness to palpation and increased pain with loading of the bone. Initially the cracks in the bone are microscopic and x-rays are normal (though bone scan and MRI will be positive). Later the x-rays show an attempt to heal the bone. The danger is that if you don't recognize this condition the microscopic fractures can "complete" and the fracture can displace. In the femoral neck this is a disaster (see femoral neck fractures below).

Sprains (ligament tears)
When a joint dislocates or nearly dislocates some of the ligaments are torn and these tears are called sprains. Sprains are classified as type 1-3. Type 1: The ligament is slightly stretched, has some hemorrhage but the joint remains stable and the patient has pain when you stress the ligament. Type 2: The ligament is partially torn, there is a lot of hemorrhage/bruising, marked tenderness, and when you stress the ligament the patient has a great deal of pain but you cannot displace the joint very far. Type 3: The ligament is completely torn, there is a lot of hemorrhage/bruising, marked tenderness, but when you stress the ligament the patient has little pain (because you cannot apply stretch to a completely torn ligament); however, you CAN displace the joint markedly. Typically type 1 is treated symptomatically, type 2 with splinting, and type 3 should be referred for orthopaedic evaluation and treatment.

Common fractures and dislocations

- **Boxer's fracture (5th metacarpal neck)**
  - Features: A fracture of the distal shaft of the 5th metacarpal usually caused by "punching" something. The apex of the angulation is usually dorsal and is surprisingly well tolerated, so that even if it heals with 45 degrees of angulation there is little dysfunction. Such angulation cannot be tolerated in the midshaft, nor in other metacarpals.

  - Treatment: Usually splinted as it lies or with some attempt to partially correct the angulation.

- **Scaphoid fracture DANGEROUS**
  - Features: Usually caused by a fall on outstretched hand and characterized by wrist pain and tenderness in the "snuffbox." The danger is that minimally displaced fractures of the scaphoid waist are often not visible on a standard AP and lateral x-ray (though they are on a "scaphoid view" as shown here) and so the diagnosis can be missed. If missed and called a "wrist sprain" the fracture often goes on to nonunion with eventual wrist arthritis.

  - Treatment: This has led to the recommendation that all wrist injuries with snuffbox tenderness be splinted for two weeks and re x-rayed when fracture site resorption makes the fracture more visible. It is probably better to always get a scaphoid view x-ray instead of plain wrist films. If a fracture is present and nondisplaced, treatment in a cast for 2-4 months if usually successful. If displaced, operative treatment is indicated.

- **Perilunate dislocations and subluxations DANGEROUS**
  - Features: Usually caused by a fall on outstretched hand and characterized by wrist pain and tenderness. The danger is that many physicians have trouble recognizing displacements of the carpal bones. You should learn to recognize the lunate and look for widening of the spacing of the joints (greater than the neighboring joints) around it, especially the scapho-lunate interval as shown here.

  - Treatment: These injuries generally should be pinned in a reduced position.

- **Colles fracture (distal radius)**
  - Features: Usually caused by a fall on outstretched hand and characterized by wrist pain and a "dinner fork" deformity where the distal radius is tilted dorsally (the apex of the fracture angulation is volar). Common in children (as shown here) and the elderly due to their propensity to fall and the weakness of their metaphyseal bone.

  - Treatment: Usually can be reduced under a "hematoma block" (injection of local anesthetic into the perifracture hematoma) and held with a splint. Some fractures will lose reduction and may be treated with surgery if the patient's condition makes the risk benefit ratio acceptable.

- **Radius and ulna fracture**
  - Features: Usually caused by a fall on outstretched hand or higher energy trauma and characterized by midshaft deformity.

- Treatment: Usually open reduction and internal fixation (ORIF) except in young children with excellent remodeling potential because angulation of the bones results in them impinging one another during pronation and supination with a significant loss of function.

- **Olecranon fracture**
  - Features: Usually caused by a fall on outstretched hand with subsequent impact to the elbow while the triceps is firing hard. Characterized by inability to extend the elbow if there is displacement (over 2-4mm).

  - Treatment: Displaced fractures should have ORIF. Undisplaced fractures can be treated in a cast.

- **Elbow dislocation**
  - Features: Usually posterior (as shown here) but often in combination with medial or lateral displacement. Frequently associated with some nerve injury.

  - Treatment: Can usually be reduced with a hematoma block plus or minus sedation. Early mobilization to prevent stiffness is important.

- **Supracondylar humerus fracture DANGEROUS IN CHILDREN**
  - Features: In children these are usually caused by a fall on outstretched hand with the elbow hyperextended (children's joints hyperextend more than adults so that this injury is uncommon in adults). This breaks the bone in the thin flat area of the distal humerus (as seen here) and the fracture opens anteriorly – when it closes (often when the elbow is splinted in flexion) the brachial artery can be pinched in the fracture site and spasm off. This can lead to a disastrous outcome of "Volkmann's ischemic contracture" of the forearm resulting from ischemic necrosis and subsequent scarring of the forearm musculature.
    In adults the elbow is usually flexed and impact with the ground drives the olecranon up between the condyles resulting in a supracondylar intracondylar fracture or "T" fracture rather than simply a supracondylar fracture.

- Treatment: In children these fractures can be treated nonoperatively with reduction and splinting but the splint must hold the elbow in a good deal of flexion and can cause vascular problems. In addition the fractures often heal with a varus or valgus deformity. Therefore most are treated with closed reduction and pinning.
  In adults the fractures usually involve the articular surface and are treated with ORIF to try to prevent post traumatic osteoarthritis.

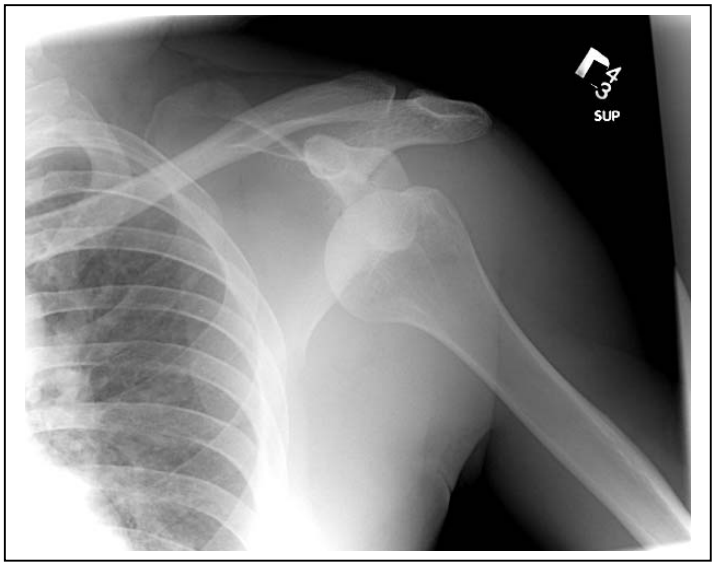
- **Humeral shaft fracture**
  - Features: Pain and deformity of the midhumeral region. Often associated with radial nerve palsy due to the fact that it runs right on the surface of the bone.

  - Treatment: Splinting these fractures is usually successful.

- **Proximal humerus fracture**
  - Features: Commonly involves the "surgical neck" just below the tuberosities in osteoporotic individuals and is minimally displaced. With more energy the tuberosities are fractured off and/or displacement occurs.

  - Treatment: Minimally displaced fractures can usually be treated successfully in a sling. Displaced (more than 1cm or angulated more than 45 degrees) fractures usually should be treated with ORIF. Severely comminuted fractures are often treated with hemiarthroplasty (replacing the humeral head with a prosthetic implant).

- **Shoulder (glenohumeral) dislocation**
  - Features: Usually anterior (as seen here) and caused by violent external rotation of the arm from the "cocked to throw" position. Characterized by a prominence anteriorly, a sulcus posteriorly and inability to internally rotate the arm. Can be associated with fracture of the greater tuberosity and axillary nerve injury. There is a high incidence of recurrent redislocation in young patients. Beware of posterior dislocations which are uncommon but may not be easily seen on a simple AP x-ray (thus you should always have an axillary or "scapular lateral" x-ray as well). They often result from seizures or electric shock.



