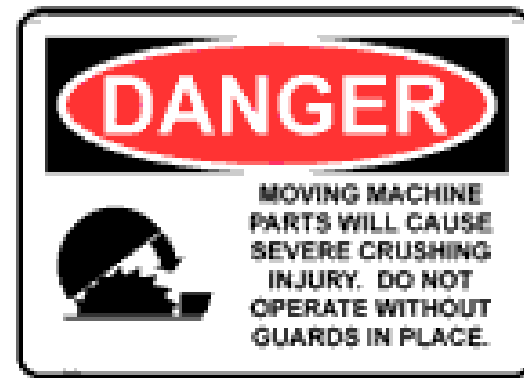
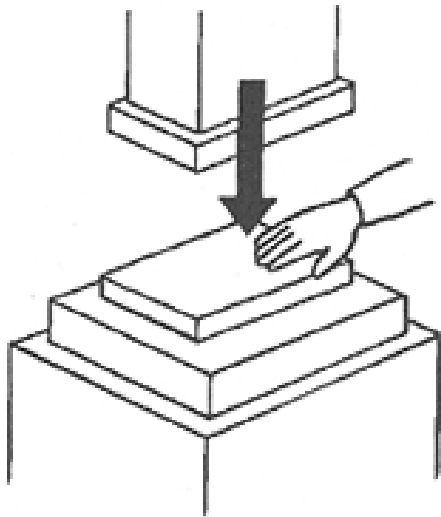


Crushing Injuries



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Philosophy

- Return patients to work ASAP.
- Specific restrictions if necessary with estimations on return to light and full duty.
- Explain expectations to patient as well, how they should progress weekly.
- Sitting work within a few days of surgery.
- WB in boot immediately if forefoot injury.
- Convert post op pain meds to non narcotics by first week.

Communication

- Office staff prioritizes workers compensation patients.
- Same day appointments.
- I can speak with you before or after any office visit to go over case.
- Case managers welcome!
- Work description from employer helpful

All Structures Involved in Crush Injuries



- ***Bone/ Joint-*** comminuted articular injuries, displaced fragments, cartilage injury.
- ***Muscle-*** tearing of fascia, crush muscle, avulse from tendon, denervation, devascularize.
- ***Tendons-*** tend to become adherent, cannot mobilize unless skeleton stabilized
- ***Vasculature-*** ischemia locally and at distance
- ***Nerves-*** direct injury or late ischemia
- ***Skin-*** injury may shear vascular supply crossing superficial or deep fascial planes leading to ischemia.

Types of Crushing Injuries

- **1. Compressive-** fracture or dislocation with/without a break in soft tissue
- **2. Contusion-** predominantly skin and subQ tissue, without fracture



3. *Shear/ Deglove*

- Soft tissue avulsion by application of tangential force
- Usually needs amputation
- Poor functional outcome with repair, but good cosmetically
- Replant only when replantation team available



4. *Mangling*

- Marked disruption of bone and soft tissue
- Power saws, mowers, fans, gears, pulleys, presses, belts, grinders, shredders
- Highly contaminated, multiple fractures
- Reduce dislocations, stabilize fractures, wash contaminated areas, delayed closure.
- Consider amputation early, or after second/ third look and extensive discussion with patient/ family.



Evaluation

- Neurovascular status-
 - Blood supply- pulses, capillary refill
 - Sensation
 - Movement of fingers, toes
- Osseous and soft tissue injuries
 - Closed injuries
 - Grade 0 minimal soft tissue injury
 - Grade 1 abrasion above fracture
 - Grade 2 muscle contusion, contaminated skin, severe fracture
 - Grade 3 degloving, crushing, compartment syndrome, vascular
 - Open injuries
 - Type 1 <1cm clean wound over fracture
 - Type 2 >1cm no severe soft tissue damage
 - Type 3 large wound, gunshots, farm injuries
 - A contaminated but good coverage
 - B needs rotational or free flap coverage
 - C vascular injury

Treatment

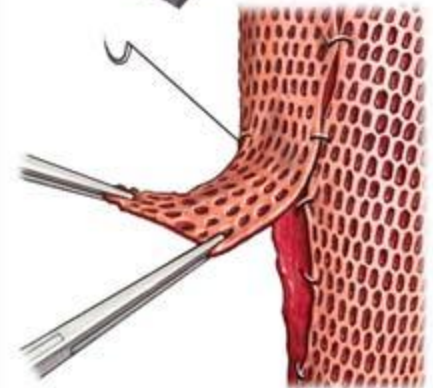
- **Soft tissue debridement-** avascular and necrotic tissues debrided. May need multiple procedures.
- **Rigid fixation-** Internal fixation with plate/screws or external fixation for open injuries.
- **Skin graft if necessary.** Split thickness for superficial loss, plastics for larger areas that may need flap coverage.
- **Faciotomies**



