

# Percutaneous Fixation of the Acetabulum

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All figures belong to Joey Johnson, MD unless otherwise noted



# Objectives

- **Goals of operative management**
- **Indications for intervention**
- **Radiographic views**
- **Fixation corridors**
- **Special Cases**
- **Combined open and percutaneous methods**

# Goals of Operative Management

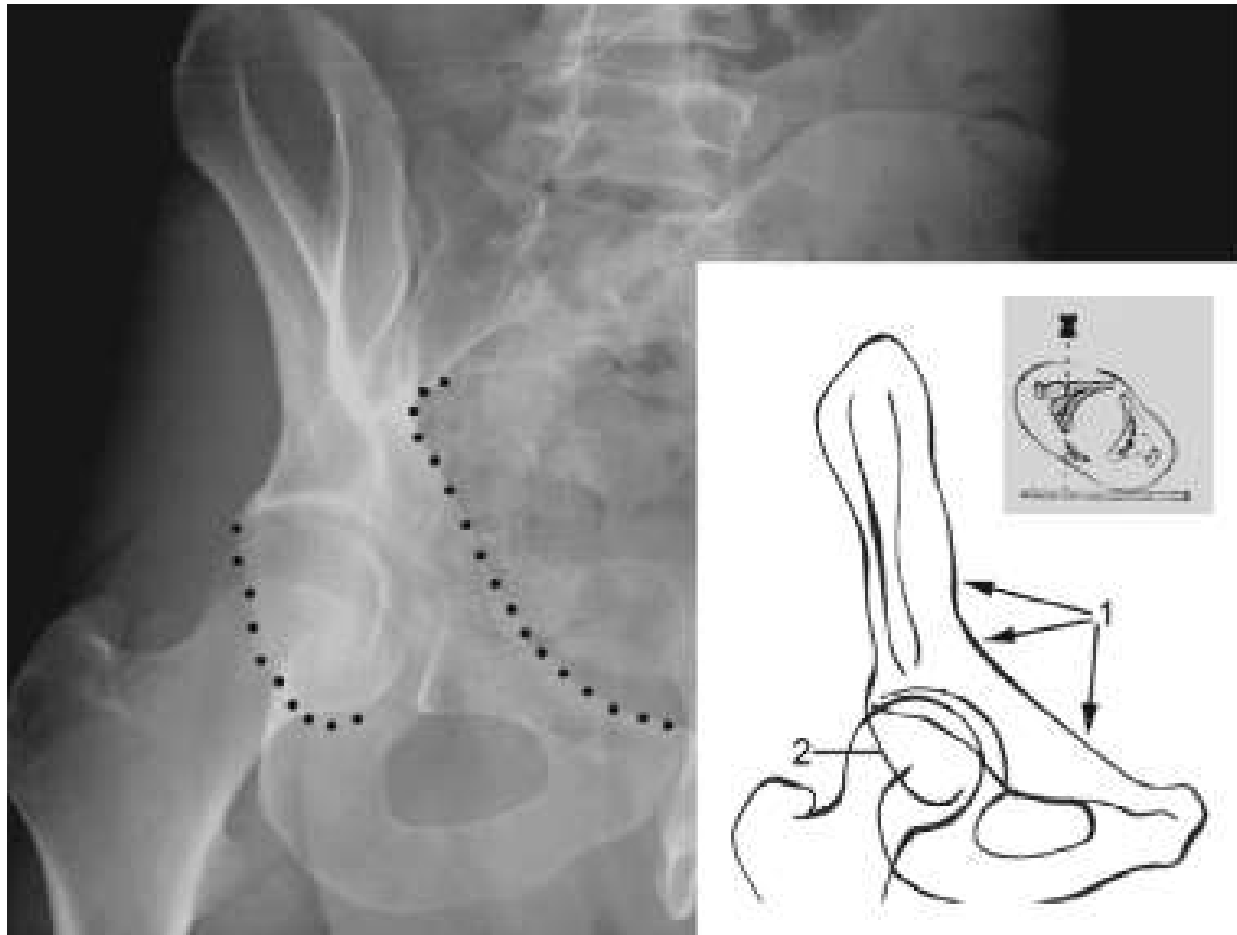
- As with all periarticular fracture work, anatomic reconstruction (particularly of the weightbearing dome) and stable fixation to allow for early mobilization are key
- In some settings when anatomic reconstruction is not feasible (elderly patients with poor bone quality, prolonged dislocation, combined femoral head and acetabular injuries, etc) percutaneous means can be used in conjunction with total hip arthroplasty to allow for an optimal outcome
- Minimizing morbidity and maximizing function are the goals of all surgical treatment and percutaneous fixation methods can offer a very useful tool in achieving these goals when used in isolation or in combination with open techniques

# Indications for Intervention

- **Hip instability**
- **>2mm displacement within the weightbearing dome**
- **Fracture lines that are amenable to fixation through bony corridors**
- **The presence of unstable posterior (and often anterior) wall components usually necessitates at least a partial open approach and percutaneous fixation of these in isolation is usually not recommended**

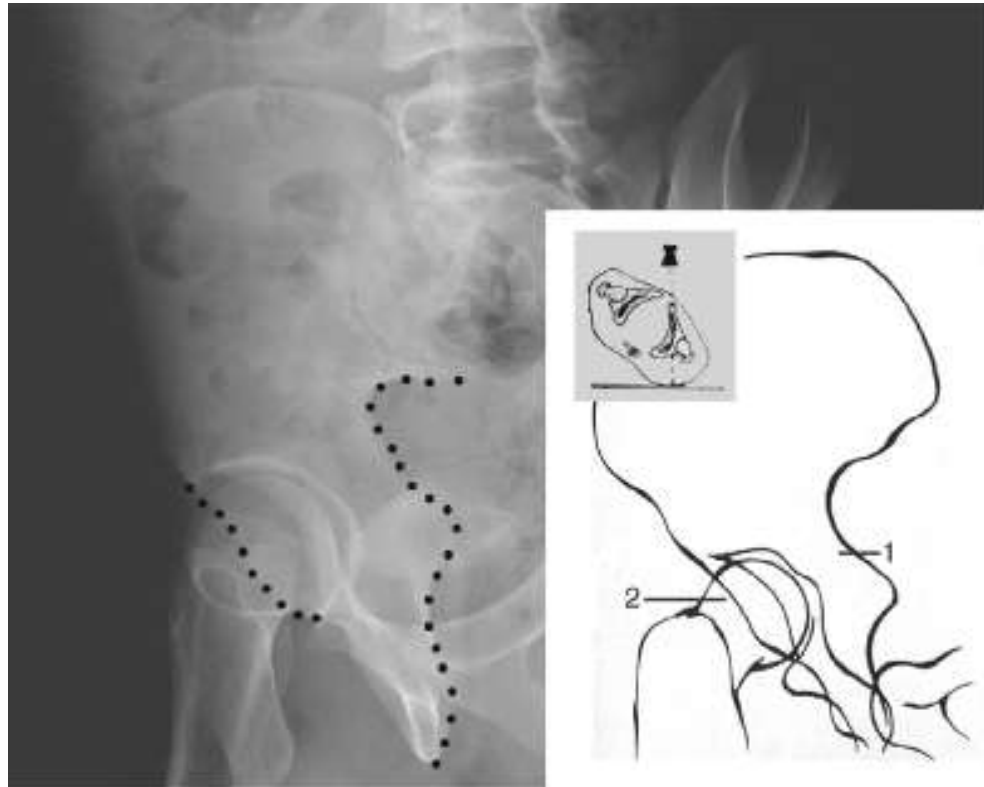


# Radiographic views- Obturator Oblique



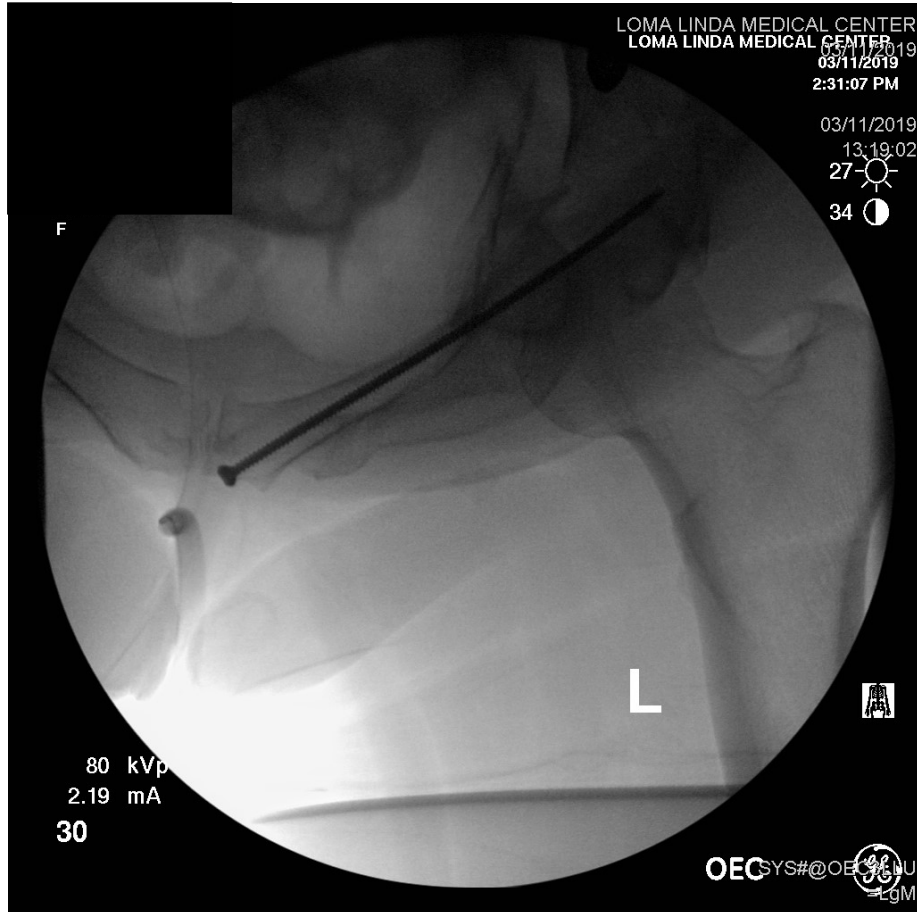
- “Percutaneous fixation is a surgery performed by the fluoro tech, where the surgeon assists him/her”
- 45 degrees roll over towards injured side (patient position, anatomy and fracture deformity can alter this number)
- Visualization of posterior wall and anterior column
- All of the following views are combinations of obturator and iliac obliques as well as inlet and outlet views