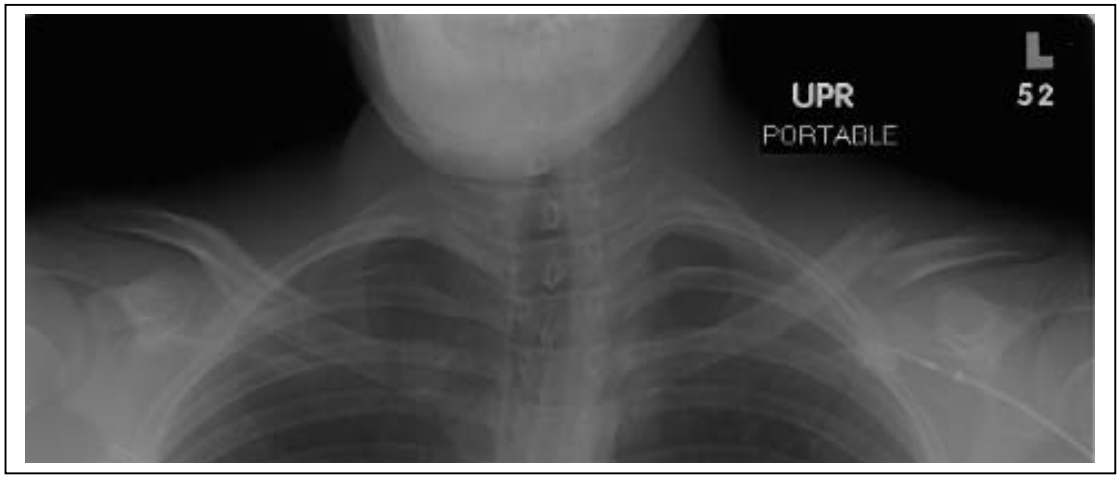
  - Treatment: Numerous techniques have been described for reduction; some do not use anesthesia or sedation but usually a hematoma block and/or sedation are used with

some form of traction. A period of several weeks of immobilization is usually recommended for first time dislocators and recent studies show that if this is done in some external rotation the capsule which has been detached from the anterior glenoid is more likely to heal back in place. Patients with recurrent dislocations usually are treated with a surgical reattachment of the capsule to the anterior glenoid.

- **Acromioclavicular dislocation ("shoulder separation" or "AC separation")**
  - Features: Usually caused by a fall onto the point of the shoulder and characterized by upward displacement of the end of the clavicle on exam and x-ray (as seen here).

  - Treatment: Symptomatic treatment with a sling for a few weeks is generally satisfactory with late operative reconstruction of those patients with persistent symptoms and dissatisfaction.

- **Clavicle fracture**
  - Features: Very common fractures, usually from a fall on outstretched hand, usually in the midshaft (as seen bilaterally in this patient). Most common in children where they heal very well with little or no treatment. Tender to palpation with palpable deformity when they are displaced.



  - Treatment: Usually in a sling for comfort. A figure 8 harness can pull the shoulders back and theoretically decrease shortening. Most heal well but completely displaced fractures (as seen on the left in this patient) have a 20-30% nonunion rate and low patient satisfaction with the deformity so are more often being treated with ORIF.

- **Jefferson's fracture (C1 ring)**
  - Features: Usually from a fall on head or MVC. Axial load "squirts" the lateral masses of C1 laterally from between the occipital articulations and the C2 articulations. Patient has neck pain but the fracture is difficult to see on x-ray. It is best recognized on the open mouth (often called the odontoid view) where the lateral masses of C1 hang out laterally to the lateral masses of C2 (as seen here). Confirmed with a CT.

  - Treatment: Usually immobilization with a hard collar or halo vest is sufficient. ORIF for significant displacement.

- **Odontoid fracturs**
  - Features: Most common is a "type 2" fracture at the base of the odontoid. Usually visible on the open mouth view and on the lateral view.

  - Treatment: When minimally displaced can be treated in a hard collar or halo vest. ORIF for significant displacement.

- **Hangman's fracture (C2 ring)**
  - Features: Usually caused by extension injuries to the neck. Most visible on the lateral x-ray. CT very helpful.

  - Treatment: When minimally displaced can be treated in a hard collar or halo vest. ORIF for significant displacement.

- **Cervical dislocations**
  - Features: Usually caused by axial load (fall on head, diving accident) with flexion. The superior vertebra slides forward on the one below it and the facets "lock." When one facet is locked the vertebral body will appear to be 25% forward on the one below it (as seen here between C4 and C5), when both facets are locked it will appear to be 50% forward.

Almost always associated with spinal cord injury.

- Treatment: Traction on the skull with a halo or tongs to unlock the facets and reduce the dislocation. Because of a high incidence of chronic instability surgical fusion is usually performed subsequently.

- **Burst fractures of the spine**
  - Features: High energy axial load to the vertebral body (fall on head, diving accident in the cervical spine, fall from height or MVC in the thoracolumbar spine) causes "bursting" of the vertebral body similar to what happens to a brick if you hit it with a sledgehammer. The "bursting" outward of bone fragments often causes neurologic injury. X-ray shows collapse of the bone and a CT can show intrusion of bone fragments back into the spinal canal.

  - Treatment: If associated with neurologic injury ORIF is often performed to "decompress" the neural elements.

- **Compression fractures of the spine**
  - Features: Low energy fractures of the thoracic or lumbar spine in osteoporotic bone (that collapses more like Styrofoam that is stepped on than a brick hit with a sledgehammer). X-ray shows "wedging" of the vertebral body but CT shows no intrusion of bone into the spinal canal.

  - Treatment: Generally symptomatic treatment aimed at mobilizing these often elderly patients with an eye to preventing complications of bedrest.

- **Pelvic fractures DANGEROUS**
  - Features: High energy fractures from falls or MVCs – have a high association with injuries to other organ systems (as the pelvis is central it is likely something else got hurt by the same trauma). There can be significant life threatening bleeding. Note than osteoporotic patients frequently have fractures of pubic rami from low energy falls that are not life threatening.

- Treatment: High energy displaced fractures should alert you to the possibility of hemodynamic instability. Large bore IV access and blood crossmatch are important. Bleeding can be diminished by wrapping a sheet tightly about the pelvis to compress it and induce tamponade. Surgical stabilization with an external fixator can be very helpful and if bleeding persists angiographic embolization of bleeders can be undertaken. The patient shown, who has a left SI fracture-dislocation and all four rami broken, was stabilized with an external fixator.

- **Hip dislocation DANGEROUS**
  - Features: Usually posterior and caused by impact of the knee on the dashboard in an MVC. Sciatic nerve injury is common. Characterized by shortening, internal rotation and adduction. While the hip is dislocated the circumflex vessels supplying blood to the femoral head may be occluded, thus reduction of the femoral head back into the acetabulum is considered urgent to prevent the often crippling effects of AVN (avascular necrosis).

  - Treatment: Numerous techniques have been described but usually require heavy sedation and heavy physical effort by the reducing physician. General anesthesia with paralysis is often necessary.

- **Femoral neck fractures (called "hip fractures" though they don't actually involve the articular surface of the hip) DANGEROUS**
  - Features: Usually due to low energy trauma (falls) in osteoporotic patients. Characterized by shortening and external rotation of the limb. When displaced, the blood supply to the femoral head (which runs in the retinacular vessels on the surface of the neck) is often damaged, leading to avascular necrosis (AVN), a disastrous and crippling outcome if the patient is young (note, the young patient with the pelvic fracture above also has a right femoral neck fracture – the prominence of the normally posteromedially located lesser trochanter is due to the characteristic external rotation which throws it into medial relief).

  - Treatment: Minimally displaced fractures are pinned *in situ* to prevent displacement. Displaced fractures are treated with replacement of the femoral head (hemiarthroplasty) or the entire joint (total hip arthroplasty) in elderly patients. Usually young patients (under 50-65) are treated with closed reduction and internal fixation (CRIF) with the thought that they will be healthy enough to tolerate later hip replacement if CRIF fails and are less likely to have an arthroplasty last them the rest of their lives.

- **Intertrochanteric fractures (also called "hip fractures" though they don't actually involve the articular surface of the hip)**
  - Features: Usually due to low energy trauma (falls) in osteoporotic patients. Characterized by shortening and external rotation of the limb. It is easy to see that the leg would appear short in this example due to the angulation.

  - Treatment: CRIF with a "sliding hip screw". This device is strong enough to tolerate immediate weight bearing for early restoration of function.

- **Femoral shaft fractures**
  - Features: Usually due to high energy trauma in young patients. Characterized by shortening and deformity of the thigh. Can result in substantial blood loss and marrow fat embolization.

  - Treatment: Immediate traction with a portable "Hare" traction device restores length (which tamponades bleeding because the short spherical thigh will hold more blood), relieves pain, and partially immobilizes the fracture. "Skeletal" traction with a pin in the proximal tibia or distal femur should be used if traction is needed for more than 6 hours. Intramedullary nailing of the fracture has a very high union rate with low rates of infection and deformity. When performed early it has been shown to lower the systemic inflammatory burden and improve the general health of the multiply injured pa-

tient. However, this is at the cost of some embolization of fat from the reaming process and so should be delayed in patients who are on the threshold of pulmonary failure.

- **Distal femur fractures**
  - Features: Occur in both low energy trauma/osteoporotic patients and high energy trauma/young patients.

  - Treatment: Intramedullary nailing or various plating systems depending on the features of the fracture.