Graft taken from patient's healthy skin

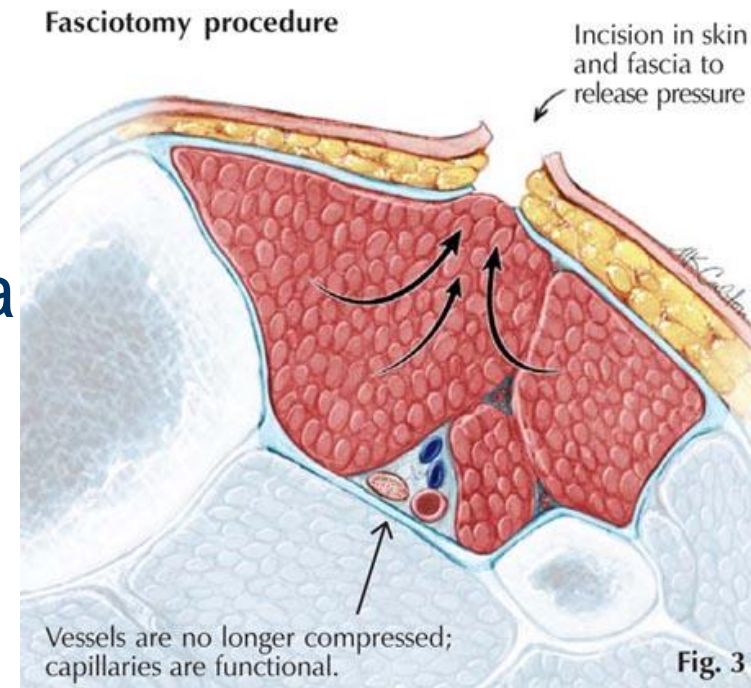


Skin is meshed to cover a large wound



Fasciotomy: Treatment of Compartment Syndrome

- CS is a group of symptoms and signs occurring together that result from increased pressure within a limited space compromising the circulation and function of the tissues in that space.



Compartment Syndrome

- Primarily a clinical diagnosis
- Muscle can tolerate ischemia for 4 hours, at 8 hours of total ischemia, irreversible damage
- Pain at rest, made worse with **passive** motion is hallmark.
- May have normal color and temperature in skin.
- Decreased sensation and motor function are second and third finding

Compartment Syndrome

- Pressure testing- Pressures higher than 30Hg or within 10-30 mm Hg of diastolic blood pressure suggest CS.



Volkmann's Ischemic Contracture

- Final state of muscles and nerves in a compartment that has died and replaced with fibrous tissue



Case 1- 38y/o with left arm crushed by compactor

- Seen initially in ER and told no fracture, splinted.
- Seen in office, and found to have numbness in fingers, pain with wrist and finger motion, swollen arm and wrist.



- Underwent fasciotomies of forearm, CTR, ulnar nerve decompression and transposition
- Post op did well, regained all sensation and motion in hand
- Patch of numbness in forearm



Post op

- Started PT once wound healed 2-3 weeks with minimal lifting affected arm
- Burning, numbness, and stinging as both nerves recovered over first 3-4 weeks.
- 2 months returned to work full duty, no impairment.

Case 2- 22y/o with crush to foot wearing steel tip boots.

- 2nd and 3rd toe amp treated at outside hospital, **3 months prior** unable to work secondary to pain.