# Radiographic views- Iliac Oblique



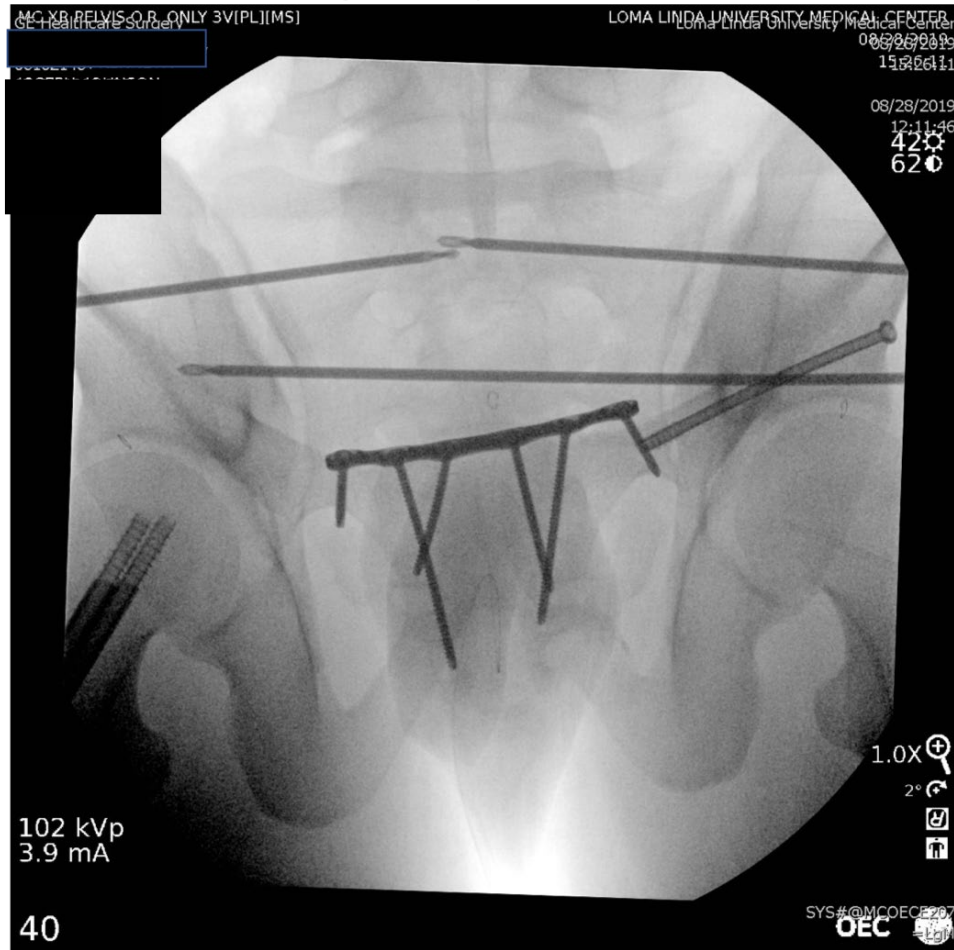
- 45 degrees of roll over away from injured side, anterior wall and posterior column are visualized
- If adequate radiographic views cannot be obtained, then percutaneous acetabular fixation cannot be performed
- High quality fluoroscopy is dependent on the machine being used, the technologist using it, and the ability of the surgeon to communicate effectively

# Radiographic views- Inlet



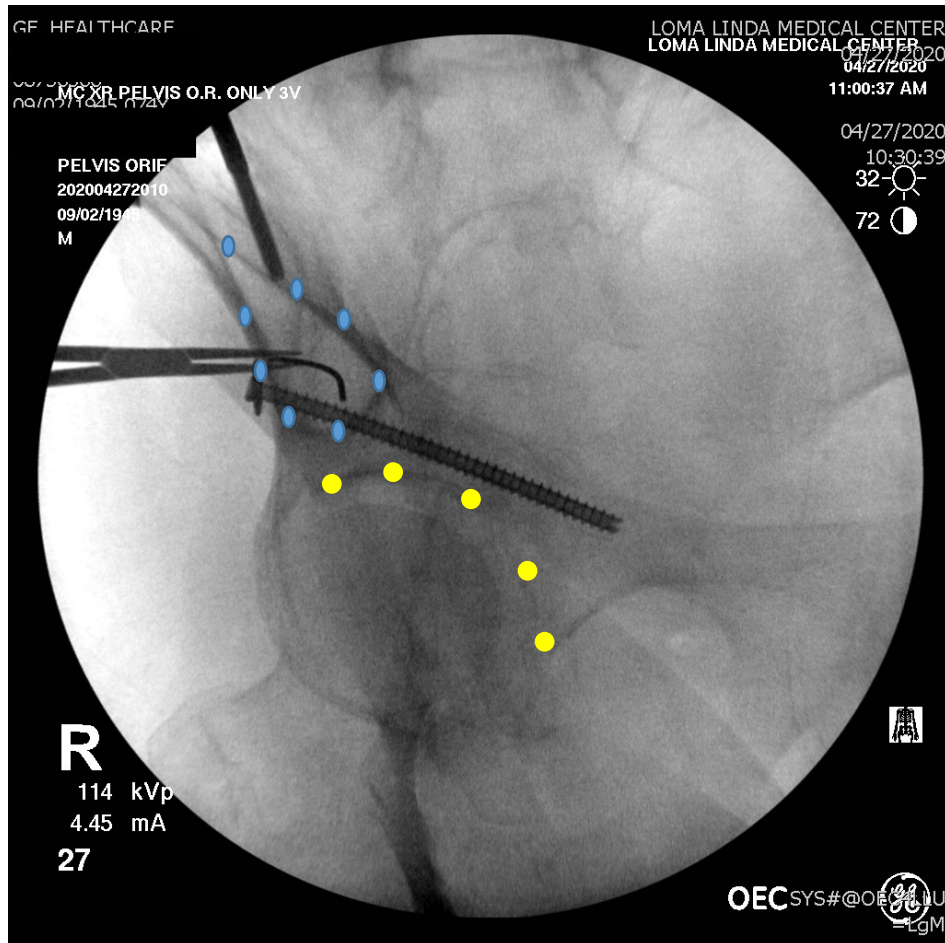
- Beam tilted 25-40 degrees caudal (dependent upon patient's sacral and pelvic anatomy, and positioning bumps/bone foam)
- Rami should be superimposed on each other

# Radiographic views- Outlet



- Beam angled 25-40 degrees cephalad (dependent on patient anatomy)
- Symphysis should line up with spinous processes and sacral foramen should appear round

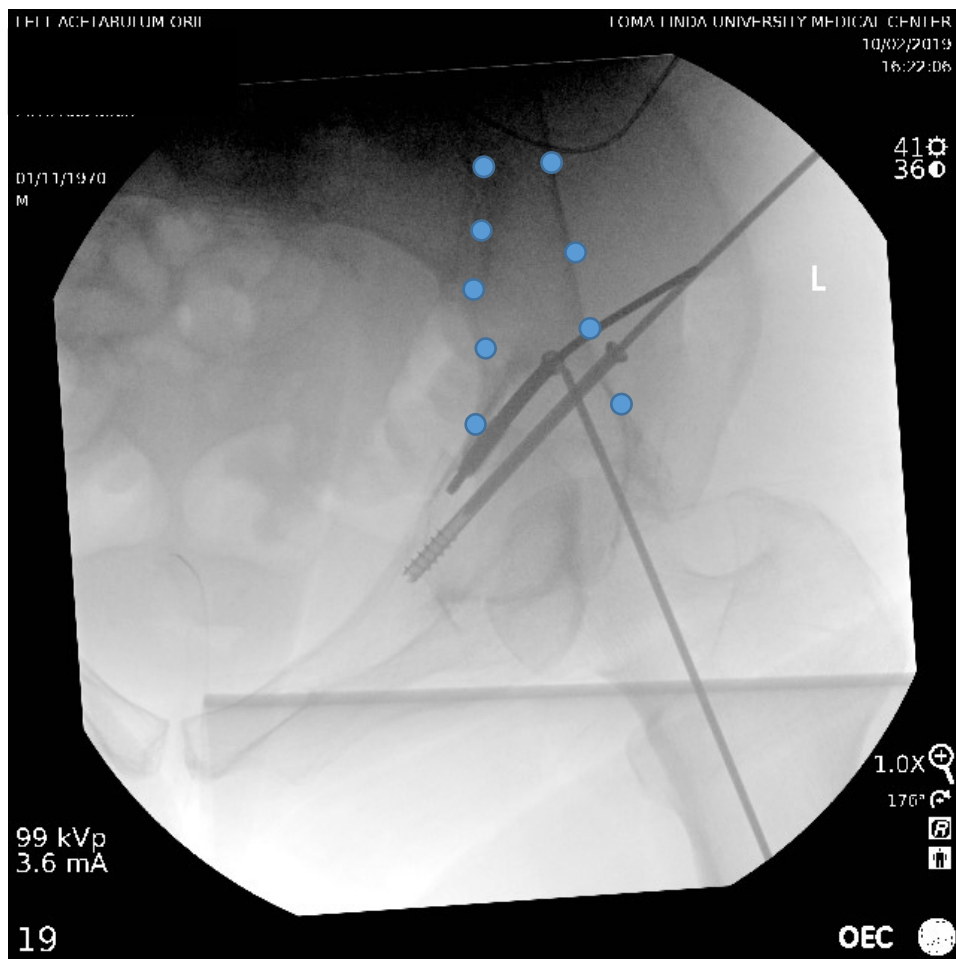
# Radiographic views- Obturator outlet (teardrop)



- This view shows the supra-acetabular corridor that runs from AIIS to PSIS (blue dots), also is a view used to confirm that an anterior column (or SPR) screw is not penetrating the acetabulum (yellow dots)
- 45 degrees of roll over towards injured side and 30 degrees of outlet

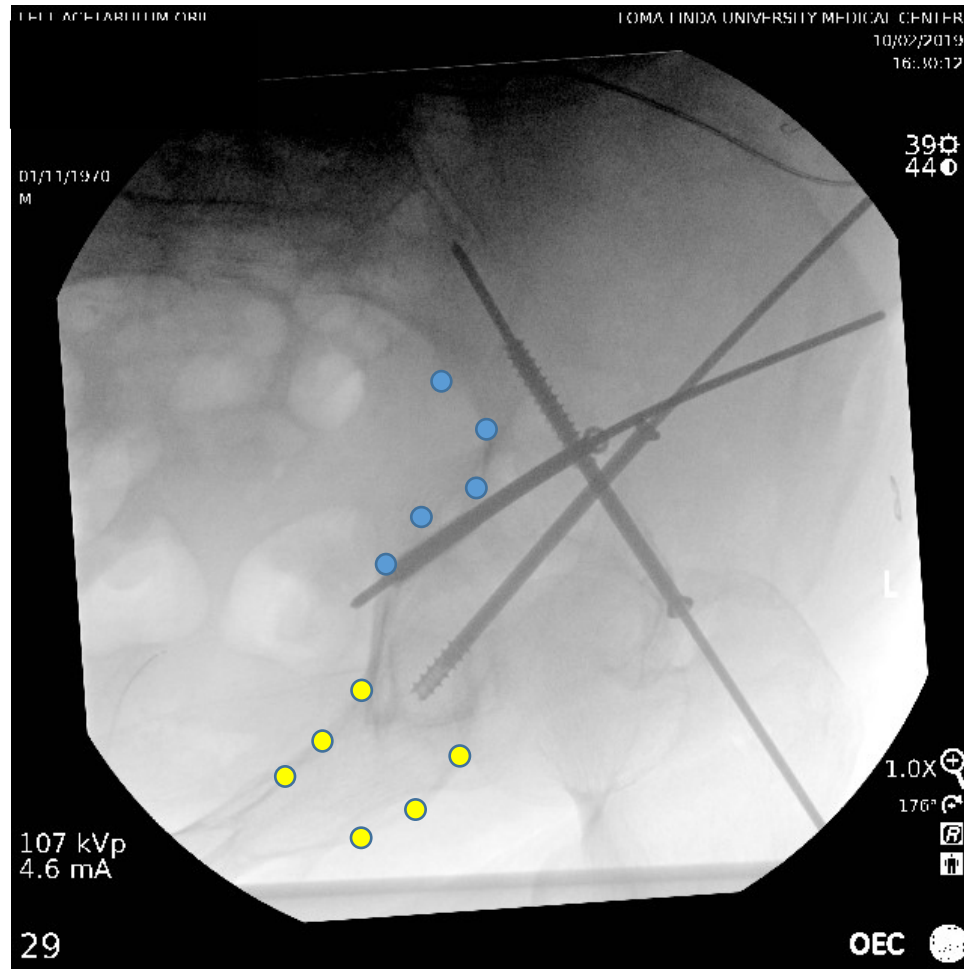


# Radiographic views- Obturator Inlet (Leeds View)



- The obturator inlet view allows for visualization of the inner and outer tables of the supra-acetabular corridor (Blue dots)
- Useful for placing supra-acetabular (LCII) screws, anterior pelvic ex fix pins, or INFIX screws
- 45 degrees of rollover towards injured side and 25-40 degrees of inlet