- **Patella fractures**
  - Features: Usually from a fall, striking the patella while firing the quadriceps vigorously which pulls the patella apart from top to bottom. When displaced more than 4mm (as seen here) the tendon surrounding the patella will usually also have given way and the patient will be unable to extend their knee against gravity.

  - Treatment: Brace in extension when minimally displaced. ORIF when displaced.

- **Patellar dislocation**
  - Features: The patella dislocates laterally and this injury is more common in young women whose natural increased valgus alignment of the knee makes it easier to dislocate, sometimes recurrently. The knee often appears grossly deformed leading to the conclusion that then entire knee has dislocated. Spontaneously reduced dislocations will be characterized by patient apprehension if the patella is pushed laterally.

  - Treatment: Simply straightening the knee almost always leads to relocation so they are often spontaneously reduced by the patient. Immobilization in extension with early rehabilitation of the vastus medialis muscle in an attempt to prevent recurrence is usually recommended.

- **Knee dislocation DANGEROUS**
  - Features: Tibiofemoral dislocation requires high energy trauma and has a high incidence of injury to the popliteal artery which is tightly applied to the back of the knee. Very careful examination for vascular injury is needed and some recommend that all patients have an angiogram to look for intimal tears. Multiple ligaments must be disrupted to allow dislocation and chronic knee instability often results.

- Treatment: Reduction of the gross dislocation is often quite easy and should be performed emergently to reduce the stretch to the vessels. Most patients should probably be treated with ligament repair or reconstruction.

- **Tibial plateau fractures**
  - Features: Usually from a fall with axial load. Most commonly axial load with valgus stress causes impaction or "depression" of the lateral tibial plateau.

  - Treatment: Usually with ORIF if there is much displacement of the articular surface as seen in this example.

- **Tibial shaft fractures**
  - Features: Many etiologies but usually high energy trauma. Have a significant association with compartment syndrome, especially the anterior compartment.

  - Treatment: If less than 1cm short and 5 degrees angulated cast or brace treatment is quite adequate. Randomized studies have shown higher patient satisfaction with intramedullary nailing.

- **Ankle fractures**
  - Features: Most are "malleolar" fractures in which the lateral or medial malleolus or both are broken usually by eversion and external rotation forces (inversion usually produces a sprain). In the example the lateral malleolus is broken and the deltoid ligament from the medial malleolus to the talus is disrupted so that the talus has shifted laterally in the "plafond." This injury is often called a "bimalleolar equivalent." The prognosis of malleolar fracture is relatively good compared to other articular fractures. When the weight bearing surface (plafond) of the distal tibia is involved the prognosis is much worse.

  - Treatment: These are articular fractures so an excellent reduction is important. This can be achieved in a cast and usually is with only one malleolus broken, but when both malleoli are involved most surgeons recommend ORIF.

- **Talus fractures DANGEROUS**
  - Features: Usually caused by high energy forced dorsiflexion of the ankle which breaks the talar neck against the anterior tibia. Most of the blood supply to the talus enters through the talar head so that displaced talar neck fractures usually result in AVN of the talar body and a poor outcome.

  - Treatment: Usually with ORIF in the hopes of obtaining anatomic reduction and early healing with subsequent early revascularization of the talar body.

- **Calcaneus fractures**
  - Features: Usually from a high energy fall with substantial axial load to the heel. Have a 10-20% association with lumbar spine fractures and may hurt so bad that the patient is unaware of their spine fracture so you must carefully check the patient and palpate their spine. Most calcaneus fractures involve the posterior facet of the subtalar joint and result in post traumatic osteoarthritis.

  - Treatment: ORIF produces somewhat better results than simple casting but patients usually still have chronic pain and limited motion in their subtalar joints and the risks of wound complications are substantial, especially in smokers and diabetics.

- **Lisfranc's tarsometatarsal (TMT) fracture dislocations DANGEROUS**
  - Features: Usually result from forced plantar flexion of the forefoot. Clinically the patient has midfoot swelling and tenderness. X-ray findings can be very subtle and difficult for the inexperienced to recognize. Small chip fractures about the base of the 2^{nd} metacarpal and/or widening of the space between the medial cuneiform and 2^{nd} metacarpal base may be all that is present. Sometimes displacement is only present on weight bearing views. The outcome of unrecognized and inadequately treated injuries are POOR.

  - Treatment: ORIF

Dangerous or problematic post traumatic conditions

- **Systemic response to multiple fractures (multitrauma)**
  - All fractures produce an inflammatory response and embolize some marrow fat into the bloodstream. In a multitrauma victim this can contribute significantly to the Systemic Inflammatory Response Syndrome (SIRS). Embolized fat produces pulmonary inflammation and edema in the lungs and in the brain causes cerebral inflammation leading to "fat embolism syndrome". This is characterized by hypoxia and confusion with an onset 24-72 hours after injury. It is treated with pulmonary support with oxygen and mechanical ventilation if necessary.

- **Compartment syndrome**

- After blunt trauma, often associated with fractures, the limb becomes swollen. In areas where the fascia is dense and strong swelling can raise the pressure in the compartment to the point that it impedes blood flow, first in the capillaries and eventually in the arteries. The compartments of the leg and forearm are most susceptible. The thigh and arm are uncommon sites but it can occur anywhere including the hands, feet, buttocks, abdomen and head (traumatic brain injury with increase intracranial pressure is a form of compartment syndrome). A history of trauma followed by increasing rather than improving pain and physical findings of pain on active muscle contraction or passive stretch are characteristic. Treatment is with fasciotomy, which is surgical release of the fascia to allow swelling without pressure.

- **Spinal cord injury**
  - This is a devastating, usually irreversible problem. Prevention should be the mainstay of care. Therefore, assume that all trauma victims have an unstable spine and may be susceptible to cord injury. Keep them in a cervical collar on a firm surface, logrolling them *only as necessary* until the spine can be "cleared" by an awake alert patient who confirms no pain or tenderness of the spine. X-ray and CT can prove an injury but cannot prove that the patient does not have a ligamentous instability. An awake, alert patient *with* pain or tenderness but normal x-rays should have lateral x-rays in flexion and extension (the patient flexes and extends their own neck and we trust that they will not go too far under their own power) to look for subluxation of the vertebrae.

- **Post traumatic osteomyelitis**
  - Fracture fragments are often devascularized by the injury and may become infected if the fracture was open or was treated surgically. It is usually impossible to resolve such "post traumatic osteomyelitis" without removing the "sequestered" dead bone. Unfortunately the sequestrum can be difficult to locate or may be an important structural part of the bone which cannot be removed (see also hematogenous osteomyelits in the pediatric section).

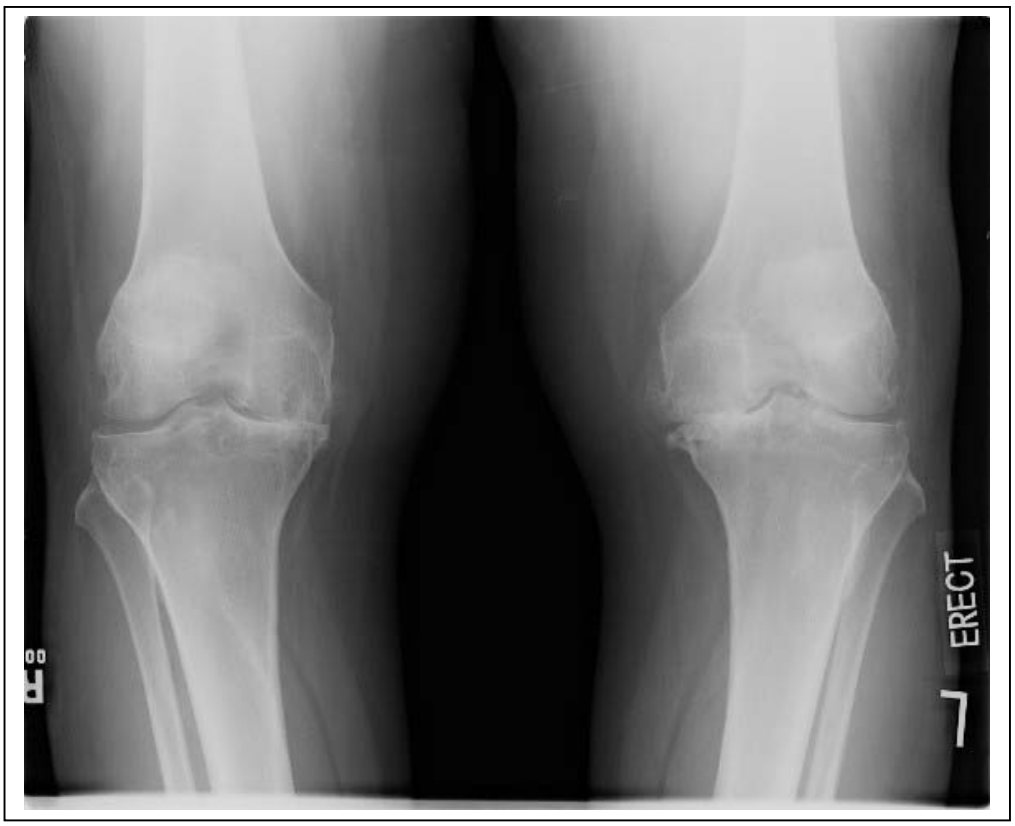
Generalized conditions

Osteoarthritis

- **General recognition**
  - May occur in any joint post trauma but without trauma has a predilection for certain joints
    - DIP and PIP joints hand
    - 1st carpometacarpal (CMC) joint hand
    - AC joint

- Spine
- Hips
- Knees
- 1st metatarsophalangeal (MTP) joint foot
- Other joints are generally spared

- Patients complain of deep aching pain, worse with activity. They often experience "gelling" or the stiffening of their joints after a period of immobility such as sitting in a movie.
- It differs from rheumatoid arthritis which often involves joints symmetrically (i.e. both knees), has swollen synovium, usually involves the MCP joints in the hands, often occurs at younger ages and is more crippling.