Case 2

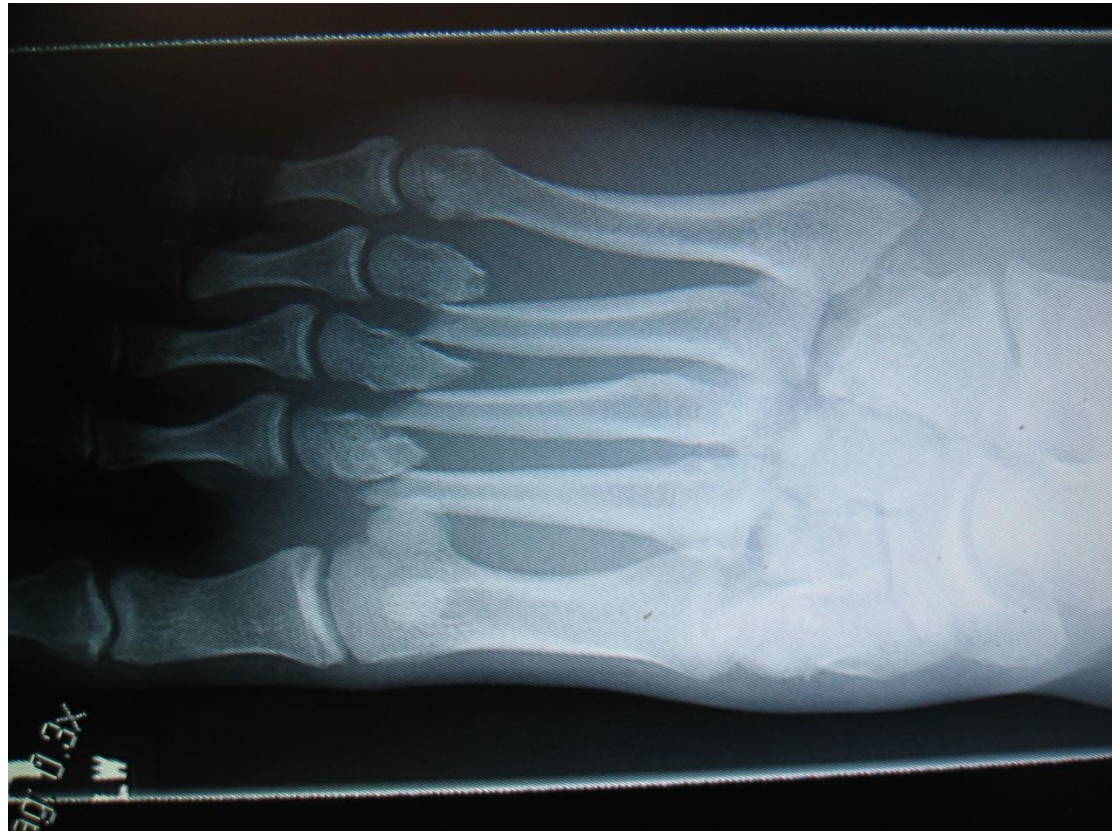


Case 2

- Pain coming from 2 places, neuroma at traumatic amputation sites of both toes
- Very thin soft tissue coverage of second toe condyle
- Underwent a 2/3 common digital nerve excision, and revision amputation of second toe, wrapping the flexor tendon around stump to provide cushion.
- Light duty at 2 weeks when wounds healed
- Full duty at 4 weeks and MMI

Case 3- 31 y/o Foot Crushed by Heavy Object

- Swollen numb foot at presentation. Taken immediately to surgery.