# Radiographic views- Iliac Inlet



- Allows for visualization of the sciatic notch (blue dots) and the pubic root (yellow dots)
- 45 degrees of roll over away from injured side and 25-40 degrees of cranial (inlet) tilt

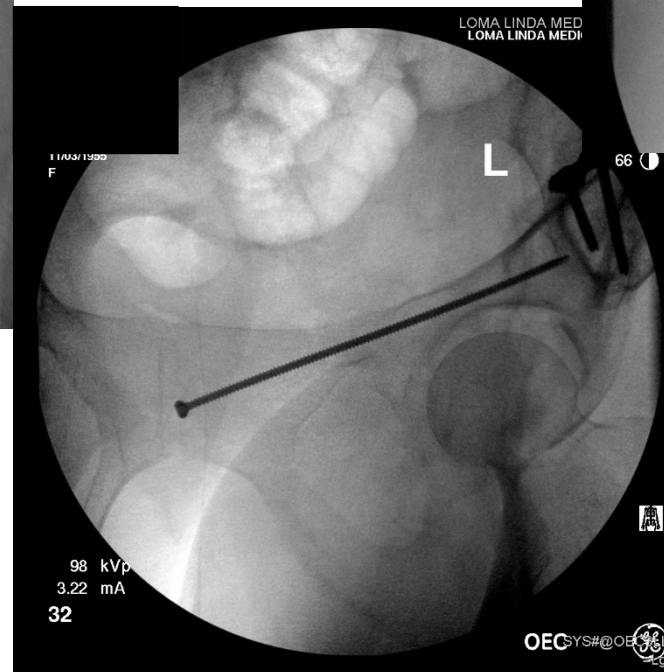
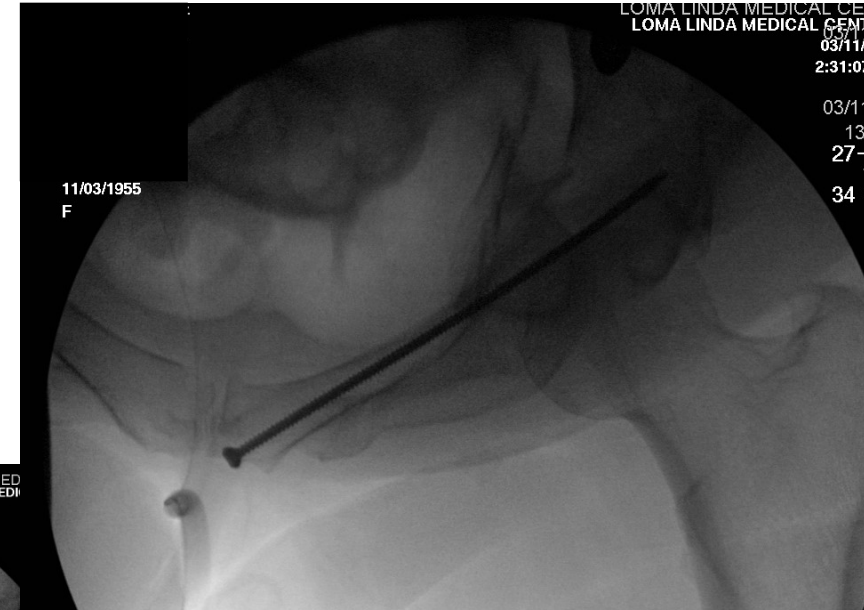
# Fixation Corridors- Anterior Column/SPR



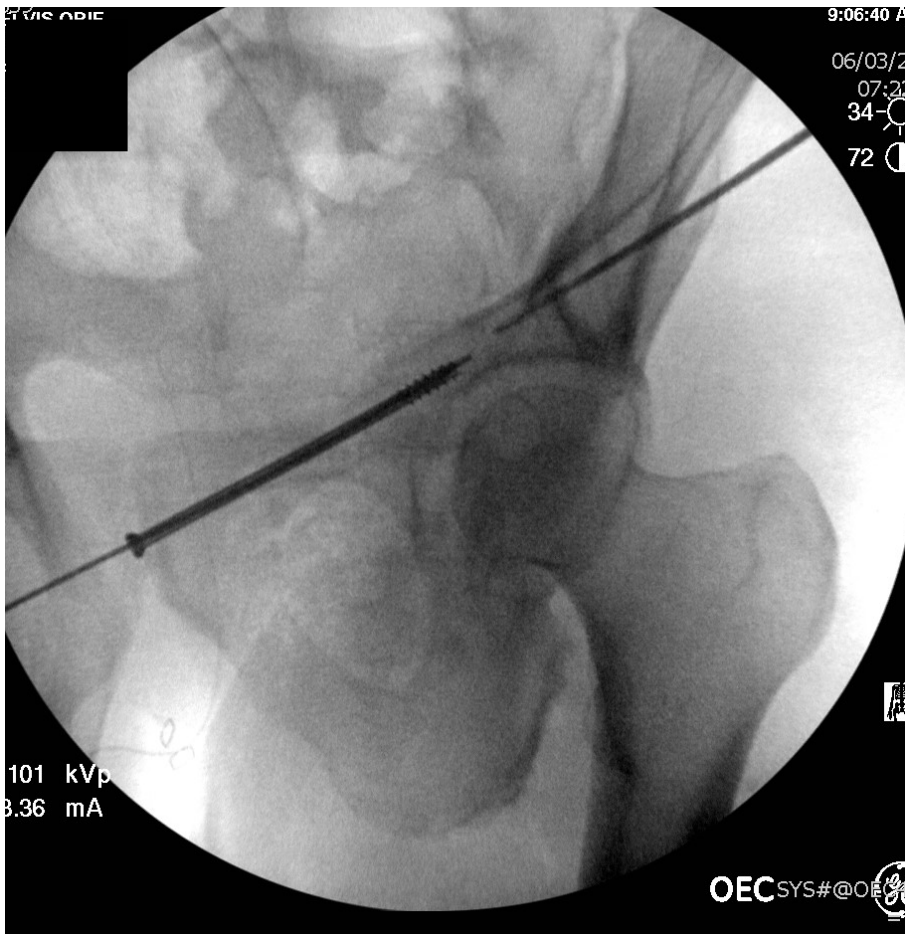
- Can be done antegrade (starting behind the acetabulum, lateral to sciatic notch), or retrograde (starting lateral to the symphysis)



# Fixation Corridors- Anterior Column/SPR (Retrograde)

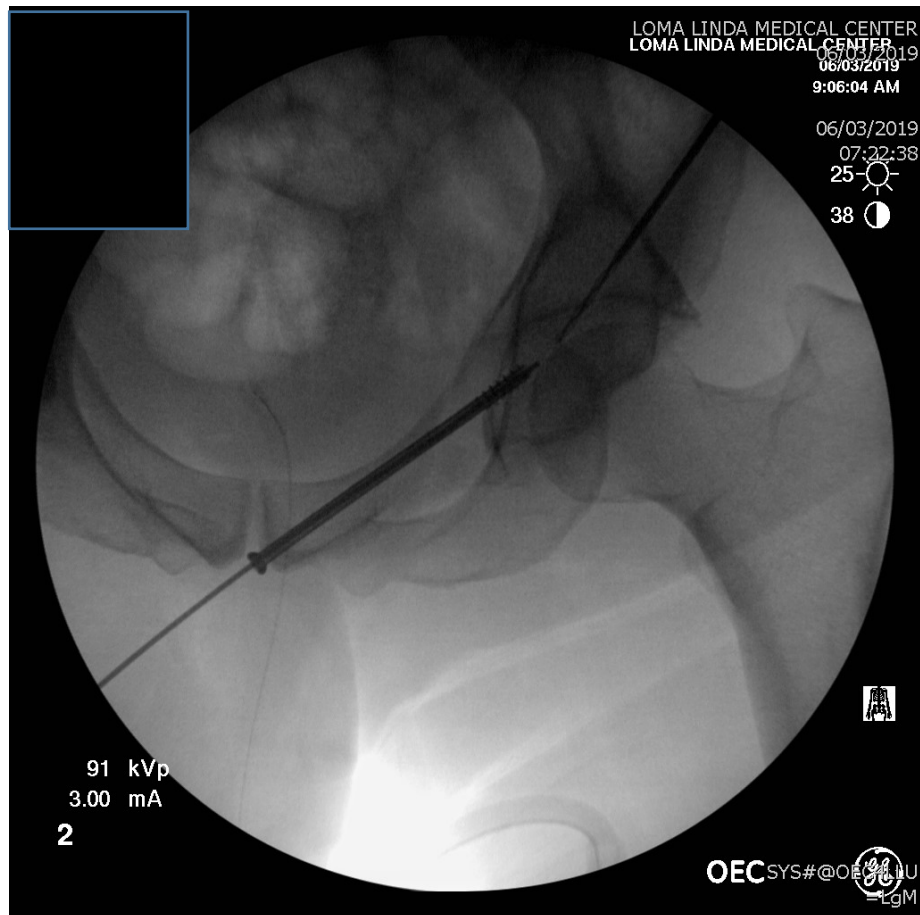


# Fixation Corridors- Anterior Column/SPR (Retrograde)



- Starting point is just lateral to the symphysis, the trajectory should be superior to the acetabulum
- Obturator outlet view confirms that you are out of the acetabulum
- Inlet, or iliac inlet, confirms that you are within the ramus
- This connects the medial anterior column, or superior pubic ramus, to intact lateral anterior column, superior to, or behind the acetabulum
- Screw length will be dependent on fracture location

# Fixation Corridors- Anterior Column/SPR (Retrograde)



- CT scan should be used to assess the presence of comminution (an antegrade screw was attempted but because of the comminuted area the screw could not hit cortex and bend past it), and the size of the ramus
- Solid or cannulated screw options can be used
- Difficult in large patients because their thighs can get in the way, a sacral bump is useful to extend the hips and drop the thighs away
- Keep C arm on the injury side of the patient