- X-ray findings include the classic four which are all seen in this moderately severe example of knee OA.
  - Joint space narrowing
  - Osteophytes
  - Subchondral sclerosis
  - Subchondral cysts

Joint Replacement

General principles
Sometimes only one side of the joint is replaced (hemiarthroplasty –often for a fracture of the femoral neck or humeral head) but more often both sides (total joint arthroplasty). Usually performed for arthritis but also occasionally after excision of a tumor. A useful analogy is to buying a car – joint replacement costs in the same range as a new car and lasts about as long 5-20 years, lasting longer if you are older and only drive it to church on Sunday than if you are young and drive it hard on rough roads.

Components
Usually the concave component is surfaced with high density polyethylene and the convex component is a chrome-cobalt alloy. Great care is taken to have smooth surfaces to prevent wear. Some joints are made with both components of metal to cut down on wear debris.

Attachment to bone
The bone is cut as precisely as possible with jigs for a good fit to the components and then may be "grouted" into place with "bone cement" made of polymethylmethacrylate. Some components have a porous surface, often of titanium, into which bone likes to grow to produce "biological fixation."

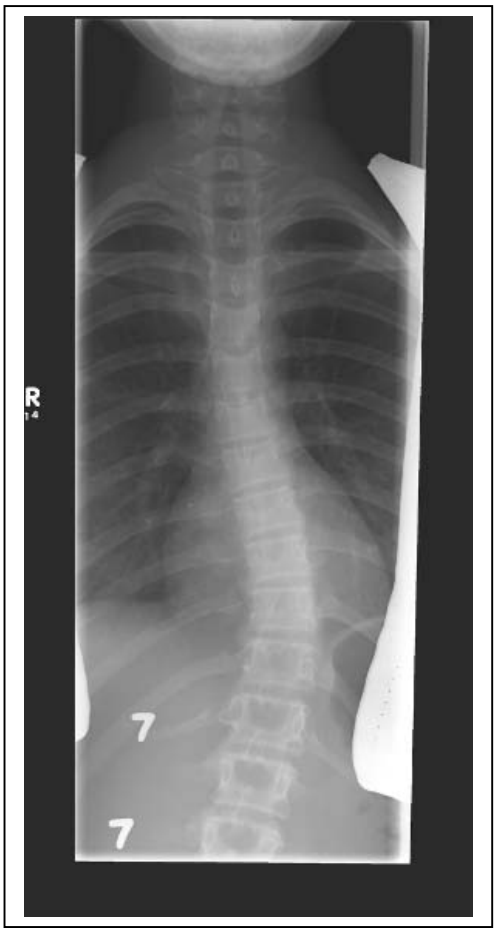
Causes of failure
Infection is disastrous and is usually impossible without removing the components (exceptions are sometimes made for acute infections with very antibiotic susceptible bacteria) and treating with long term antibiotics. Most failures are "aseptic" and are thought to be due to an inflammatory reaction to "wear debris" (usually polyethylene) particles that results in bone resorption.

Longevity
Replacements last longer in older, lighter, slower moving patients (for example when multiple joints are involved as in rheumatoid arthritis) who have sedentary jobs. Thus a 30 year old obese, alcoholic laborer with AVN and collapse of his hip is a particularly poor candidate. He will likely fail his replacement in only a few years but needs one until the end of his life – after failure it can be revised but revisions seldom last as long as the original joint.

Pediatric Orthopedics

Common conditions

Scoliosis



Description: Scoliosis refers to a curvature of the spine which can be congenital due to abnormally formed vertebrae (often associated with other congenital abnormalities), neuropathic due to muscular imbalance (cerebral palsy) or idiopathic due to unconfirmed causes and developing during the adolescent growth spurt, most commonly in girls.

Diagnosis: Pain is usually not an issue. Small curves are not easily recognized until the patient bends forward to touch their toes where the vertebral rotation that accompanies the curve results in a "rib hump" on the convex side of the curve (severe rib humps result in the term "hunchback"). X-rays show the curve which is quantified by measuring the angle between the "most tilted" vertebrae above and below the curve. X-rays also reveal deformed vertebrae in congenital scoliosis. A careful check for neurologic abnormalities is important as "tethering" of the cord can result in significant spinal cord injury during surgical correction.

Conservative treatment: Bracing is effective in halting progression of the curve during growth in certain patients.

Operative treatment: Patients with large curves (over 40 degrees) are generally treated with spinal instrumentation to at least partially correct the curve and fusion to fix it in place, preventing further curvature.

Hematogenous osteomyelitis

Description: This condition usually starts in the metaphysis where "hairpin" turns in the blood vessels going to the physis are thought to drop off organisms that get in the bloodstream in an area where they can proliferate. It can break out of the bone into the joint resulting in a septic joint.

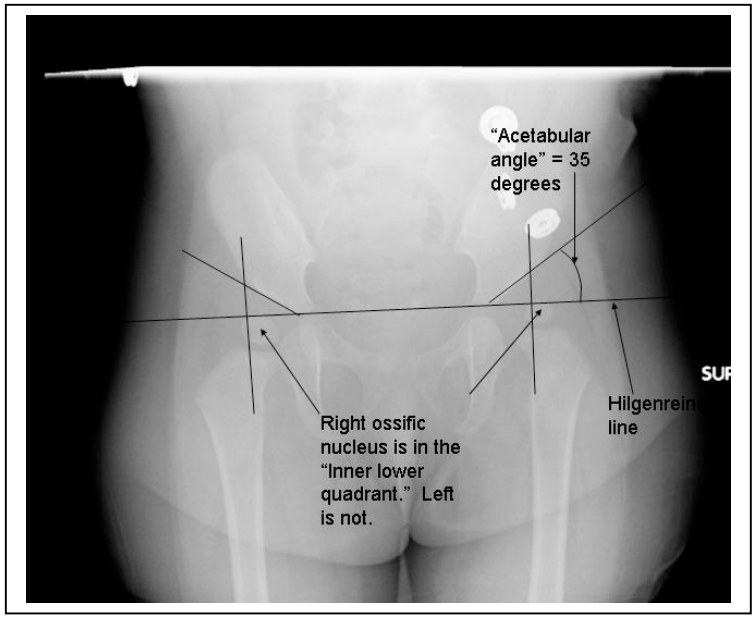
Diagnosis: Marked pain with “pseudoparalysis” of the limb in children too young to cooperate. Erythema, warmth, swelling and tenderness to palpation are usually present. X-rays are often normal initially but become mottled and moth eaten in about 2 weeks. MRI and bone scan can be localize the lesion within a few days. Aspiration of the subperiosteal abcess or sometimes the bone itself identifies the organism and guides antibiotics.

Conservative treatment: Antibiotics alone usually for 6 weeks are usually successful in children.

Operative treatment: Only for those who fail antibiotic treatment, are thought to have a large abcess under pressure or have evidence of sequestered bone (usually from delayed treatment).

Developmental dysplasia (congenital dislocation) of the hip

Description: This condition is partly genetic (runs in families) and partly environmental (increase in breech presentation and when babies are swaddled with their hips adducted rather than abducted). When the femoral head is not deeply seated in the acetabulum the acetabulum does not develop fully and can be shallow or the head can dislocate completely.



Diagnosis: Pain is seldom an issue. Newborns should be checked for a leg length discrepancy and a “hip click” as the hip palpably clunks in (Ortolani’s) and out (Barlow’s) of the socket during abduction and adduction. X-rays will show a smaller ossification center of the femoral head (as in the left hip in this example) with lateral and superior displacement of the femoral neck/head relative to the acetabulum. The slope of the acetabulum will be more vertical. Bilateral cases are often missed because “both hips are the same” on exam and x-ray. Ultrasound and MRI are good tests when the diagnosis is unclear.