Lis Franc midfoot dislocation



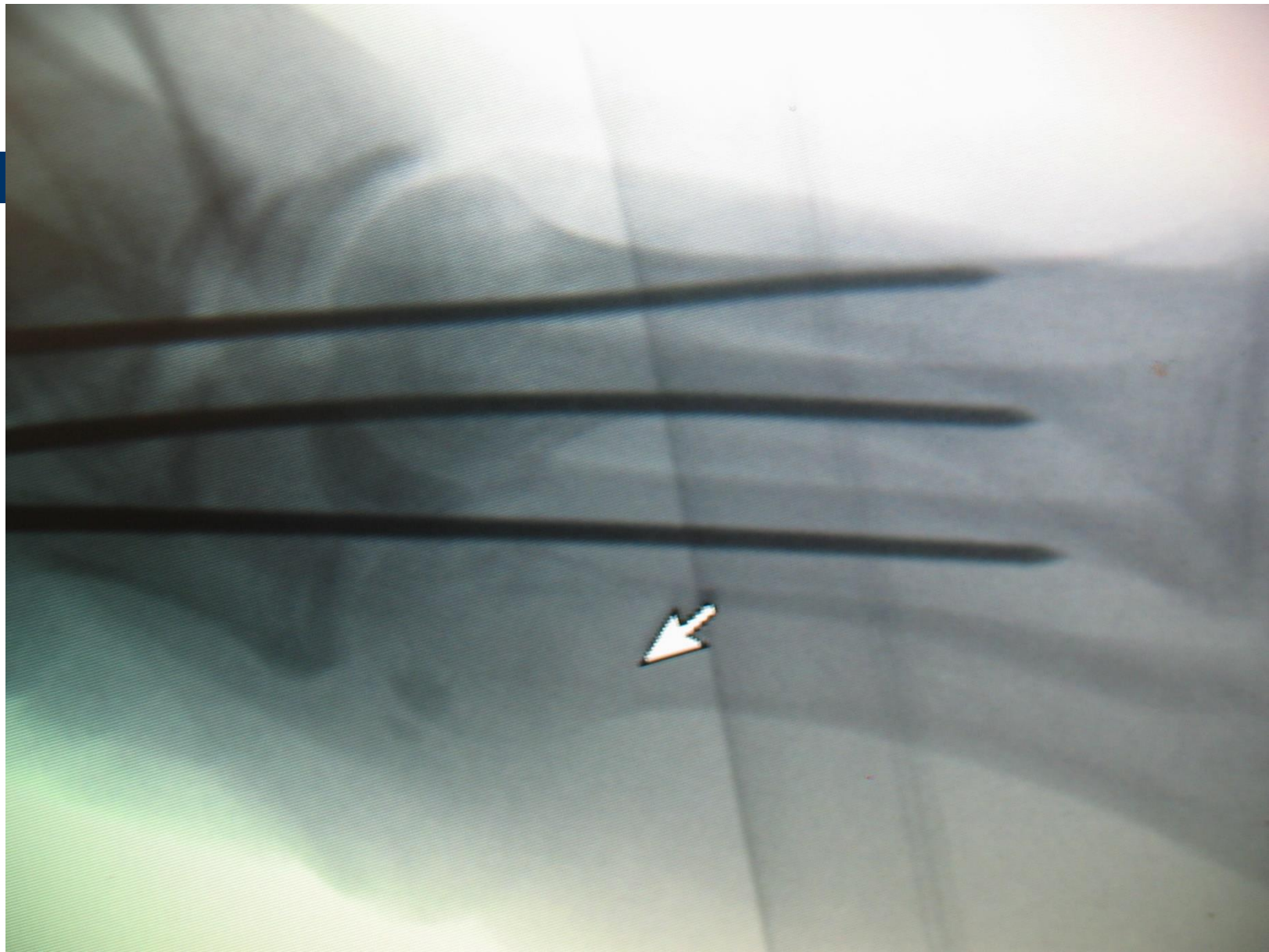
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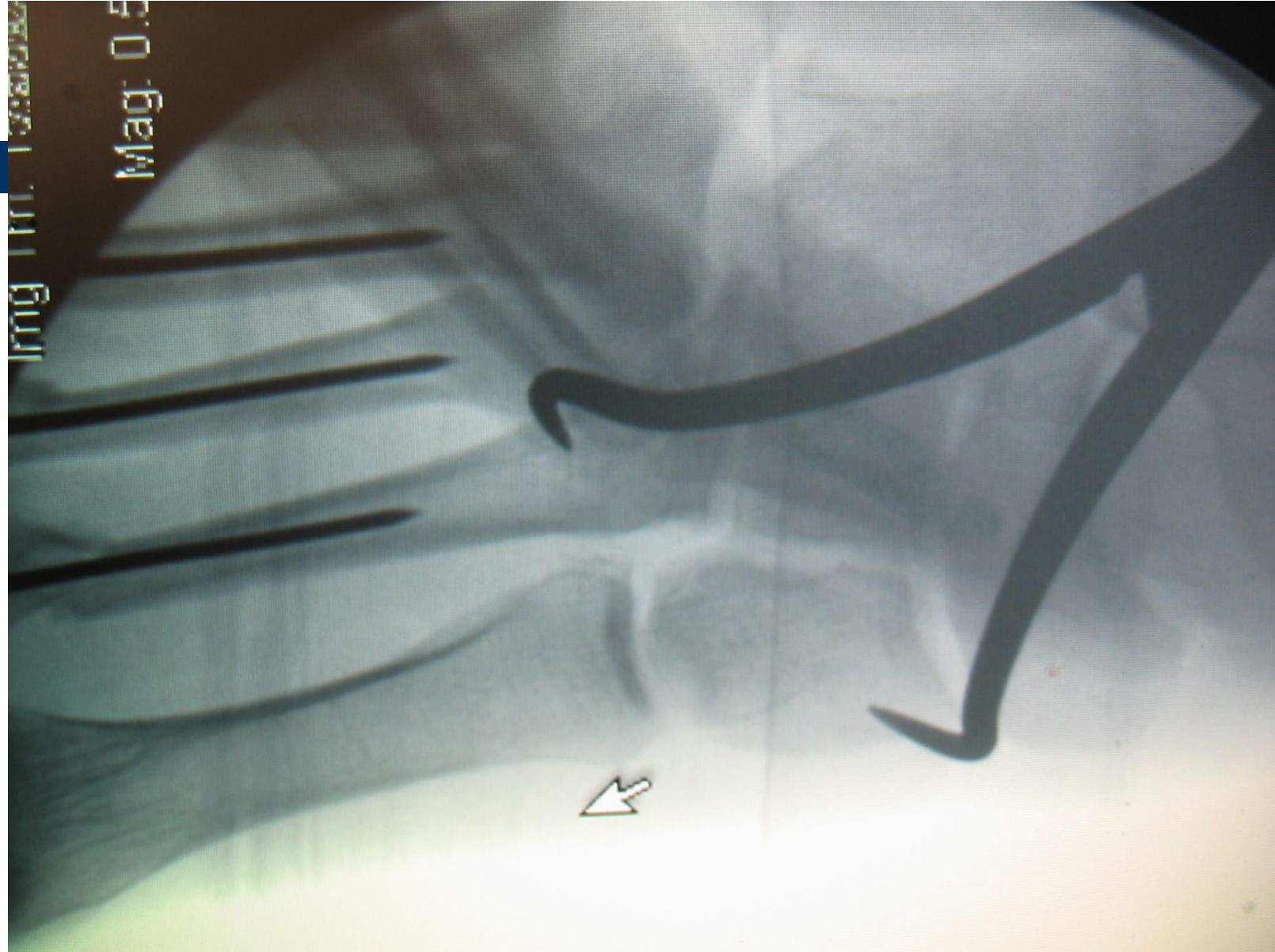
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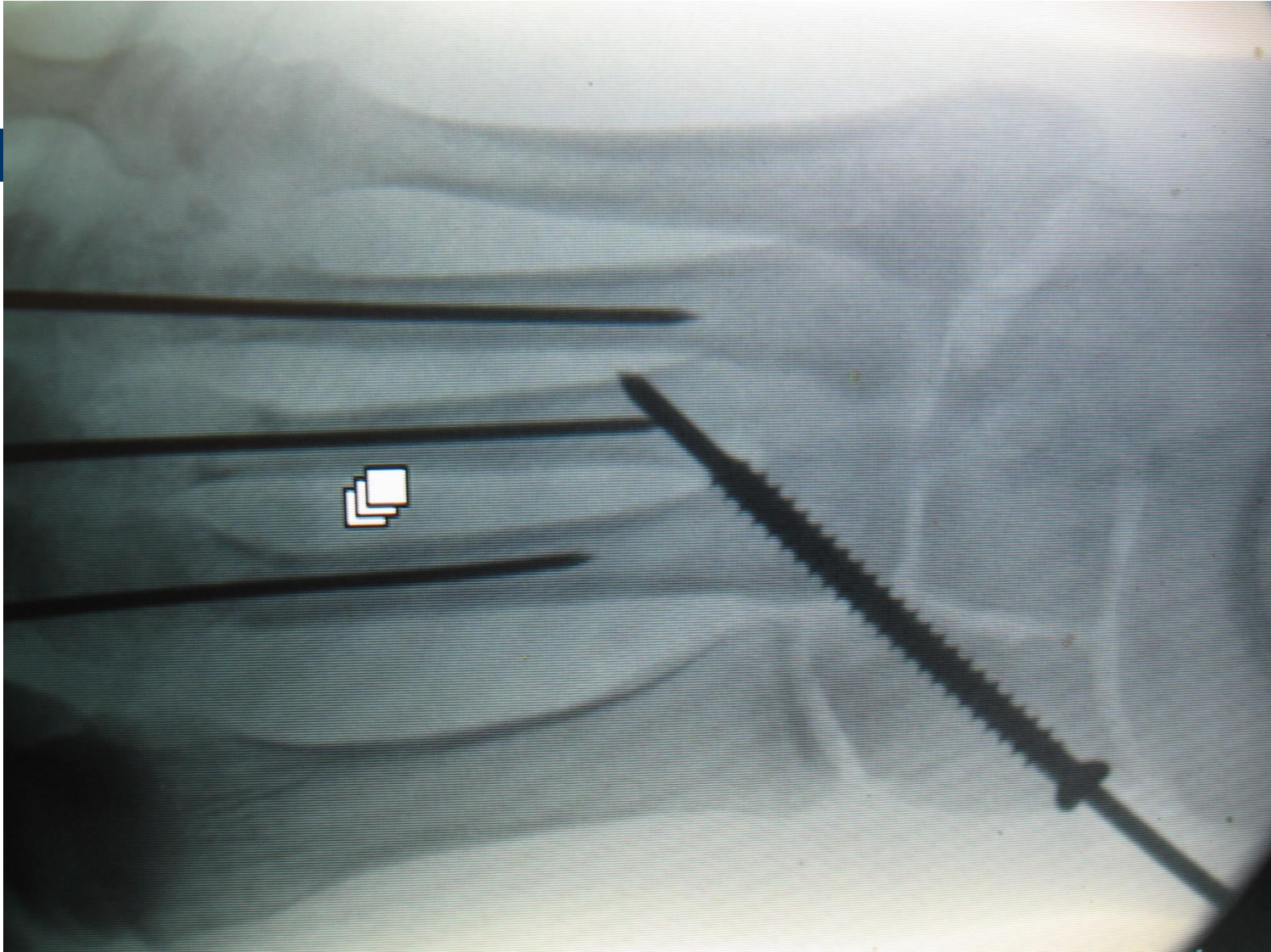


