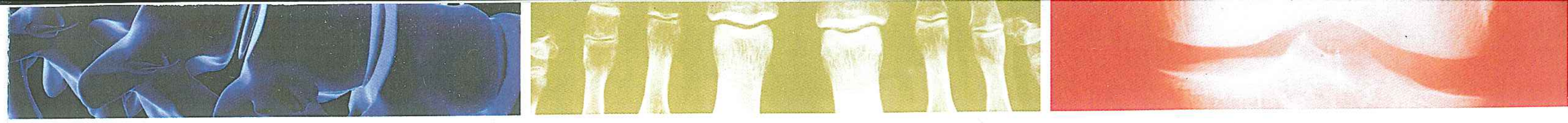

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THE UNIVERSITY OF TOLEDO MEDICAL CENTER

ORTHOPAEDIC MONTHLY

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Moments of Inspiration

I am continuously humbled and inspired by my patients. Former patients of mine frequently reach out to me, and I am always encouraged by their support and kind words.

One patient in particular reached out to me saying, "Today 29 years ago I met you. I was in pain and scared. But you took me under your care and put me back together. And for this I am forever grateful. Not only did you give me my life back you also inspired me to become a nurse! I am very proud to know you and be able to call you a dear friend! Thank you from the bottom of my heart Dr. Ebraheim"

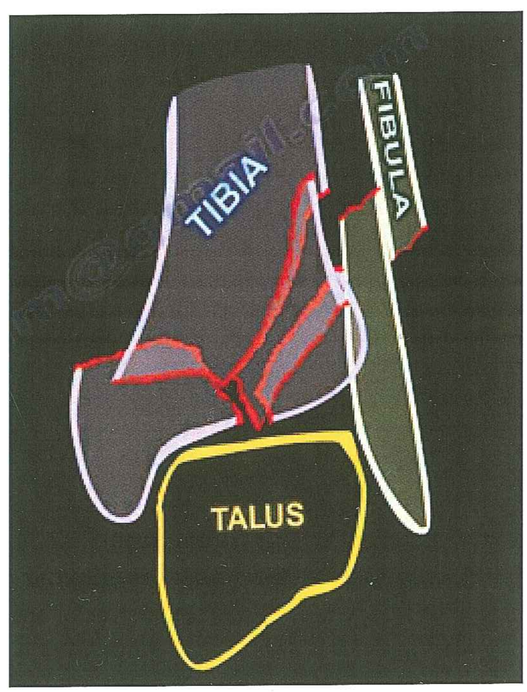
These are the stories that make me love what I do and make me want to continue to do it. Being a surgeon isn't just about saving the lives of people with devastating injuries; rather, restructuring lives and inspiring others to perform to the best of their ability.

Tibial Pilon Fractures

Tibial Pilon fractures are high energy axial load injuries. This injury is characterized as a major soft tissue injury because it is a high energy fracture that can be classified as open or closed. The ankle joint and the metaphysis of the tibia is usually involved.

An early or immediate open reduction and internal fixation is not recommended due to the soft tissues being in poor condition. Usually, initial treatment consists of a closed reduction and a splint, followed by a staged ORIF. In the operating room, the surgeon will start by applying an external fixator. Once the external fixator has been applied, the physician will perform a CT scan in order to decrease the incidence of wound complication and deep infection. When internal fixation is used, it is better to use a minimally invasive fixation. The soft tissue condition should improve before definitive surgery. The surgeon will want to wait 1-3 weeks depending on the magnitude of the injury, the anticipated surgery, and the presence of the wrinkle test.

After applying the external fixator, the physician will want to have a CT scan done to check the joint and fragments. This will help the physician select the best operative approach once the soft tissue condition improves. The physician needs to be aware that the AP radiographs may look okay but, it can be misleading. The joint usually has three fragments attached to ligaments. Because the ligaments are intact, the fragments can be pulled by the external fixator, which is called ligamentotaxis.



The three fragments in a Tibial Pilon Frature are:

1.Medial Malleolus- Attached to the deltoid ligament

2.Anterolateral fragment: or Chaput fragment—attached to the anterior inferior tibiofibular ligament. In children, this is called a Tillaux fracture. If the fracture involves avulsion of the fibula, it is called a Wagstaffe fracture, as rarely seen in some ankle fractures.

3.Volkmann Fragment- Posterolateral fragment attached to the posterior inferior tibiofibular ligament

Continued on page 2

When the fibula is intact, the lateral collateral ligament of the ankle may rupture (fibula is intact in 20% of the cases).