Conservative treatment: If diagnosed within weeks of birth treatment in abduction with bracing or casting to seat the femoral head deeply in the acetabulum can result in a nearly normal hip. Later treatment can result in a shallow acetabulum with early osteoarthritis.

Operative treatment: Open reduction may be used for toddlers whose hips cannot be reduced with braces or casts. Osteotomy about the acetabulum may be performed to deepen or reorient the hip socket.

Slipped Capital Femoral Epiphysis (SCFE)

Description: This usually occurs during the adolescent growth spurt in children who are either obese or tall

Diagnosis: Pain is significant but it may be entirely referred to the knee and some patients are misdiagnosed because the physician fails to x-ray the hip. As the epiphysis slips posteriorly as seen in the left hip here (whereas the right epiphysis protrudes anterior to the femoral neck), the hip will assume an externally rotated posture.

Conservative treatment: Seldom used.

Operative treatment: Pinning of the physis with a screw usually arrests the progress of the slip.

Legg Calve Perthes disease of the hip (AVN)

Description: This condition's etiology is unknown though it is thought by some to be related to abnormal clotting. It occurs between age 3-12 (usually 4-8) most commonly in males and may be bilateral. It is a source of hip pain and must be differentiated from a septic hip (sometimes the hip must be aspirated to rule out infection) and from an idiopathic condition called toxic synovitis. The prognosis is dependent mostly on age with younger children doing better and somewhat on how much of the femoral head is involved.

Diagnosis: The x-rays are usually diagnostic but may not be at initial presentation.

Conservative treatment: Generally successful in younger children and often uses bracing in an attempt to direct the femoral head more deeply into the acetabulum so that it will be molded into a spherical shape. The effectiveness is controversial.

Operative treatment: Involves osteotomies to direct the femoral head more deeply into the acetabulum so that it will be molded into a spherical shape .

Varus and valgus deformities of the legs

Description: Normal children have varus legs up to age 2-4 when they drift into valgus up to age 6-10. Valgus deformities are seldom pathologic unless severe. Marked varus deformities in infants and adolescents may be due to medial tibial physeal arrest and are termed "Blount's disease". Varus may also arise from rickets, usually vitamin D resistant or hypophosphatemic rickets as in the example here.

Diagnosis: Marked angular deformity, often asymmetrical with pain uncommon. X-ray shows deformity of the proximal tibial physis in Blounts and widening of the physis in rickets.

Conservative treatment: Bracing is not usually effective.

Operative treatment: Osteotomy and realignment in infant and adolescents. Stapling or fusion of the lateral part of the physis to allow the medial half to "catch up" may be used in adolescents.

Clubfoot (talipes equinovarus)

Description: This condition also is at least partly genetic. There is a contracture of the posteromedial structures about the hindfoot pulling the foot into equinus and varus. Left untreated the patient may be forced to walk on the dorsolateral surface of the foot.

Diagnosis: The foot position is diagnostic if it cannot be passively corrected.

Conservative treatment: Generally successful and involves vigorously stretching the foot into a corrected position and holding it with casts which are changed every few weeks.

Operative treatment: Only for those who fail cast treatment and involves surgical release of the contracted posteromedial structures, pinning in a corrected position and casting to hold it.

In toeing and out toeing

Description: This usually spontaneously corrects and is seldom pathologic but is a source of significant angst in worried parents who fear their child will be crippled.

Diagnosis: May be due to torsion (twisting) of the femur or tibia, or due to varus postures of the foot.

Conservative treatment: Braces are generally ineffective. Reassurance of the parents is the mainstay (they are often comforted to know that it can still be corrected surgically later if the child doesn't "grow out of it").

Operative treatment: Derotational osteotomy of the femur or tibia is quite effective.

Tumors

Malignant neoplasms

- **General recognition of malignant indicators**
  - Pain and swelling without "significant trauma" (patients often first notice something is wrong after a minor trauma to their tumor).
  - An enlarging mass
  - A mass beneath the fascia (masses superficial to the fascia are usually benign)
  - Generalized symptoms of malaise, anorexia, etc.
  - X-ray showing a lesion which has "broken out" of the bone.
  - X-ray showing a lesion without any sclerosis (reactive bone) around it. In this example lateral x-ray of the lumbar spine there are multiple lytic lesions without reactive bone around them

- **Metastases**
  - Most common malignant bone lesions
  - Usually from prostate, breast, kidney, thyroid, lung (Pb KTL or "lead kettle).
  - Metastases actually go to hematogenous marrow as the bone itself and the fatty marrow have poor blood supplies. The hematogenous marrow lives in the central part of the body so mets occur in the axial skeleton (the example lateral lumbar spine x-ray with multiple spine lesions *could* be due to metastatic disease) and the hips and shoulders.
  - Prostate and sometimes breast can produce "blastic" or bone forming mets that appear dense on x-ray.

- Treatment is usually with chemotherapy or radiation but stabilization of fractures or impending fractures can be helpful.

- **Multiple myeloma**
  - Most common malignant tumor arising in bone itself.
  - Also originates in hematogenous marrow in the central skeleton. Later in the disease the fatty marrow in the distal skeleton converts back to hematogenous in an attempt to make up for the loss of central hematogenous marrow and so then lesions are found in the distal skeleton.
  - Lesions are "punched out" so called because the bone destruction is so aggressive that there is no sclerotic reactive border at all (the lumbar spine x-ray above is actually from a patient with myeloma). Because of this phenomenon the lesions are often "cold" on bone scan so bone scan may not be a good way to find other lesions.
  - Treatment is usually with chemotherapy or radiation but stabilization of fractures or impending fractures can be helpful.

- **Osteogenic sarcoma**
  - Most common malignant tumor arising from an actual musculoskeletal tissue.
  - Arises in rapidly growing bone, most commonly near the rapidly growing physes in adolescents (in order of their growth rate: 1. distal femur, 2. proximal tibia, 3. proximal humerus, 4. distal radius) but also in the high turnover bone of Paget disease in older adults. Is "blastic" (bone forming) and breaks out of the bone in the classic "sunburst" pattern seen in the example.
  - Treatment involves radical resection and often difficult reconstructions. Chemotherapy can be very effective.

Nonmalignant conditions

- **Ganglion cyst**
  - Outpouching or cyst forming off of a joint or tendon sheath and filled with a gelatinous fluid that appears to be condensed synovial fluid.
  - Most common about the wrist and ankle frequently being "pumped up" by activity to become larger, harder and more painful. Rest results in their becoming smaller softer and less tender.

    - Treatment can involve physically rupturing the cyst or puncturing it with a needle or surgical excision but is not necessary except for patient comfort. Recurrence is fairly common.
- **Lipoma**
    - Most common nonmalignant mass found about the body.
    - Usually subcutaneous and outside the fascia but can occur in deeper tissues.
    - Treatment is not necessary except for excisional biopsy to confirm the diagnosis or when pain is present.
- **Osteochondroma**
    - Most common bone mass.
    - Best thought of as a "lost" piece of the physis which grows off in an odd direction.
    - Near the joint and its "stalk" has a medullary canal that is connected to the medullary canal of the rest of the bone, not separate from it.
    - Stops growing when the patient does, further growth after adulthood may indicate malignant conversion into a chondrosarcoma.
    - Treatment is by excision but is not necessary except when the prominence is painful or may be continuing to grow (see above)
- **Fibrous cortical defect (nonossifying fibroma)**
    - Most common bone lesion
    - Is a *defect in the cortex* of the bone recently formed by the physis and filled with *fibrous* tissue. Has a sclerotic rim on x-ray.
    - Thus it is usually found in adolescents or young adults as an incidental finding on an x-ray obtained for an injury.
    - Treatment is by excision but is not necessary except when the lesion is so large the bone may break.

Localized conditions

Hand and Wrist

Common conditions

Carpal Tunnel Syndrome (CTS)
Description: A condition caused by swelling of the contents of the carpal tunnel which includes the flexor tendons and median nerve. More common in women and idiopathic but can be associated with some metabolic conditions such as diabetes, amyloidosis and thyroid disease. Often blamed on "overuse". This puts pressure on the median nerve causing the patient to complain of numbness in its distribution. When severe it can cause wasting of the median innervated thenar musculature.

Diagnosis: The patient often complains that "all" fingers are numb but on prodding will find that the small finger is spared. Symptoms are often worse at night. Tinel's test involves tap-

ping with a finger over the median nerve just distal to the wrist; a complaint of increased symptoms is a positive indicator of CTS. Phalen's test involves holding the wrist in maximal flexion for 60 seconds again looking for increased symptoms. EMGs and NCVs can be done to obtain objective evidence of denervation of the thenar muscles and slowing of median nerve conduction across the wrist.