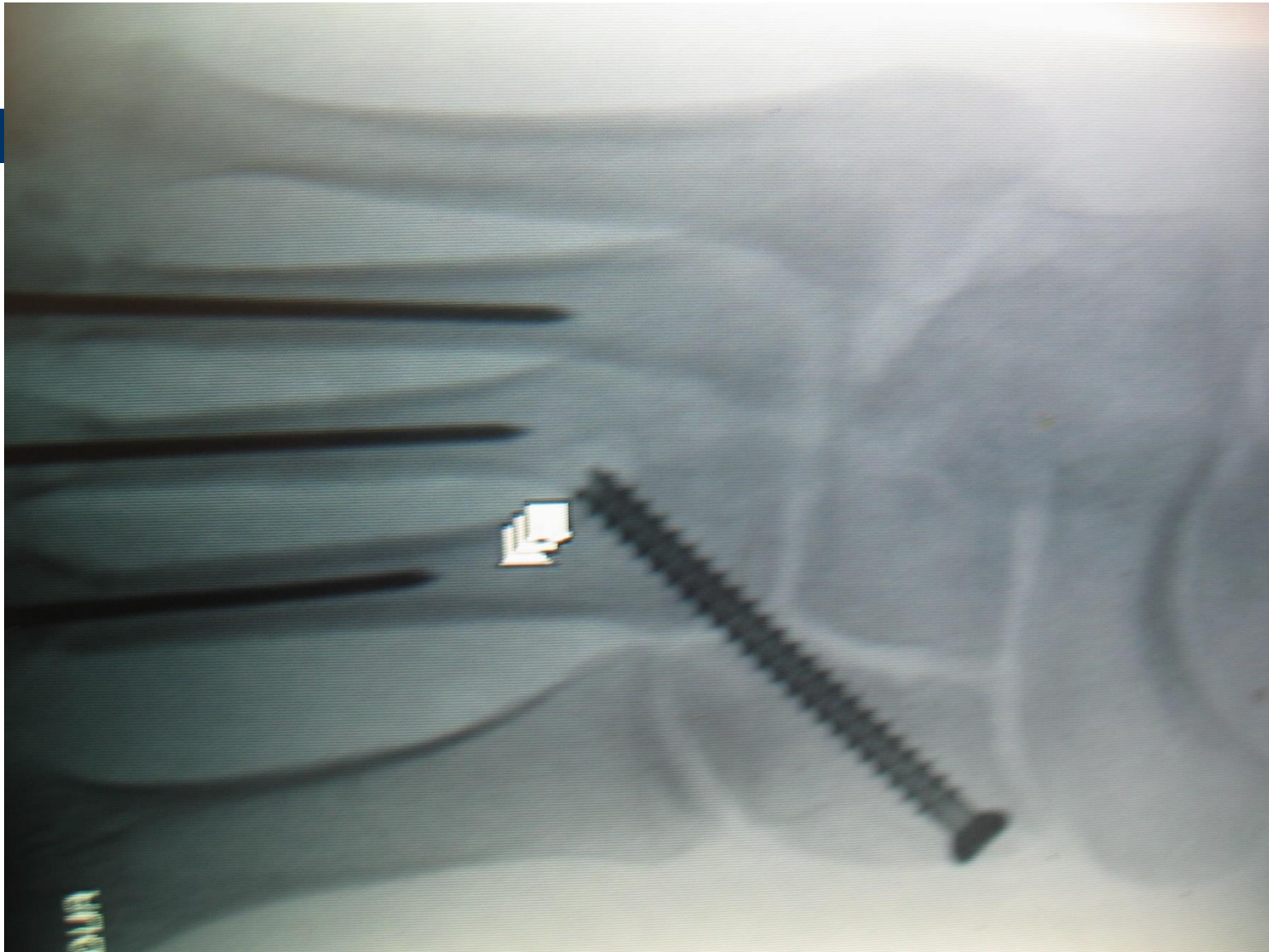
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Mag: 0.8