With tibial pilon fractures, patients are able to drive 6 weeks after initiation of weight-bearing. In ankle fractures, patients are able to drive 9 weeks after fixations (post-operatively).

In surgery, the goal is an anatomic reduction and stabilization of the articular surface. Surgery may begin as a fixation of the fibula with a plate or screw (in some cases the screw is better because it is minimally invasive). A fibular plate may add stability to the external fixator of the tibia, especially if there is a defect or comminution of the metaphysis of the tibia. When there is a metaphyseal defect of the tibia, plating of the fibula can enhance the stiffness of the external fixator. The surgical approaches are many and vary between limited and extensile. Regardless of the case, try to protect the superficial peroneal nerve! When performing surgery with a dual incisions approach, make sure that the distance between the incisions is no less than 7 cm. Surgeons agree that a staged ORIF is the best. Arthritis occurs in about 50% of cases and increases with time. Athrodesis is rare. Usually after two years, most of the patients return to work despite having some pain.

Significant disability in physical function was noted even with successful treatment in 36-Item Short Form Survery (SF-36). In pilon fractures, SF-36 scale is lower than in patients with pelvic fractures, multiple trauma, and AIDS. Patient socioeconomic factors are predictive of the clinical outcome, and the outcome really did not correlate with reduction of the fracture or with arthritis. Improvement in function and pain may take up to 2 years and eventually about 10-15% may need an arthrodesis.

For Pilon fractures with a fracture of the tibial shaft, the surgeon will want to perform a fixation of the articular surface (usually percutaneously), then a fixation of the tibial shaft, typically with IM rodding. The surgeon will either use external fixator calcaneal pins or talar pins. The physician will want to be aware of the location of the neurovascular structures and avoid the bulge area. Error in the placement or direction of the calcaneal pin can interfere with the neurovascular bundle. Application of the calcaneal traction pin is done at the posteromedial site. There is a ¾ distance between the palpable tip of the medial malleolus and the heel. The calcaneal transfixation pin is inserted in a transverse direction. When using an external fixator, it is better to keep the pins away from the area of future incisions. When using pins in the talus, pin insertion should be medial to lateral and anterodistal to anterior collicusus of the medial malleolus. The placement of the pin should be in 10 degrees anterocephalad direction.

Three great principles in Pilon Fracture treatment are:

1.Anatomical reduction

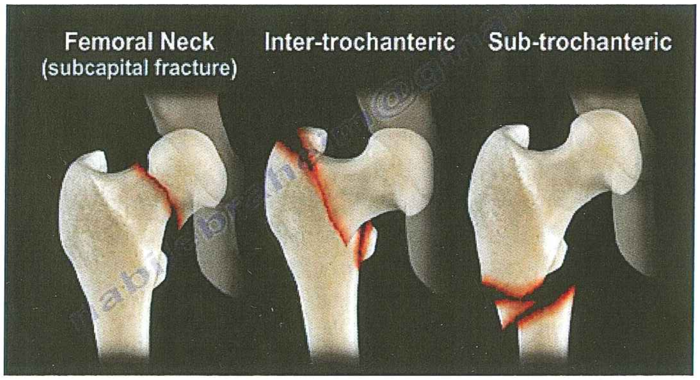
2.Stable internal fixation

3.Early range of motion

However, achieving these three principles in every case of pilon fractures may not be possible.

Hip Fracture Types and Fixation

A hip fracture can be a femoral neck fracture (or subcapital fracture), an intertrochanteric fracture, or a subtrochanteric fracture. With femoral neck fractures, there is a high incidence of avascular necrosis (AVN) and nonunion. Femoral neck fractures have high mortality rates in the elderly. Nondisplaced femoral neck fractures can be treated with pinning by cannulated screws for young and elderly patients. Displaced fractures in young patients will need an open or closed reduction followed by pinning with cannulated screws. Displaced femoral neck fractures in elderly patients will require a prosthesis, either bipolar, unipolar, or total hip. It is not advisable to do a closed reduction and screw fixation in displaced subcapital fractures in the elderly.



There are two types of intertrochanteric fractures: regular and reverse oblique. Regular intertrochanteric fractures can be treated with a compression hip screw or with an intramedullary nail. A long or short intramedullary nail may be used; however, if a long nail is used, it is important to make sure there is no perforation of the anterior cortex of the distal femur. Reverse oblique intertrochanteric fractures affect the lateral cortex of the femur and are usually treated with an intramedullary nail but, can be treated with a blade plate or a fixed angle plate as well. Surgeons should not use a compression hip screw in intertrochanteric fractures because this may cause a medial displacement of the fracture due to the pull from the adductor muscles. A compression hip screw is not a suitable device for reverse oblique fractures.