Conservative treatment: NSAIDs may decrease swelling of the other tissues in the tunnel and abate symptoms. A night splint to hold the wrist slightly extended will decrease attacks. Injection of steroids into the tunnel is usually helpful but relief is usually only for a few months duration.

Operative treatment: Carpal Tunnel Release (CTR) involves cutting the carpal ligament over the tunnel at the base of the palm and can be done open with a 3 cm incision or arthoscopically (quicker recovery but increased risk of nerve injury).

DeQuervain (tenosynovitis of the 1st dorsal extensor tendon compartment)
Description: Inflammation of the tendon sheath over the radial styloid causing radial sided wrist pain. There are often congenital abnormalities of the tendons and sheath in recalcitrant cases.

Diagnosis: Pain and tenderness over the radial styloid, radiating proximally and distally into the thumb. Finkelstein's test involves folding the thumb into the palm with the fingers wrapped around it in a fist, then the wrist is ulnarly deviated. Markedly increased pain with this test is almost diagnostic.

Conservative treatment: NSAIDS and splinting of the thumb in a functional position for a few weeks sometimes helps. Injection of the tendon sheath with steroids can be quite effective.

Operative treatment: Surgical release of the tendon sheath is very effective. It is important to look for abnormal tendon slips and sheath divisions.

Dupuytren contracture
Description: A contracture of the palmar fascia which draws up the fingers into flexion, first at the MCP joint and later the IP joints. The ring finger followed by the long and small fingers are most commonly involved.

Diagnosis: There are palpable nodules in the palm and the fingers cannot be completely extended.

Conservative treatment: Therapy to stretch the fascia in an attempt to prevent further contracture.

Operative treatment: Surgical excision of the palmar fascia. This can be complicated by injury to the digital nerves which can be entwined in the fascia.

Dangerous conditions

Gamekeeper's thumb
Description: Acute or chronic rupture (sprain) of the ulnar collateral ligament of the MCP joint of the thumb. Named because "gamekeepers" developed the chronic form from repeatedly wringing the necks of birds. The acute form is a problem because the ligament can flip up behind the extensor hood and is then unable to heal. Surgical treatment of the acute injury is easy but reconstruction if it fails to heal is quite difficult.

Diagnosis: Common after a fall where the thumb catches and is radially deviated (skier's thumb). Tender about the 1st MCP with laxity to stress of the ulnar collateral. A lack of pain on stress is concerning as it may indicate that the ligament is completely torn (see type 3 sprains at the beginning of minitext, there is no real stress on the ligament to cause pain).

Conservative treatment: Many surgeons would say that it always be explored and should not be treated conservatively.

Operative treatment: Exploration to be sure the ligament is not flipped up behind the extensor hood and to suture it.

Tendon lacerations
Description: The hands are very frequently wounded due to our propensity to put them in harm's way. If the wound transects a tendon and this is unrecognized the outcome can be very poor.
Diagnosis: First observe the resting posture of the hand. A finger with a transected tendon will rest in a different posture than its neighbors (or the fingers of the other hand if you're not sure). Then check to see if each joint of the finger can be moved independently. Because the flexor digitorum profundus (FDP) can flex both the PIP and DIP joint it can be difficult to test for a laceration of the flexor digitorum superficialis (FDS). To do this you must take advantage of the fact that the FDP does not power each finger independently wheras the FDS does. Thus if you hold the other fingers in extension the FDP will not be able to flex the finger in question very far.

Conservative treatment: Tendon lacerations should be repaired.

Operative treatment: Extensor tendons can usually be repaired with simple sutures under local anesthesia in the Emergency Department. Flexor tendons can have very poor outcomes in the hands of inexperienced surgeons due to their tendency to fail and to scar down to the surrounding tendon sheath resulting in severe loss of function. They are generally repaired by surgeons with a special interest in the hand.

Nerve lacerations (most common in the hand but these descriptions apply anywhere)
Description: Nerve injuries are classified into neuropraxia (bruising of the nerve which recovers in minutes to days), axonotmesis (a bruise so bad that the axons break down but because the myelin sheaths are intact the axons grow back down the nerve at a rate of 1 mm/day) and neuronotmesis (transection of the nerve).

Diagnosis: Check for sensory, motor and reflex function of the nerve suspected of injury. Pinprick is a better test than light touch for a transected nerve.

Conservative treatment: Tendon lacerations should be repaired. In blunt trauma where you might suspect neuropraxia or axonotmesis observation for recovery is in order.

Operative treatment: In sharp lacerations, exploration of the nerve with repair will essentially convert a neuronotmesis to a axonotmesis with potential for recovery. Nerves which are bluntly crushed or avulsed by traction cannot be repaired but can sometimes be grafted if they are important enough to warrant sacrificing a less important nerve to serve as a donor.

Elbow

Common conditions

Lateral epicondylitis of the elbow (Tennis elbow)
Description: Lateral elbow pain due to degenerative changes in the origin of the radial wrist extensors. Usually in patients age 30-60 and associated with a repetitive task involving wrist extension and a terminal impact such as the tennis backhand or hammering.

Diagnosis: Tenderness over the lateral epicondyle at the origin of the radial wrist extensors. Increased pain on resisted wrist extension.

Conservative treatment: Rest, stretching and strengthening excercises for the wrist extensors can be effective. There are numerous braces and straps which help some patients. NSAIDs and injection with steroid preparations can be quite effective.

Operative treatment: Surgical incision or debridement of the degenerative area incites a repair response which usually resolves the problem.

Olecranon bursitis
Description: After acute impact injury or chronic rubbing the bursa over the olecranon becomes swollen and painful.

Diagnosis: Swelling and tenderness over the olecranon with normal xrays.

Conservative treatment: NSAIDS and rest of the part (prevention of rubbing of the olecranon on desks, armrests etc.) Steroid injection can be effective but as the bursa is right under the skin can sometimes produce chronic drainage and subsequent infection.

Operative treatment: Surgical excision is effective but seldom necessary.

Shoulder

Common conditions

Osteoarthritis of the acromioclavicular joint
Description: The patient complains of shoulder pain but localizes it over the AC joint.

Diagnosis: Tenderness and palpable swelling or osteophytes over the AC joint. Crepitance is often palpable in the joint when the patient makes a slow throwing motion. Pain may be increased when the arm is forced across the chest (positive "cross arm" test).

Conservative treatment: Reassurance that it is not a serious condition, NSAIDS and rest can be helpful. Injection of the joint can be diagnostic, confirming that the pain is not coming from other shoulder structures, as well as therapeutic but relief is usually temporary.

Operative treatment: Surgical resection of the distal 10-12 mm of the clavicle to leave the shoulder suspended on the coracoclavicular ligaments is often quite effective.

Adhesive capsulitis (frozen shoulder)
Description: Usually follows some (often minor) injury where the patient holds their own arm still for a while. Adhesions form within the joint and the capsule may become contracted. More common in diabetics. The patients often complain of being awakened at night.

Diagnosis: Loss of ROM, usually external rotation (compare carefully to the other arm) with benign x-rays.

Conservative treatment: Physical therapy stretching program and NSAIDS is usually effective but may take many months. There is evidence that most patients will resolve spontaneously in 2 years.

Operative treatment: If recalcitrant to PT can be treated with manipulation under anesthesia to break the intraarticular adhesions and stretch the capsule. Arthroscopic or open surgical release is rarely necessary.

Impingement → bursitis → rotator cuff tendonitis → rotator cuff tear
Description: This is a continuum of disease caused by "impingement" of the humeral head against the underside of the acromion. The intervening structures of the subacromial bursa and the rotator cuff are initially inflamed then worn and eventually may become torn. Some cuff pathology is due to intrinsic degeneration of the tendons, etiology unclear.

Diagnosis: Pain and inability to reach up into the air (can't reach their shelves). Tenderness over the greater tuberosity, pain and weakness on resisted elevation of the shoulder and increased pain when the elevated arm is internally rotated to force the larger greater tuberosity under the acromion are often present. When the supraspinatus tendon is torn there may be atrophy of the muscle visible above the spine of the scapula and marked weakness of elevation. MRI can show the defect in the torn cuff tendon and is useful if the patient's symptoms and condition warrant possible surgical treatment.

Conservative treatment: NSAIDs and occasional injection to relieve bursal inflammation. Physical therapy to strengthen the internal and external rotator muscles allows them to pull the humeral head downwards, reducing impingement.

Operative treatment: Acromioplasty involves removing downward protruding portions of the acromion to decrease impingement. Rotator cuff repair is most effective if performed soon after a tear and in combination with an acromioplasty.

Spine

Common conditions

Osteoarthritis
Description: Osteoarthritis is common in the spine of older patients. It often flares up with severe pain but usually settles back down to a tolerable level of symptoms after a few weeks or months.