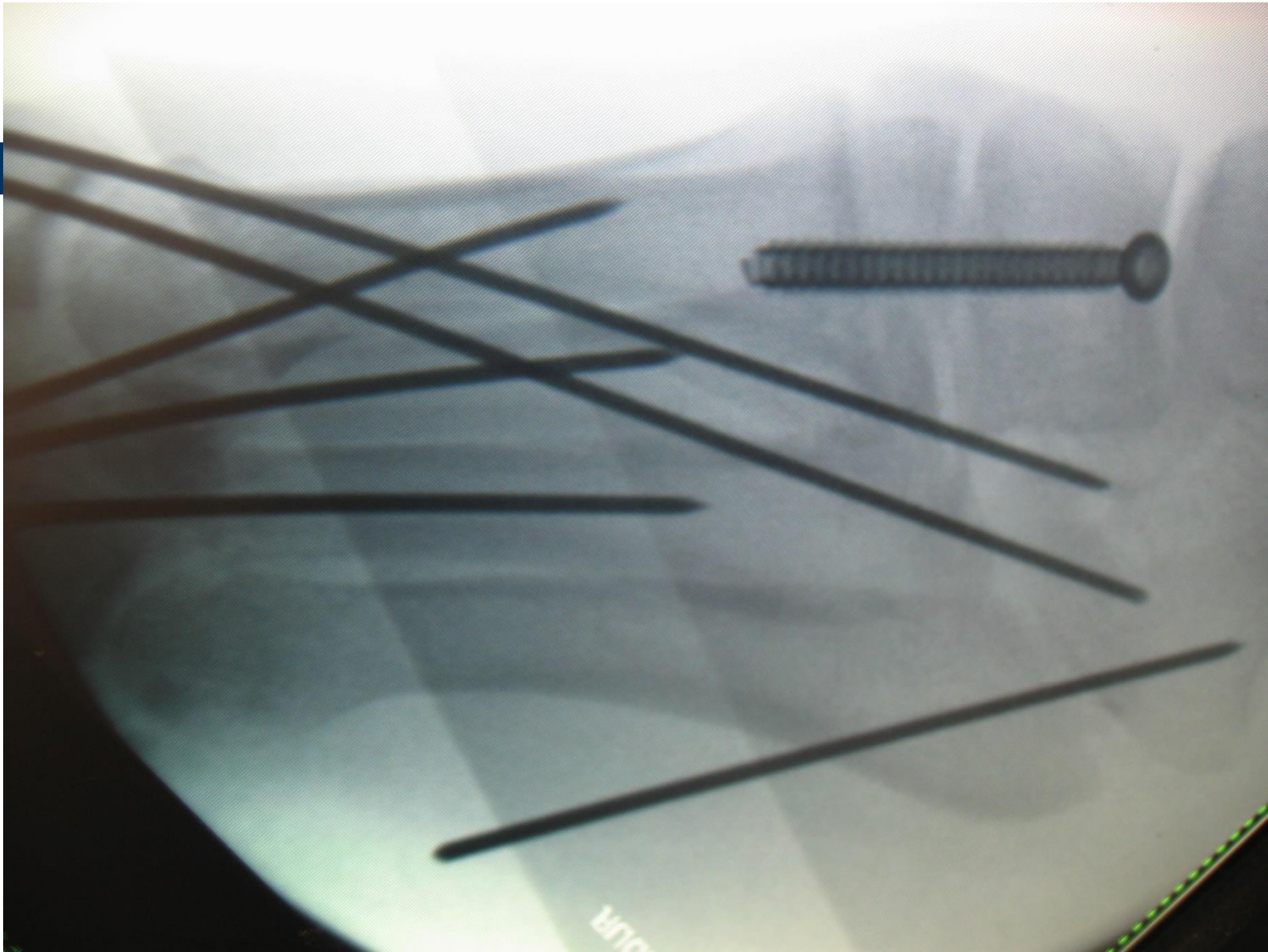
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E. MAHESH
ARM OVER 1 HOUR