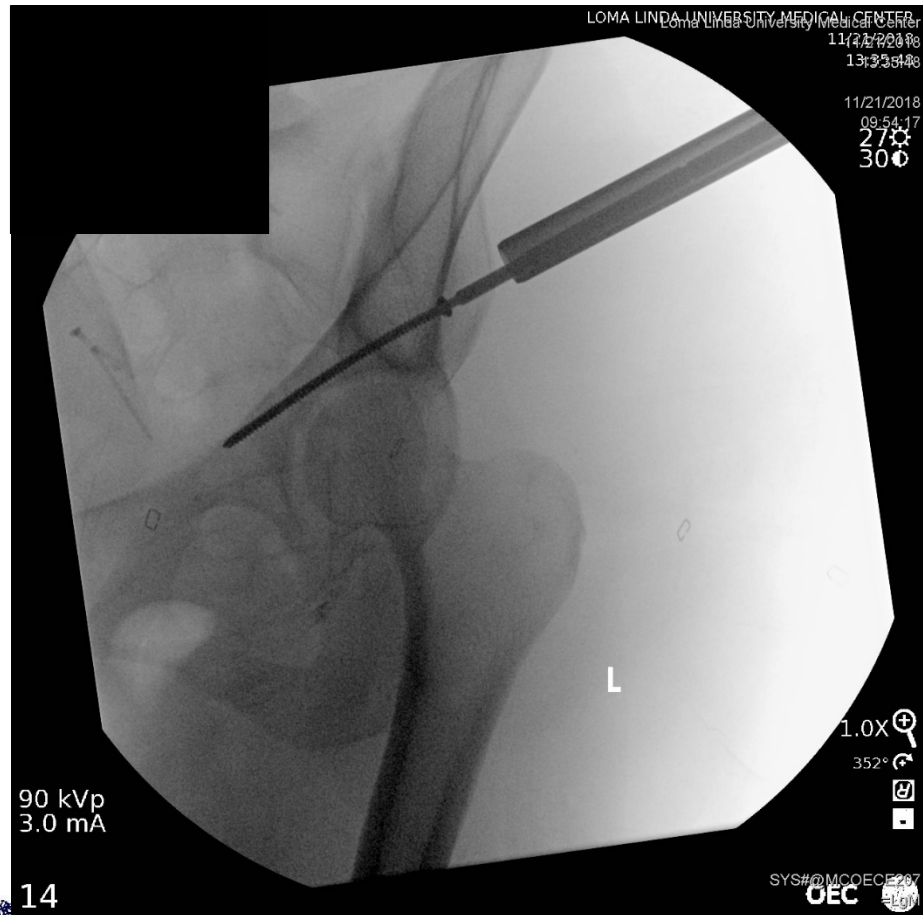


# Fixation Corridors- Anterior Column/SPR (Retrograde)



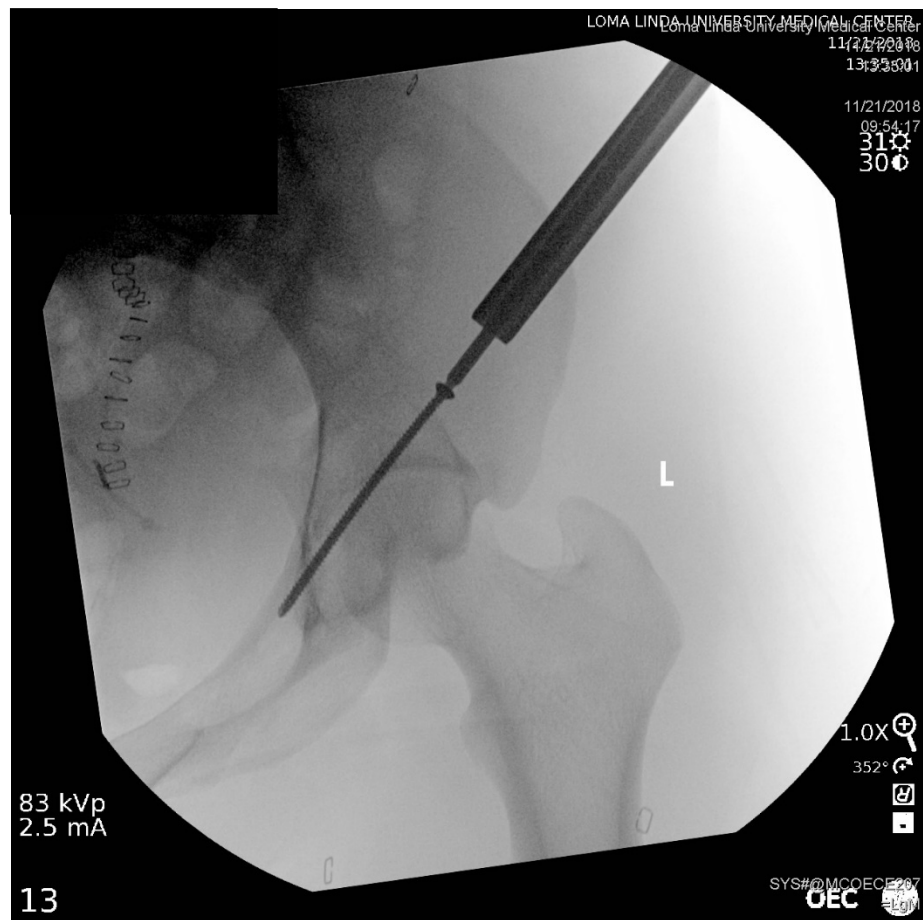
- Careful nick and spread technique and the use of cannulas/drill guides is recommended to prevent damage to surrounding structures
- The skin incision is on the opposite side of the symphysis and inferior to the starting point to allow for the proper trajectory
- Intra-pelvic penetration risks bladder injury, while exiting out the front of the ramus can injure the iliac vessels

# Fixation Corridors- Anterior Column/SPR (Antegrade)



- For an antegrade column screw the starting point is retroacetabular and lateral to the sciatic notch
- The skin incision starting point is nearly the same as the location of an S2 sacral screw, but the trajectory aims towards the symphysis (posterior to anterior)
- Because of this, bumping the patient's sacrum to allow dropping your hand is critical
- Moving the patient so the injured hip is as lateral on the bed as possible is also helpful

# Fixation Corridors- Anterior Column/SPR (Antegrade)



- The same views are used as retrograde anterior column screw (obturator outlet, and inlet or iliac inlet) but the C arm needs to be on the contralateral side
- If using solid screw options, after breaching the lateral cortex, using a long 2.5 drill on oscillate can allow the bit and screw to “bounce” and avoid cortical penetration
- A 1.6mm k wire can be used to find the starting point, and overdrilled first with a 3.2mm cannulated drill to “fine tune” our trajectory on inlet and obturator oblique views, after this, a 2.5mm drill can be introduced and drilled through the rest of the path
- We find this technique through a cannula very useful in most percutaneous fixation techniques



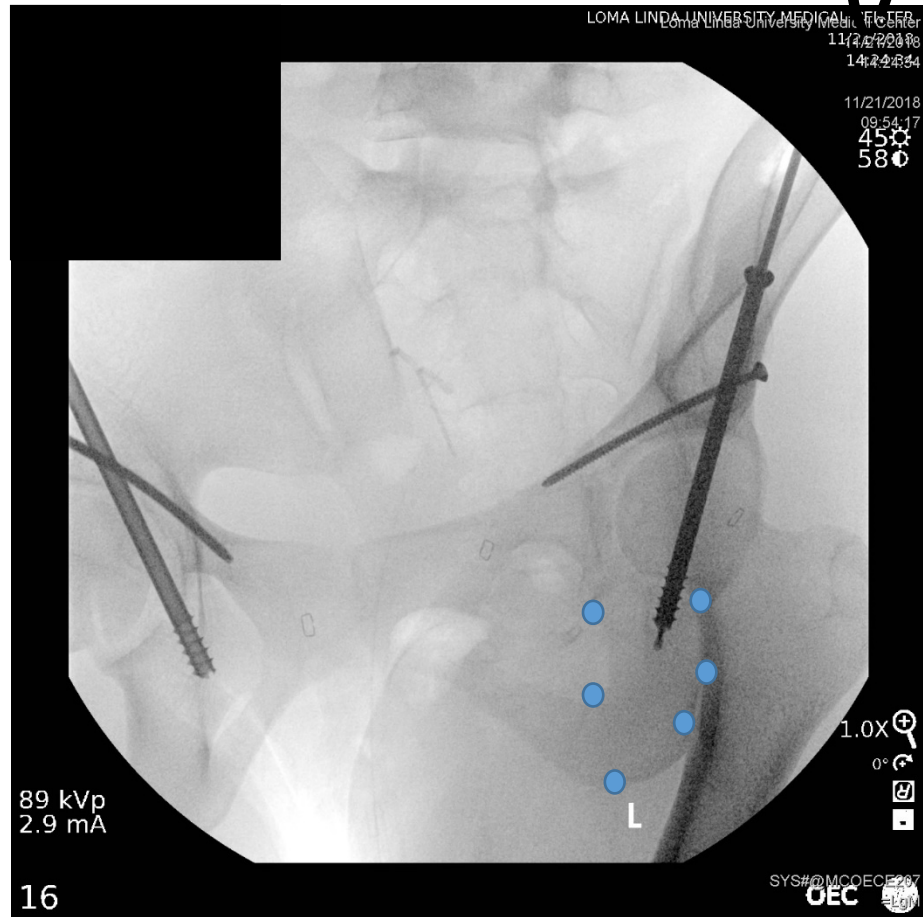
# Fixation Corridors- Posterior Column (Antegrade)



- This technique is not truly “percutaneous”
- A small 3-4cm incision over the medius pillar is needed to allow safe screw placement, then Cobb dissection down the inner table allows for identification of the start point



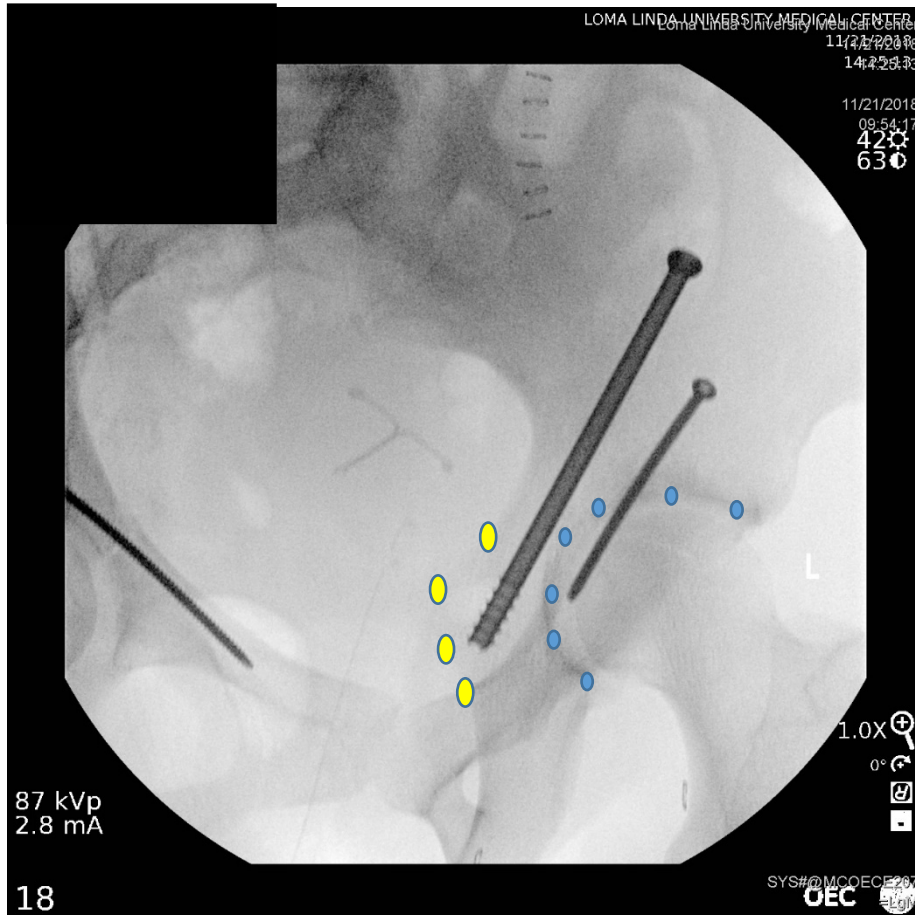
# Fixation Corridors- Posterior Column (Antegrade)



- The obturator outlet view confirms that you are staying within the ischium (blue dots), the target should be the middle of the ischium on this view
- Trajectory runs from the inner table of the ilium to the ischial tuberosity
- Keep C-arm on the uninjured side
- The starting point is on the inner table and posterior to the acetabulum
- This can be difficult or impossible with morbidly obese patients because of trajectory limitations from their abdomen