Diagnosis: Pain of a chronic deep aching nature with x-ray showing osteoarthritis (seen in the example as sclerosis and irregularity of the endplates with osteophyes at C3-4, 4-5, and 5-6. Note that C2-3 is relatively normal for comparison). Rule out other causes as under degenerative disc disease. MRI is not helpful.

Conservative treatment: Rest, immobilization in a collar or corset, NSAIDs and patience are very important. For neck osteoarthritis, intermittent halter traction is very helpful to some patients.

Operative treatment: For OA at a single level fusion can be effective but often neighboring levels rapidly deteriorate.

Low back and neck pain – usually due to degenerative disc disease
Description: These are very common complaints and are thought to most commonly stem from tears of the annulus fibrosus of intervertebral discs with a degenerated nucleus pulposus. The degenerated nucleus no longer retains water and becomes "deflated" leading to folding and fatigue tears in the annulus. The tears become inflamed producing pain.

Diagnosis: Pain (often perceived in the PSIS or buttock) with a gradual or sudden onset of a deep aching nature often made significantly worse by chronic spasm in the surrounding muscles which are trying to "splint" the painful structures. A primary role of the physician should be to rule out other causes of back pain such as fracture, neoplasm and retroperitoneal disease (which is often perceived as back pain) such as pyelonephritis, pancreatitis, duodenal ulcer and aortic aneurysm. X-ray is nondiagnostic except to rule out other conditions and usually should not be obtained unless the patient has failed to respond to 4-6 weeks of conservative treatment. MRI can show degenerative discs but the fact that they are degenerative does not mean that they are painful because once they become degenerative they do not recover, thus it has little role in this condition.

Conservative treatment: NSAIDs for the inflammation of the annulus. Rest from heavy physical activity is helpful though complete bed rest for extended periods is seldom recommended anymore. The muscle spasms are effectively and more safely treated with heat rather than pharmacologic agents. Patience is indicated as most of these patients will recover spontaneously.

Operative treatment: Operative treatment of back and neck pain is often ineffective and has a bad reputation.

Herniated nucleus pulposus
Description: This diagnosis implies a tear in the annulus fibrosus with herniation of a degenerated nucleus pulposus into contact with a nerve root. The nucleus incites a significant inflammatory response which causes nerve irritation so that significant pressure against the nerve is not necessary. It is characterized by "radicular" pain radiating along the course of the nerve.

Diagnosis: Pain along the course of a nerve (most often the sciatic). Associated numbness in that dermatome and weakness of the associated muscles is often present. Stretching the involved nerve (the "straight leg raising test" stretches the sciatic nerve) is very painful. MRI should be ordered only to confirm the diagnosis and location of the HNP in preparation for surgery for patients who fail conservative treatment. The example MRI confirms a severely degenerated "black" disc at L5-S1 which

has herniated back into the spinal canal. Other cuts show the HNP is in contact with the S1 nerve root.

Conservative treatment: NSAIDs and sometimes epidural steroid injections or steroid dosepacks to relieve the inflammation next to the nerve. Rest and patience is important as many of these patients will recover on their own in a few weeks.

Operative treatment: Surgical discectomy is quickly effective in recalcitrant cases but the long term outcome has not been shown to be better than nonoperative treatment.

Spondylolysis and spondylolisthesis

Description: Spondylolysis is a lesion of the pars intraarticularis or the pedicle of the posterior elements of the spine. It can be congenital or can be an acute fracture or stress fracture. Fractures are associated with hyperextension injuries of the spine in gymnasts and "down" linemen in football. Spondylolisthesis is a slipping forward of one vertebral body on the one beneath it, usually due to a spondylolysis. In the example L5 has slipped 25% forward on S1 due to a defect in the pars intraarticularis of L5.

Diagnosis: Pain in association with hyperextension should raise the suspicion of spondylolysis. Oblique x-rays are often necessary (looking for a break in the neck of the Scotty dog) and sometimes a bone scan or CT is required to make the diagnosis. A simple lateral x-ray will demonstrate spondylolisthesis.

Conservative treatment: Rest and a brace will often lead to healing of acute and stress fractures. Spondylolisthesis, unless severe (greater than 50-75% forward on the lower vertebral body) can often be effectively treated with rest and NSAIDs

Operative treatment: Seldom necessary. Grafting of a nonunion of a spondylolysis is sometimes performed in young patients and fusion of the slipped vertebrae can be effective in persistently painful spondylolisthesis.

Dangerous conditions

Cauda equina syndrome

Description: This is considered to be a surgical emergency and implies a very large HNP that is crushing multiple nerve roots in the center of the distal spinal canal.

Diagnosis: Pain, marked numbness, significant weakness and incontinence. MRI reveals a large HNP in the lumbar spine

Conservative treatment: Not indicated.

Operative treatment: Emergent discectomy

Hip

Common conditions

Osteoarthritis
Description: This is a common condition in patients age >60 and characterized by loss of cartilage. It tends to run in families.

Diagnosis: Patients will complain of "hip" pain when they have pain in the buttock (usually low back pain), trochanter (usually trochanteric bursitis) or groin. The groin is usually where true hip pain is perceived. The patients complain of deep aching groin pain, gelling and often walk with a "coxalgic" gait where they lean over the affected hip during stance phase (this lowers the load on the hip as the patient doesn't have to fire their hip abductors to keep the pelvis level). X-rays show the typical 4 findings (see osteoarthritis above).

Conservative treatment: NSAIDs and a cane.

Operative treatment: Joint replacement surgery. Occasional patients are candidates for osteotomy.

Avascular necrosis
Description: This occurs after traumatic injuries to the blood supply of the femoral head due to fracture of the femoral neck or dislocation of the hip. It can also occur from medical conditions such as steroid use, alcoholism, caisson's disease ("the bends") which are believed to cause swelling of the marrow producing a "compartment syndrome" inside the femoral head.

Diagnosis: Deep aching pain in the groin and history of injury, steroids or alcoholism. X-ray may be negative but often shows a mottled pattern of density and lucency in the head as seen in the example in both hips but much worse on the left. Later, collapse of the necrotic bone causes the head to lose its shape. MRI show marrow changes long before x-ray changes are evident.

Conservative treatment: Not effective but symptoms may be palliated with a cane and analgesics.

Operative treatment: Drilling holes into the femoral head from the greater trochanter can relieve pressure similar to a fasciotomy for compartment syndrome. In addition, new blood vessels invade the hole to restore vascularity. Once collapse of the head occurs little is effective except joint replacement but these patients are often poor candidates.

Trochanteric bursitis

Description: This is much more common in women (attributed to their wider hips). Impacts to the greater trochanter cause irritation and subsequent inflammation of the overlying bursa. Snapping of the iliotibial band (fascia lata) over the trochanter can also cause or perpetuate the bursitis.

Diagnosis: Lateral pain and tenderness over the trochanter. X-rays normal.

Conservative treatment: NSAIDs and/or steroid injection are usually successful. Wearing a lift in the opposite shoe and strengthening the hip abductors may lessen IT band snapping. Stretching the IT band and strengthening the hip abductors are though to be helpful.

Operative treatment: Seldom necessary but include excision of the bursa and release of the IT band.

Knee

Common conditions

Osteoarthritis

Description: This most often starts in the medial compartment of the knee as it is more heavily loaded in stance phase. It is more common in patients with varus alignment of the knee as this also overloads the medial compartment.

Diagnosis: Deep aching pain in the knee, worsened with activity and gelling. X-rays are best performed weight bearing and show the classic four findings (see osteoarthritis above), ini-

tially worse in the medial compartment. In the very mild example here all that is seen is mild medial joint space narrowing and the slight "squaring" of the medial condyles caused by early osteophytes.

Conservative treatment: NSAIDs, rest, a cane, an elastic knee bandage/brace, hyaluronic acid injections and steroid injections can all be helpful.

Operative treatment: If only the medial compartment is involved in a young patient (<50) a "high tibial osteotomy" to make the alignment of the knee valgus instead of varus, transferring the loading to the better compartment is said to produce 70% relief in 70% of the patients for 7 years (rule of 7s). Older patients are successfully treated with total knee arthroplasty.

Ligament injuries

Description: These are common sports injuries with the MCL and ACL being the most susceptible. The MCL heals well with protection while the ACL, if completely ruptured almost always causes chronic instability.

Diagnosis: Acute pain and hemoarthrosis (indicated by rapid swelling) after an injury should raise the possibility. If x-rays do not show a fracture the knee should be carefully examined in 20 degrees flexion for varus (LCL) or valgus (MCL) instability, then in 90 degrees flexion for anterior (ACL) or posterior (PCL) drawer signs. The anterior drawer should also be performed with the knee in 20 degrees flexion (called a Lachman test).