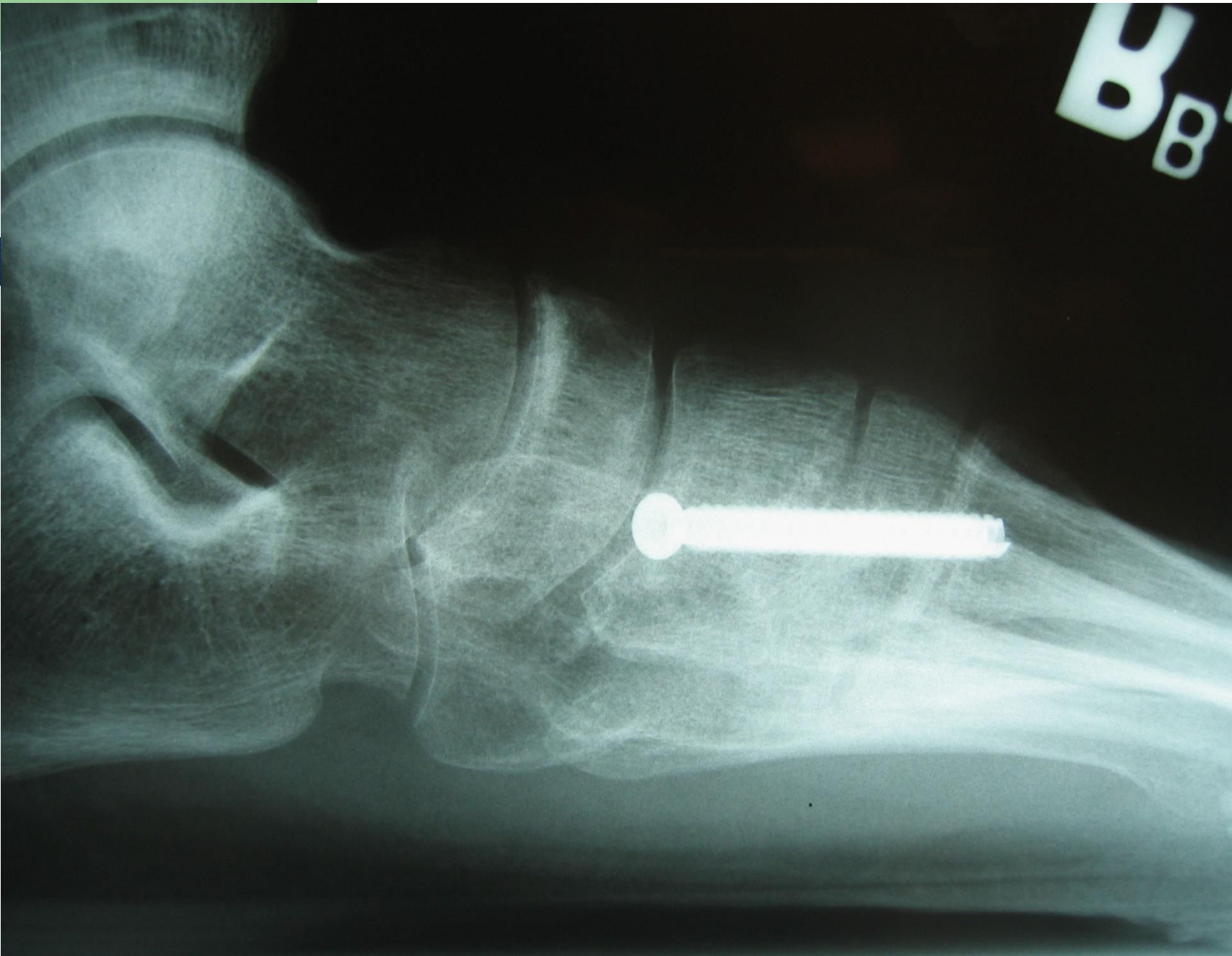
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61 kVp
1.52 mA
10