# Fixation Corridors- Posterior Column (Antegrade)



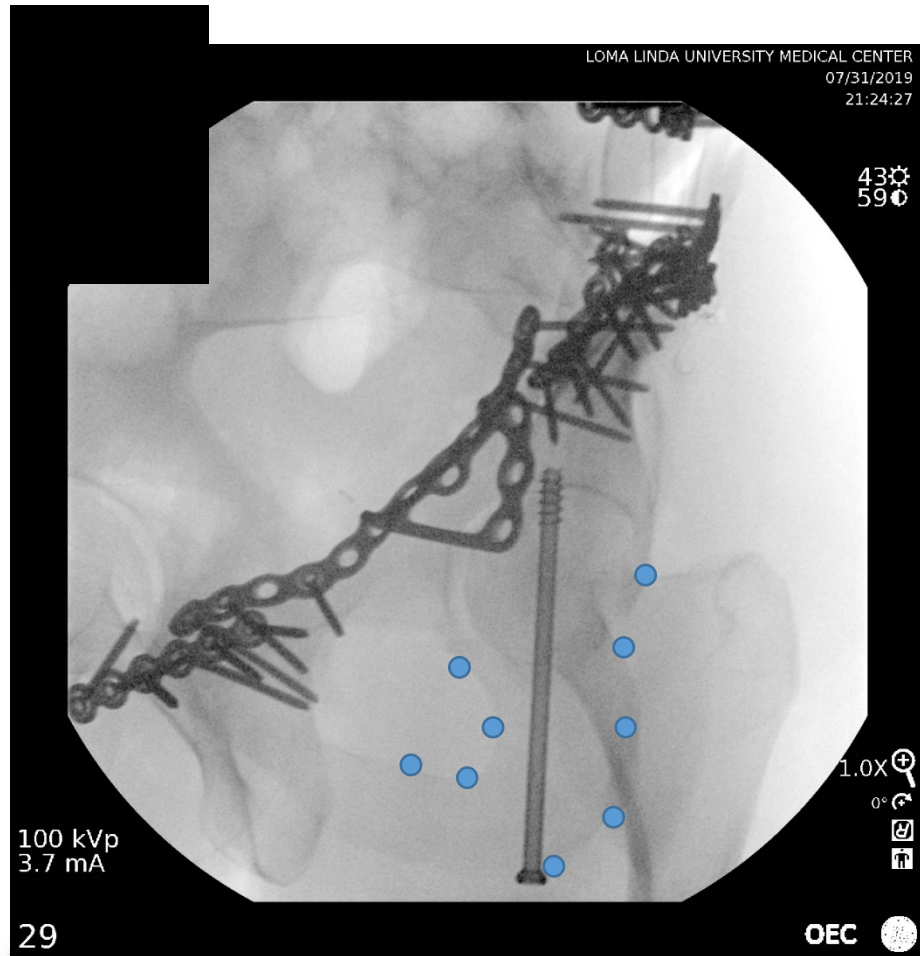
- This iliac oblique view confirms that you are outside of the acetabulum (blue dots) with a posterior column screw, it also provides a view of the ischial spine (yellow dots)
- Note that on this view the anterior column screw appears to transit the acetabulum
- Also note on this view, the anterior and posterior column screws appear parallel
- Unless a full formal open lateral window is created, cannulated screw options are most useful

# Fixation Corridors- Posterior Column (Retrograde)



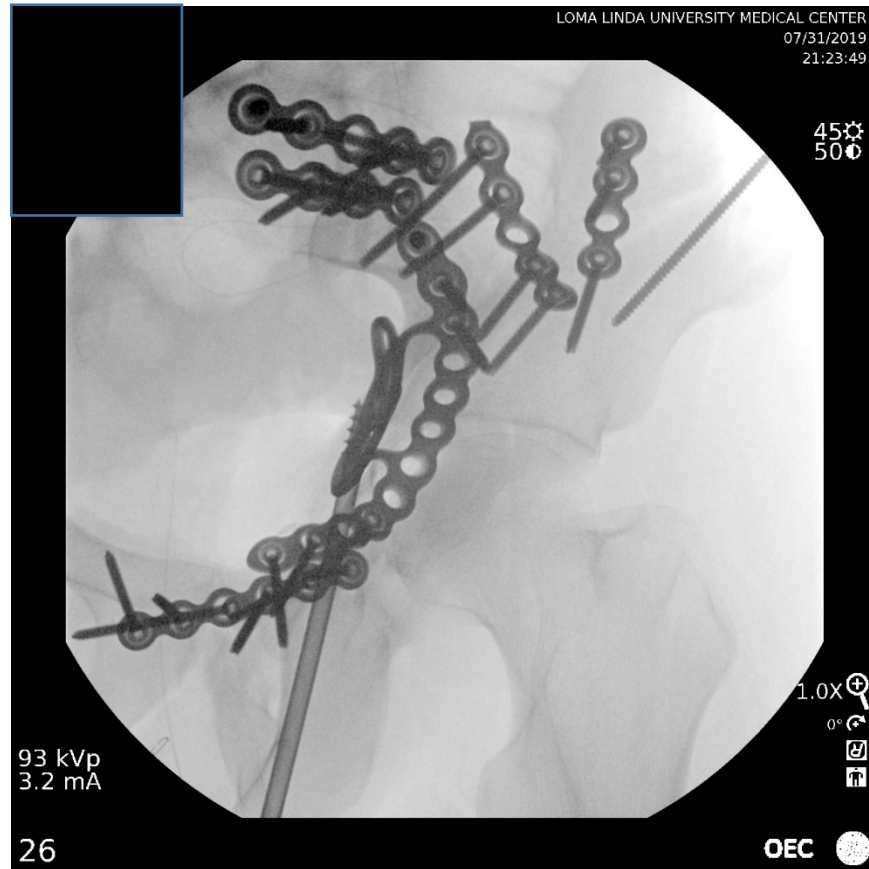
- This is a truly percutaneous technique, from the ischial tuberosity to the inner table of the ilium, setup is critical
- One person must hold the leg with the hip flexed, and the ischial tuberosity must be prepped into the field
- The patient must also be bumped enough to allow access to the ischial tuberosity

# Fixation Corridors- Posterior Column (Retrograde)



- The starting point is found on the ischial tuberosity and meticulous nick and spread technique is vital
- Staying medial on the tuberosity protects the sciatic nerve (this is lateral)
- The obturator outlet confirms that you are staying within the posterior column (blue dots), and staying medial on it

# Fixation Corridors- Posterior Column (Retrograde)



- An iliac oblique confirms that the screw is extra-articular
- Drill tip guide wires are useful here as feedback on them can tell when you have reached a bony cortex (on the inner table of the ilium), this is difficult to evaluate radiographically
- This technique is useful for low posterior column fracture components

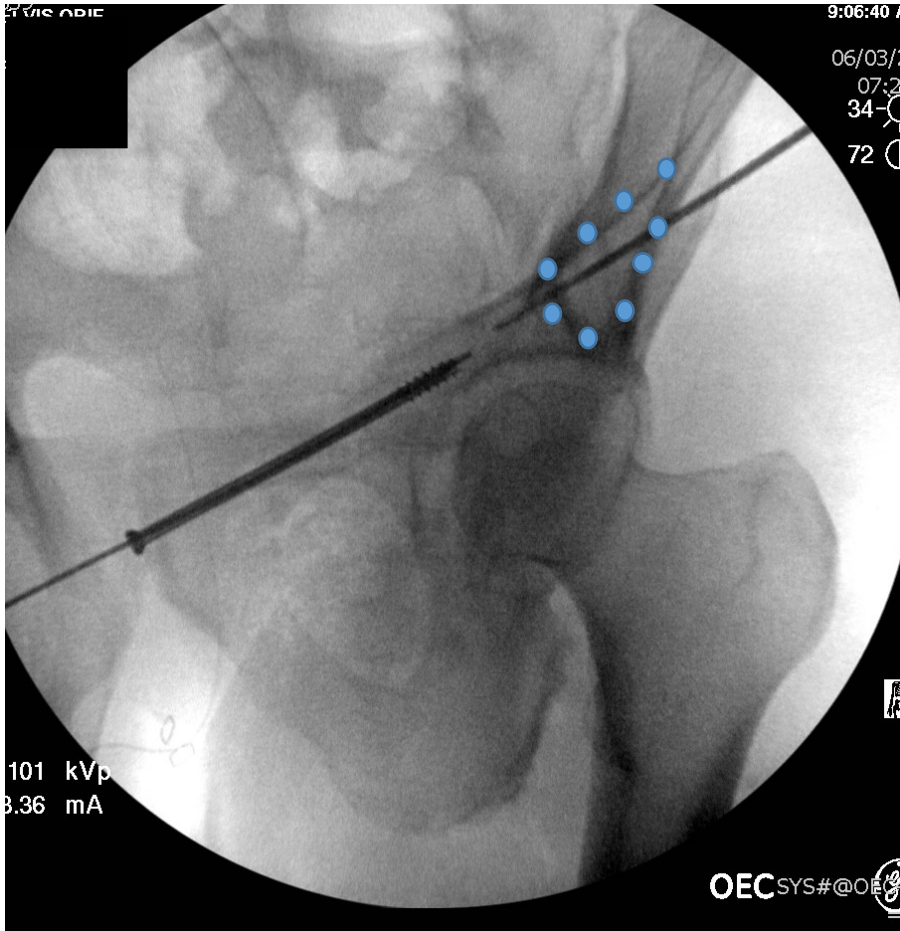


# Fixation Corridors- Supra-acetabular corridor (LCII screw)



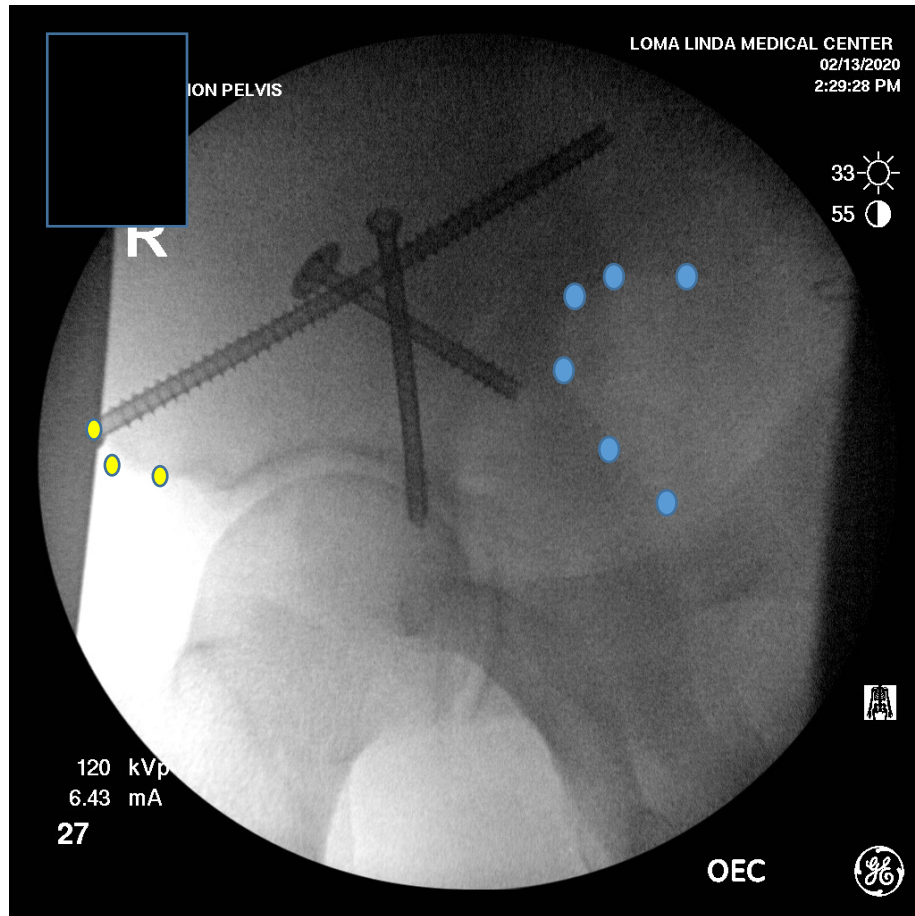
- Corridor useful for acetabular fractures, pelvic exfix, pelvic infix and stabilization of LC pelvic ring injuries
- Screw fixation here allows for fixation of anterior column components to the sciatic buttress/PSIS