Conservative treatment: Initially RICE (rest, ice, compression with an ace wrap, and elevation) then immobilization in a splint or brace with protected ROM to prevent stiffness. NSAIDs can be helpful with the pain and reactive inflammation. After a few weeks, physical therapy to strengthen the musculature and restore any lost ROM.

Operative treatment: Surgical repair of the ligaments is not performed much anymore as the MCL heals well without it and the ACL fails to heal with it. Instead late reconstruction of ligaments that fail to heal, using tendons as grafts to replace them is felt to be more effective.

Meniscal injuries

Description: This occurs in young patients (15-30) usually from single violent sports events that catch the meniscus between the femur and tibia and cleave it. In older patients (40+) the meniscus degenerates and "delaminates" into separate layers which fall loose into the joint. The major problem arises from the loose parts of the meniscus "catching" in between the working parts of the joint (femur and tibia).

Diagnosis: Sudden intermittent painful episodes associated with a sensation of "catching," "locking" or "giving way." The patient has recurrent effusions. X-rays are normal. MRI can demonstrate tears of the meniscus but sometimes demonstrates tears that are not actually displacing into the joint and causing symptoms, therefore many surgeons feel that with a classic

history unrelieved by NSAIDs the patient should go directly to diagnostic arthroscopy which can also be therapeutic for other nonmeniscal derangements.

Conservative treatment: The meniscus does not heal but patients with typical symptoms sometimes improve after a course of rest and NSAIDs, presumably because the catching was caused by some other structure such as swollen synovium pinching in the joint.

Operative treatment: Arthroscopic examination of the joint with removal of the torn portion of the meniscus.

Ankle

Common conditions

Sprains

Description: This is one of the most common reasons for ED visits. It occurs with inversion of the ankle and tearing of the lateral ligaments (usually the anterior talofibular ligament is the first to go). They usually heal well but repeated sprains can result in chronic lateral ankle instability.

Diagnosis: Pain after a twisting injury to the ankle. Inversion causes sprains but beware of eversion which usually causes fractures. Swelling and tenderness is present distal and anterior to the lateral malleolus. X-rays are normal or may show small chips of bone avulsed from the tip of the lateral malleolus.

Conservative treatment: RICE (see knee sprains) and NSAIDs. Many good ankle braces that allow motion but prevent inversion are available and should be worn for 4-12 weeks to prevent reinjury.

Operative treatment: Seldom indicated acutely but reconstruction of the ligaments for chronic instability is effective.

Achilles rupture and tendonitis

Description: Ruptures usually occur in “weekend warriors” age 30-60, playing sports intermittently and the tendon fails about 3-7 cm above the calcaneus. Tendonitis occurs in the same demographic with a gradual rather than sudden onset.

Diagnosis: Patients who rupture sustain such a violent failure that they often believe something struck them in the back of the ankle. Contrary to expectation they retain the ability to plantar flex because the post tib, FHL, FDL and peroneal tendons all still act a plantarflexors. Diagnosis is based on a boggy hematoma in the area of the tendon and a Thompson test

where the patient kneels with the foot hanging off the edge of a chair and the examiner squeezes the calf. If the tendon is intact the foot plantarflexes. Tendonitis causes chronic pain and tenderness with a markedly swollen tendon.

Conservative treatment: Ruptures can be treated by casting the ankle in equines (plantarflexion) for 6 weeks and then gradually bringing it up. Tendonitis is difficult to treat. NSAIDS, physical therapy for stretching and eccentric exercises can be slowly effective. Steroid injections are warned against because of a possible association with rupture.

Operative treatment: Surgical repair of ruptures has a lower rate of rerupture and decreased atrophy/stiffness but a significant wound complication rate. Percutaneous repair methods are gaining favor. Tendonitis is occasionally debrided of degenerative areas of tendon with some success.

Foot

Common conditions

Plantar fasciitis (heel pain)

Description: This condition is very common in people who spend much of their days standing (such as physicians and nurses). It is believed to be a degenerative condition of the origin of the plantar fascia from the calcaneus.

Diagnosis: The pain is on the plantar surface of the heel, is often described as feeling like a "stone bruise" from stepping on a sharp pebble, and is usually worst upon first walking on it in the morning. There is tenderness to deep palpation. X-rays may show a "traction spur" of bone at the origin of the fascia from the calcaneus but are not really helpful with diagnosis or treatment except to rule out other causes of heel pain.

Conservative treatment: NSAIDs and shoes with well cushioned, slightly higher heels such as running shoe are usually effective. This is often combined with physical therapy and bracing to stretch the Achilles tendon. Occasionally steroid injection is helpful.

Operative treatment: Seldom indicated.

Metatarsalgia and interdigital (Morton's) neuroma (forefoot pain)

Description: This is often associated with atrophy of the fat pad under the ball of the foot in older individuals.

Diagnosis: Pain in the forefoot on weight bearing. Calluses form under a prominent metatarsal head but must be differentiated from plantar warts (which have a cauliflower pattern in-

terrupting the “fingerprint” ridges in the skin). Morton’s neuroma also causes pain in this area and is due to intermetatarsal bursitis irritating or direct metatarsal pinching of the common digital nerve to the toes (usually between the 3rd and 4th).

Conservative treatment: A wider toe box shoe with good cushioning helps both metatarsalgia and Morton’s toe. Addition of a metatarsal pad which is place under the metatarsal shafts to lift and spread the metatarsal heads is also helpful.

Operative treatment: If the problem is a callus under a single prominent metatarsal head, an osteotomy can lift it so that it is less prominent. Morton’s toe can be treated by resection of the involved digital nerve.

Pes planus (flatfoot)

Description: A flexible flatfoot is not necessarily pathologic. If the foot is stiff it may indicate a tarsal coalition (congenital failure of the hindfoot bones to separate). If it has recent onset in an older patient it may indicate degeneration and attritional rupture of the posterior tibial tendon.

Diagnosis: Pain with loss of inversion/eversion suggests coalition. Tenderness over the course of the posterior tib tendon with weakness of inversion and unilateral flatfoot suggests tendonitis.

Conservative treatment: A period of immobilization in a cast can help both of these conditions. A rigid arch support may be quite helpful for tendonitis.

Operative treatment: The abnormal bridging tissues of small tarsal coalitions can be surgically removed in young patients. Older patients usually do better with a complete surgical fusion of the involved bones. Ruptures of the posterior tibial tendon can be repaired or reconstructed but are better prevented prior to rupture with proper support.

Hallux valgus (bunion) and hallux rigidus (osteoarthritis)

Description: Bunion is an exostosis on the medial side of the 1st metatarsal head caused by rubbing against the inside of the shoe and is associated with lateral deviation of the great toe (valgus at the MTP). It was very prevalent in women when high heeled, pointed toed shoes were in style. Hallux rigidus is osteoarthritis of the 1st MTP joint.

Diagnosis: The bunion deformity is obvious on physical exam; x-rays are obtained to plan surgery. Hallux rigidus is characterized by a palpable dorsal osteophyte over the MTP joint and a loss of dorsiflexion with pain when it is attempted.

Conservative treatment: Bunion: wider toe box shoes with donut cushions around the exostosis and straps or pads to separate the 1st and 2nd toes, correcting the valgus. Hallux rigidus: a rocker front sole to the shoe or a rigid plate in the sole to prevent dorsiflexion at the MTP joint.

Operative treatment: Bunion: excision of the exostosis and realignment of the valgus. Hallux rigidus: excision of the dorsal osteophyte when mild. Arthroplasty or fusion when severe.

Neuropathic ulcers

Description: This occurs in asensate feet, mostly in diabetics. The ulcers are usually on the plantar surface and are usually not dysvascular as evidenced by granulation tissue attempting to heal them.

Diagnosis: Pain will be present but at a low level for the size of the sore. Proprioception is usually diminished in the toes. Ulcers between toes and without granulation tissue may be due to microvascular disease.

Conservative treatment: Distribution of pressure evenly across the sole of the foot with shoes that are not too tight. The first line of defense should be prevention with comfortable running shoes (which are constructed with good cushioning). A brace shop can make custom molded inserts (to distribute pressure evenly over the entire sole accommodating foot deformities) and place them in "extra depth" shoe that have room for them. Once an ulcer has developed it will often heal in a "total contact cast" which is carefully molded to the sole of the foot.

Operative treatment: This is only necessary for infections that get out of control and usually involves amputation at some level.

Ingrown toenail

Description: This is a troublesome condition (almost always the great toe) resulting from toenails cut too short and shoes worn too tight so that the shoe pushes the flesh of the toe up into the toenail forcing the nail to cut into it. Cellulitus worsens the symptoms.

Diagnosis: A painful red toe with the nail cutting into the flesh.

Conservative treatment: Loose shoes and teach the patient to cut their nails longer. Gently massage the flesh back under the toenail several times a day. Antibiotics for cellulitus.

Operative treatment: Excision of the inflamed tissue or removal of all or part of the toenail.