Recovery

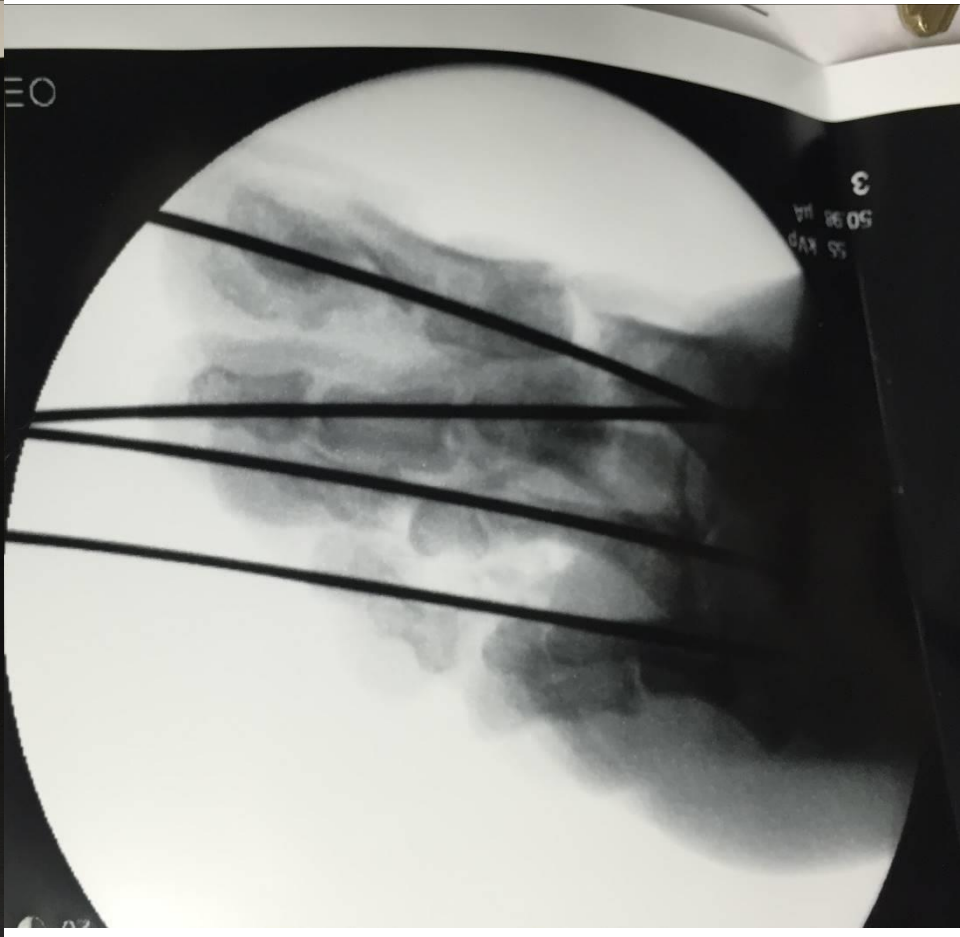
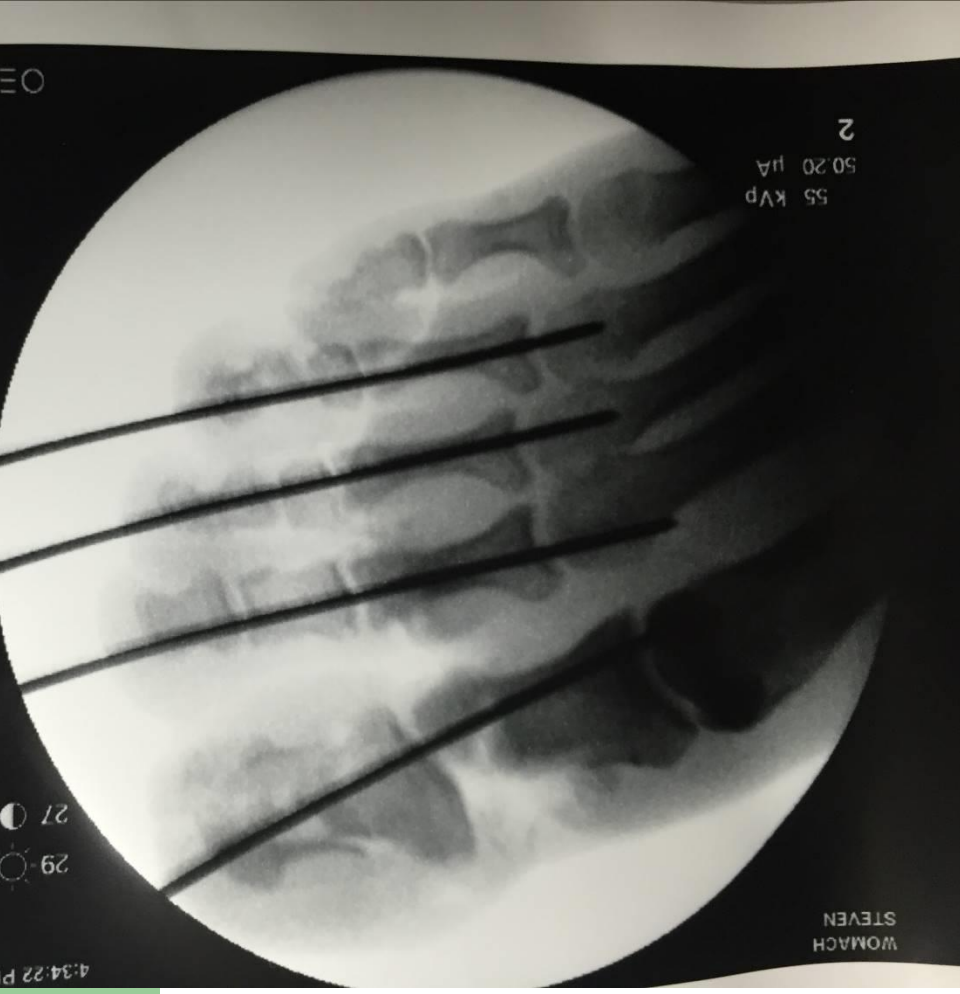
- Lateral pins pulled at 4 weeks
- MT pins pulled at 7-8 weeks
- Started walking at 2 months post op
- Physical therapy for muscle strengthening and mobility of ankle/foot
- Returned to work full duty MMI 4 months post op





Case 4: Crush injury to forefoot

















Returned to work

- Once all wounds healed patient began full weight bearing in therapy
- Foam spacers in shoe to make up for missing toes
- Returned to work full duty without restrictions after completion of physical therapy

Case 5

- 30y/o male, foot caught between pallet jack and wall at a warehouse briefly.
- Trouble walking, ripping sensation across middle of foot. Initial bruising gone.
- ER found no fracture, told to go back to work
- Walking on heel only, avoiding midfoot, presented for 2nd opinion 2 months after injury

WB vs non WB



- Isolated repair of Lis Franc ligament with internal brace
- Non WB 5 weeks then started PT
- Return to full duty at 12 weeks post op



Thanks!

- Questions?