# Fixation Corridors- Supra-acetabular corridor (LCII screw)



- The obturator outlet view provides a starting point within the “teardrop” (blue dots)
- This corridor is usually broad enough to accommodate larger (6.5-8.0) cannulated screws

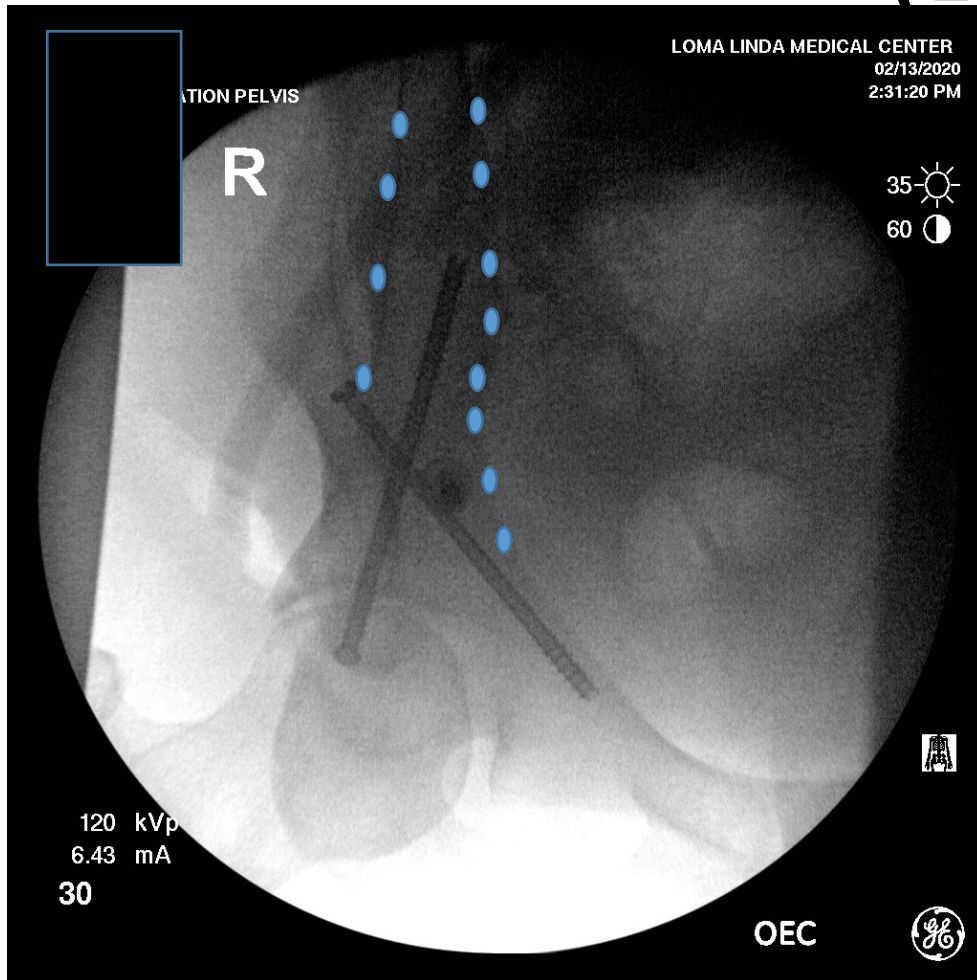
# Fixation Corridors- Supra-acetabular corridor (LCII screw)



- The iliac oblique view confirms that the screw is superior to the sciatic notch (blue dots)
- This view also helps visualize the AIS (yellow dots) which is often the starting point for this screw (though variations in individual anatomy and fracture characteristics can necessitate higher/lower starting points)
- The trajectory of this screw is slightly lateral to medial and often slightly inferior to superior



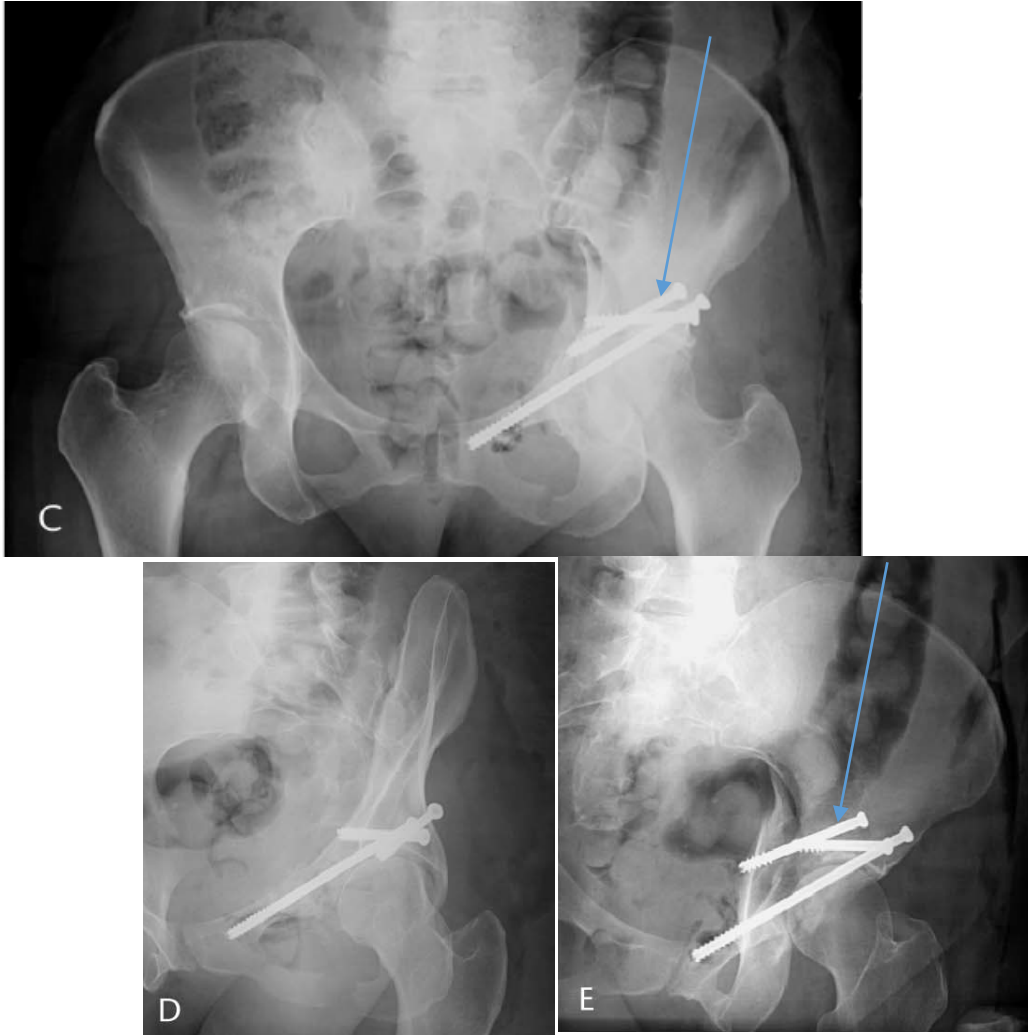
# Fixation Corridors- Supra-acetabular corridor (LCII screw)



- The obturator inlet view can be useful to advance the screw and keep the c-arm out of the way
- This gives a “between the tables” view confirming that the screw stays within the bony corridor
- This can assist in determining screw length as well, care should be taken to prevent perforation of the PSIS and making this screw prominent posteriorly



# Fixation corridors- Magic screws



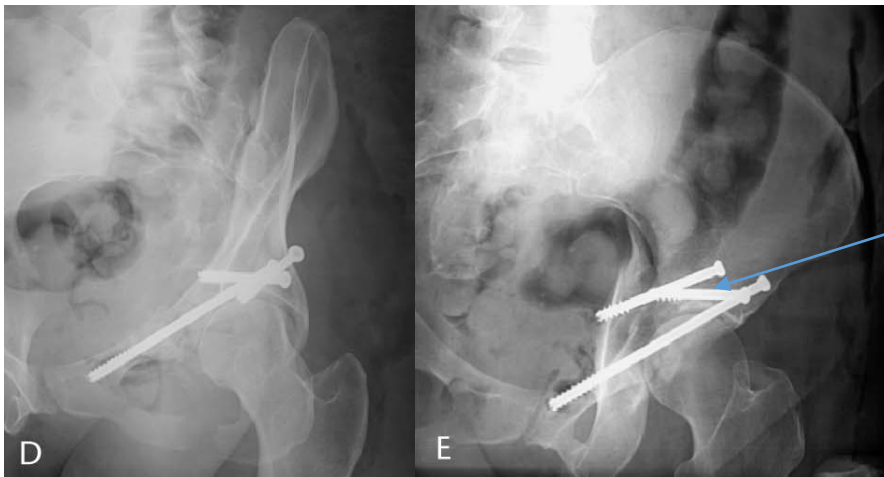
- Start on the outer table and aim into the posterior column towards the ischial spine
- The goal is to hold a quadrilateral plate reduction, or fixation alternative to a posterior column screw (sometimes necessary based on patient size/fracture location)
- AP shows (c) that the start is superior to the hip, iliac oblique (e) shows it is retroacetabular

Functional Outcomes in Elderly Patients With Acetabular Fractures Treated With Minimally Invasive Reduction and Percutaneous Fixation; Gary et al. JOT; May 2012; 26(5) 278-83

# Fixation corridors- transverse supra-acetabular screws



- Used to support the weightbearing dome or the medial quadrilateral plate
- Directed from lateral to medial directly superior to the dome
- Using an AP (c) confirms trajectory, slight inlet/obturator (e) helps quadrilateral plate visualization



Functional Outcomes in Elderly Patients With Acetabular Fractures Treated With Minimally Invasive Reduction and Percutaneous Fixation; Gary et al. JOT; May 2012; 26(5) 278-83