In subtrochanteric fractures, the fracture line extends distal to the lesser trochanter. This fracture is subjected to a high stress load and non-unions occur here quite frequently. The subtrochanteric region has a hard cortical bone that does not heal very well. A majority of these cases are treated with an intramedullary nail. Some surgeons still use compression hip screws; however, this is not common and threatens a greater chance of non-union. The surgeon may want to do this case closed in order to preserve the blood supply and the healing ability of the fracture.

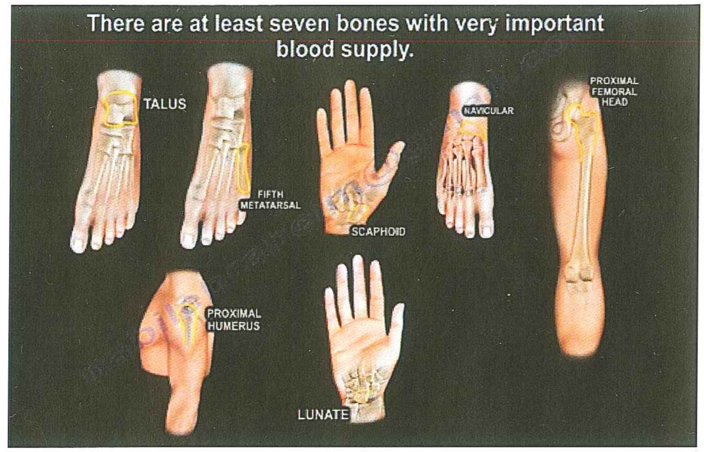
Important Blood Supply of Bones

There are at least seven bones with very important blood supplies. A fracture in these bones or a dislocation of their joints may interrupt this peculiar blood supply and threaten the death of the bone, which is called avascular necrosis. A fracture or dislocation of these bones may also result in a delay in healing of the bone or a nonunion of the fractures. Fractures in these areas are usually due to trauma or stress related injuries.

The most important blood supply of the talus comes from an artery of the tarsal canal. This artery arises from the posterior tibial artery and the deltoid branch arises from the posterior tibial artery. Keep in mind that the deltoid branch of the tarsal canal artery is probably the only remaining artery with a displaced fracture of the talar neck. Every attempt should be made to preserve this small but important branch. A fracture of the talar neck will interrupt the blood supply and cause a nonunion of the fracture or death of the bone. In this case, death of the bone occurs to the body of the talus. The more displacement of the fracture, the more likely that the bone will develop avascular necrosis and the fracture will develop nonunion. The Hawkin's Sign is a subchondral radiolucent line that is seen on the dome of the talus on x-rays. Look for a radiolucent line below the subchondral bone. It is more commonly seen on the medial side and is seen on the mortise view. The Hawkin's Sign is usually seen at 6 weeks after an injury. This means that there is resorption of the subchondral bone because there is vascularity. The Hawkin's Sign is seen when avascular necrosis doesn't happen.

If a fracture occurs in the watershed area of the blood supply of the fifth metatarsal bone, then the patient may develop a nonunion. Fracture distal to the tuberosity will disrupt the nutrient artery blood supply, resulting in relative avascularity. Interruption of the blood supply usually causes a nonunion and delayed union. There are three types of fractures at the proximal fifth metatarsal: Zone I (tuberosity avulsion fracture), Zone II (Jones fracture), and Zone III (stress fracture). The Jones fracture compromises the blood supply which leads to a nonunion of the fracture. It is called a "Jones fracture" when it occurs at the level of articulation of the 4th and 5th metatarsals. Treatment of a Jones fracture consists of non-weightbearing orders with a cast or intramedullary screw fixation. A majority of patients will have an intramedullary screw fixation. Intramedullary screw fixation is usually done in athletes and in active individuals. If the fracture occurs distal to the 4th and 5th metatarsal articulation, the fracture is probably a result of stress and will not heal very well without some form of fixation. If the fracture occurs in the rich area of the tuberosity, which is proximal, then this fracture will heal (pseudo-Jones fracture). When this occurs, the patient will do well with a boot. Nonunion fractures in Zone II (Jones fractures) can occur in up to 30% of cases. In Zone III (stress fracture), always check the foot for a cavovarus deformity, it can be very subtle.