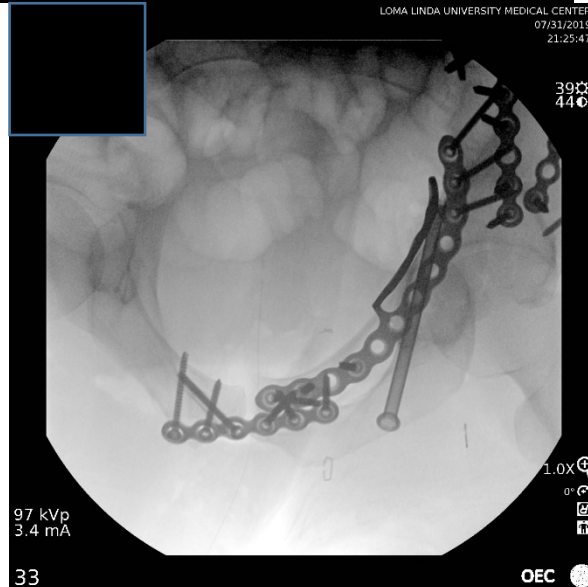
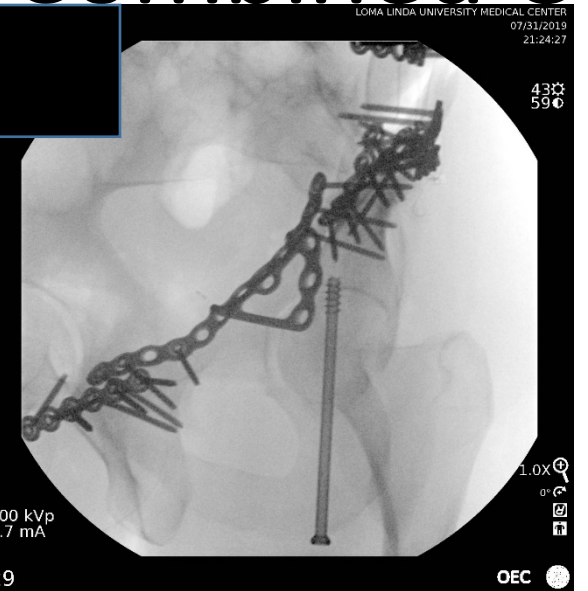
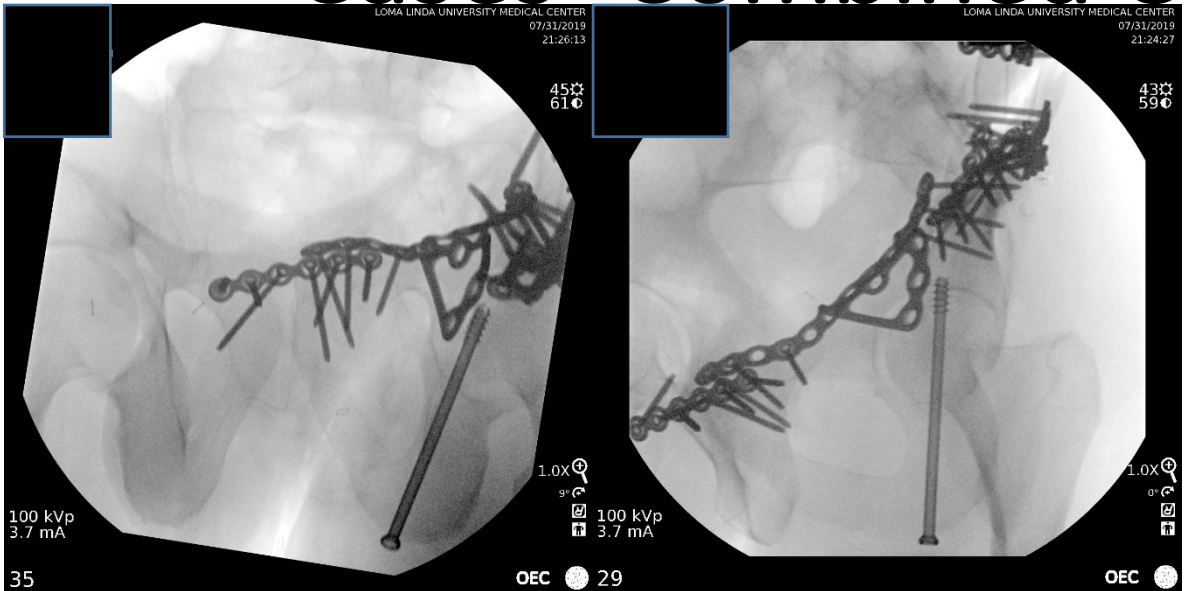
# Cases- Combined Open and Percutaneous



36yo both columns acetabulum + symphyseal disruption;  
sciatic buttress was rotated 90 degrees, necessitating either  
an extended iliofemoral, or 2 approaches



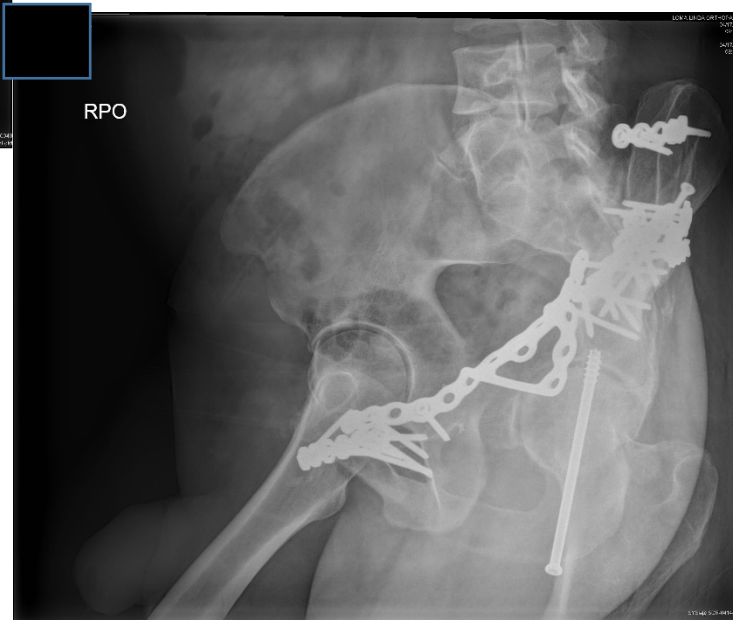
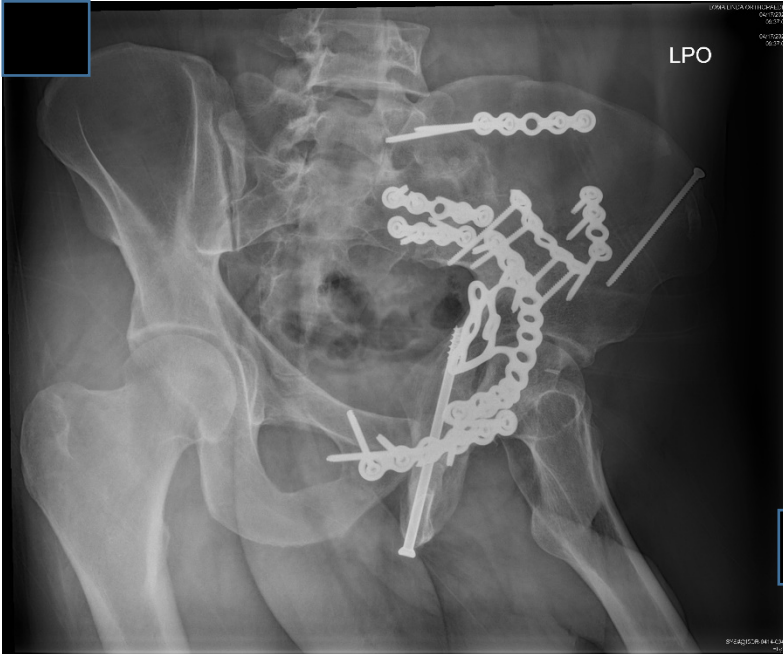
# Cases- Combined Open and Percutaneous



- Posterior SI/iliac approach used to reduce and fix the sciatic buttress, anterior approach (stoppa + lateral window) used for anterior column/wing/quadrilateral plate
- Posterior column component was very low, and ideal for a retrograde column screw
- Without this, a separate kocher incision, or a much more difficult (screw traffic) antegrade screw would have been needed

# Cases- Combined Open and Percutaneous

- Percutaneous column fixation prevented further dissection, and was ideal for this low posterior column component