The blood supply of the scaphoid is unique and tenuous. The main blood supply of the scaphoid comes from the dorsal branch of the radial artery. The dorsal branch of the radial artery supplies approximately 70-80% of the blood supply and occurs in a retrograde fashion. Scaphoid fractures can lead to nonunion and avascular necrosis due to interruption of the blood supply. AVN is



best seen with an MRI. MRIs are also helpful in diagnosing occult fractures. The more proximal the fracture, the more likely the fracture may develop AVN because of the retrograde circulation. AVN of the proximal fifth of the scaphoid occurs in up to 100% of the cases.

Navicular fractures are uncommon, but popular. Its blood supply is unique. Branches of the dorsialis pedis artery supply the dorsum of the navicular while the medial plantar branch of the posterior tibial artery supplies the plantar surface of the bone. The navicular tuberosity receives its blood supply from an anastomosis between these two vessels. The area where a stress fracture may occur is avascular. It is the central third of the navicular that is relatively avascular and has the greatest stress. There are risks of developing avascular necrosis, nonunion, and delayed union when a stress fracture occurs in this area of the bone. Navicular fractures are always treated initially with a non-weightbearing cast.

The medial femoral circumflex artery is the primary source of blood supply to the femoral head. Damage to the MFCA due to trauma, fractures, or dislocations may lead to avascular necrosis (AVN) of the femoral head. The risk of AVN will increase with delay in reduction of a dislocated hip. The hip should be reduced within 6 hours of injury. Avascular necrosis of the femoral head occurs due to interruption of the terminal branches of the medial femoral circumflex artery. This is different from fixing a femoral shaft fracture in a younger patient, where the patient may get AVN of the femoral head due to an injury of the deep branch of the medial femoral circumflex artery.

The blood supply of the proximal humerus is controversial. There are two important arteries: the anterior humeral circumflex artery and the posterior humeral circumflex artery. Additionally, there are two branches from the axillary artery: the ascending branch of the anterior circumflex artery and the arcuate artery. The arcuate artery was considered to be the artery that gives the majority of the blood supply to the humeral head. It is also the terminal branch and one of the primary blood supplies to the humeral head. Recent studies are suggesting that the posterior humeral circumflex artery provides the main blood supply to the humeral head, so it is controversial.

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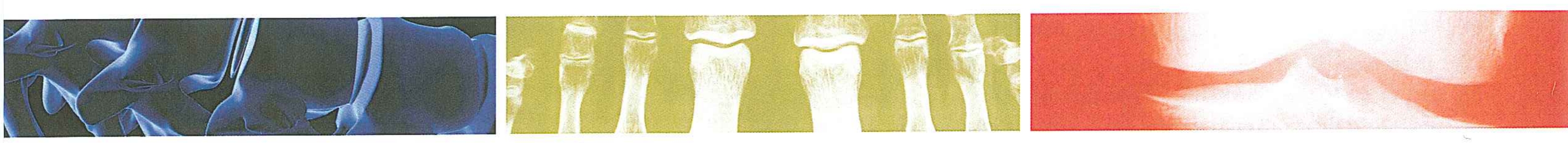

Important Blood Supply of BonesImportant Blood Supply of Bones continued

It is universally agreed that AVN usually occurs in four part fractures and in fractures or dislocations of the humeral head. AVN can also occur in head-splitting fractures or due to a disrupted medial hinge.

A short calcar segment can also lead to AVN. The vascularity of the articular segment is more likely to be preserved if more than 8mm of the calcar is attached to the articular segment. If there is avascular necrosis of the humeral head, you may want to look at the hips of the patient.

Avascular necrosis of the lunate bone is referred to as, “Keinbock’s disease”. Keinbock’s disease is usually associated with a negative ulnar variance that will lead to an increased stress on the lunate area. The lunate has a unique pattern of blood supply: the “Y” pattern, the “X” pattern, and the “I” pattern. The “I” pattern is considered to be the pattern with the highest risk of developing AVN because its supply pattern goes in a straight line. Keinbock’s disease may be caused by repetitive trauma that interrupts the blood supply of the Lunate bone. Initially, the condition feels like a wrist sprain; however, if it is not recognized and treated early, the condition will progress and collapse the lunate which will cause the wrist to develop arthritis. MRIs are helpful in the early diagnosis of Keinbock’s disease. A shortening osteotomy of the radius is the main procedure used to treat Keinbock’s disease when it is symptomatic, in Stage II (can be seen as sclerosis of the lunate), and when the patient has a negative ulnar variance.

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Dr. Ebraheim, Amanda Critton and Lauren Corba do not have any relationships with industry to disclose.

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