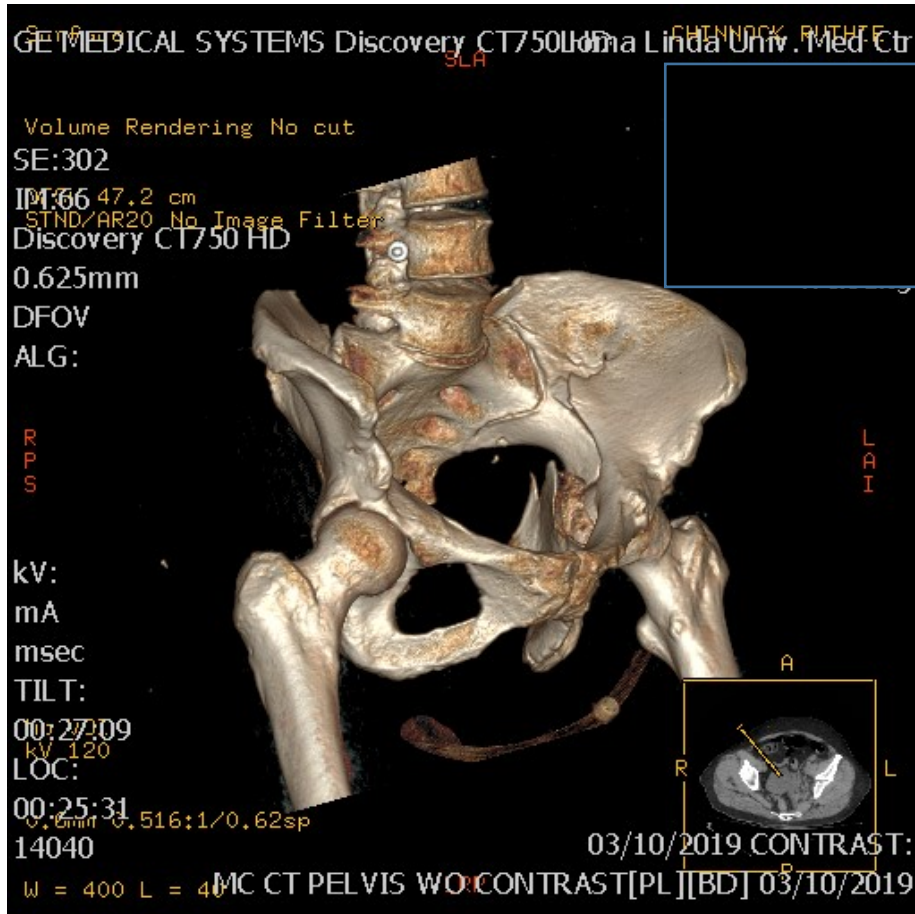


# Cases- Combined Open and Percutaneous



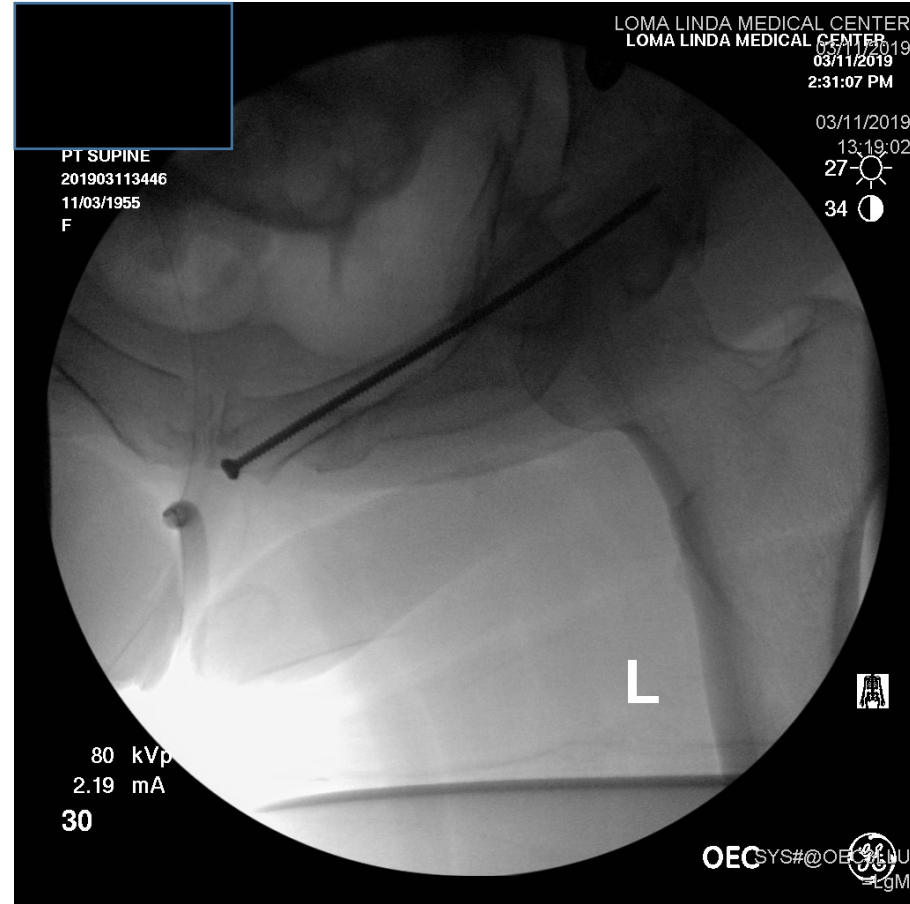
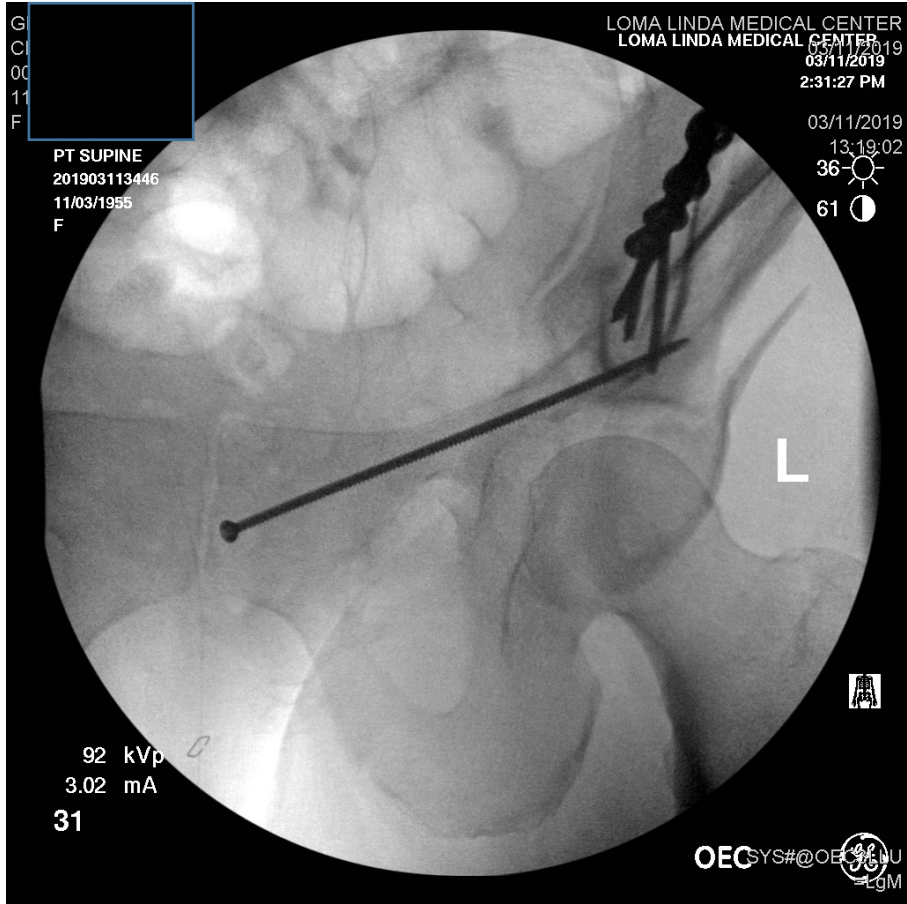


# Cases- Combined Open and Percutaneous



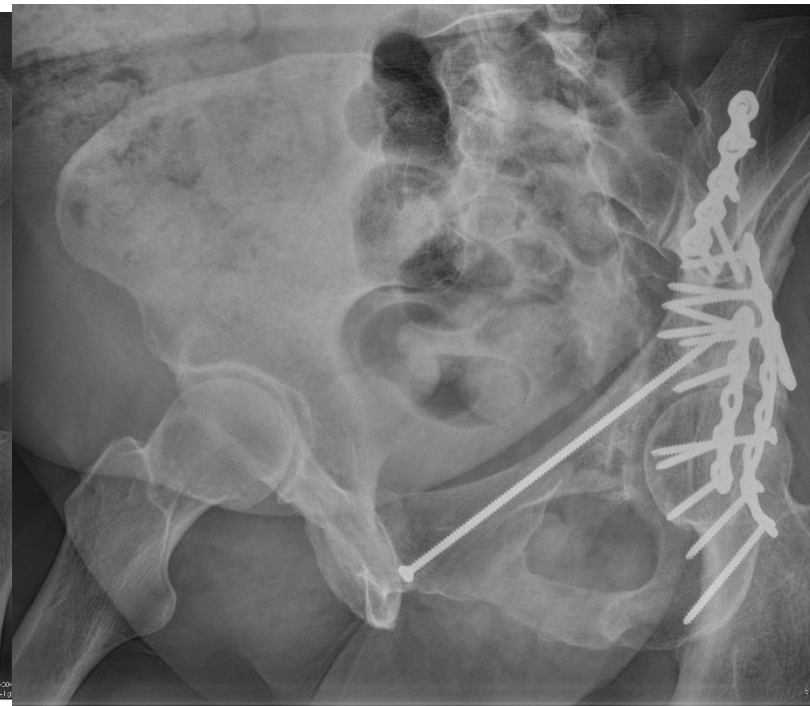
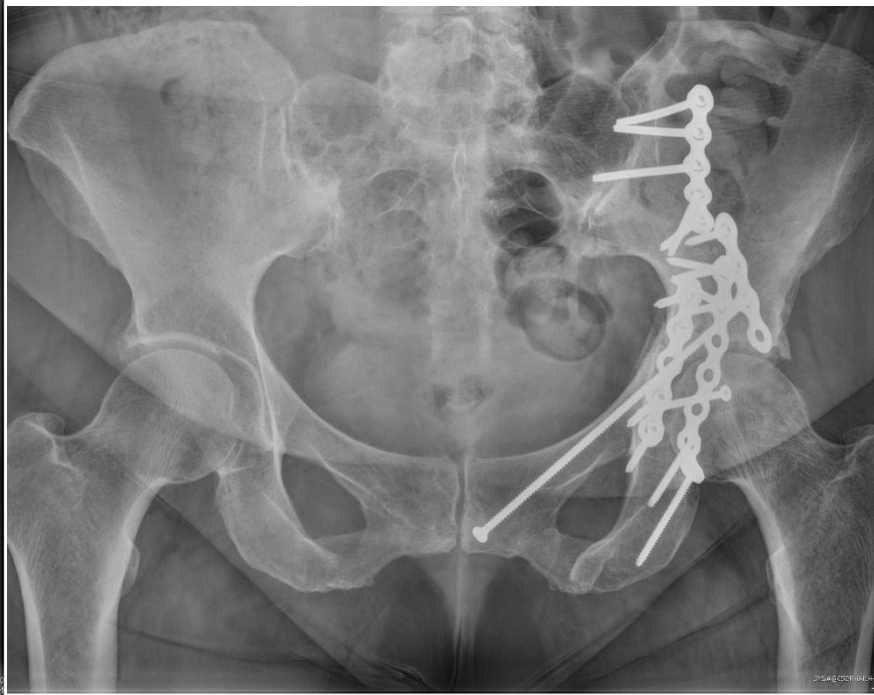
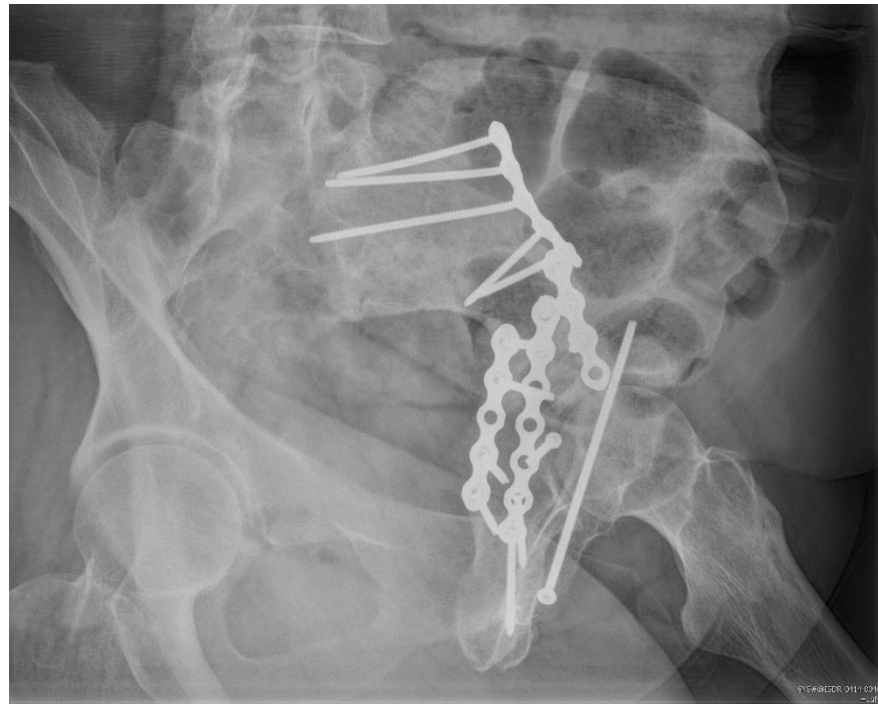
- 62 yo f with a both columns with a large posterior wall component
- The patient had had 2 prior C sections and a hysterectomy complicating her anterior dissection planes
- An isolated lateral window, and percutaneous anterior column fixation was used in conjunction with a posterior approach to treat this fracture and prevent the morbidity of a larger anterior approach

# Cases- Combined Open and Percutaneous

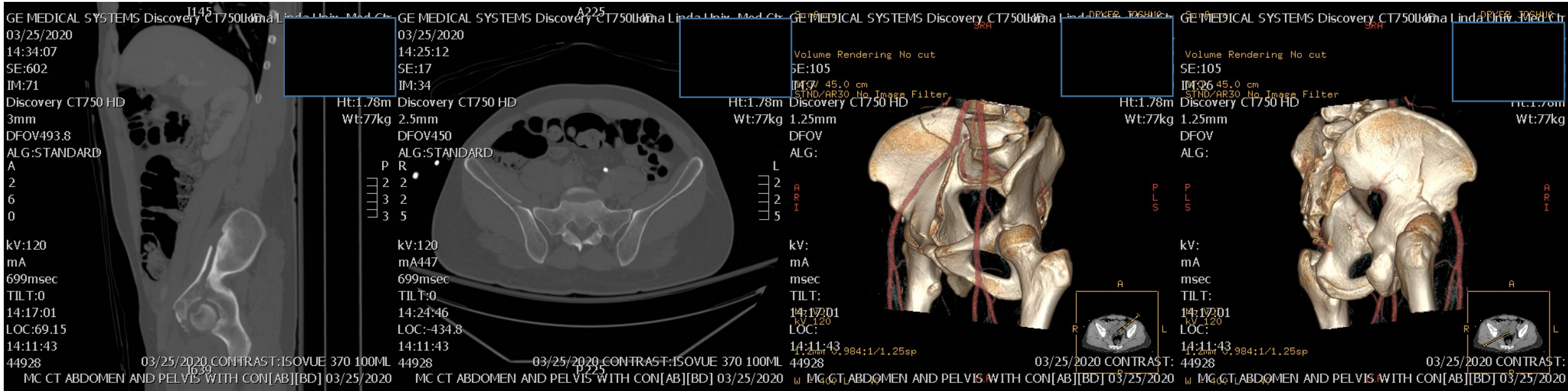




# Cases- Combined Open and Percutaneous

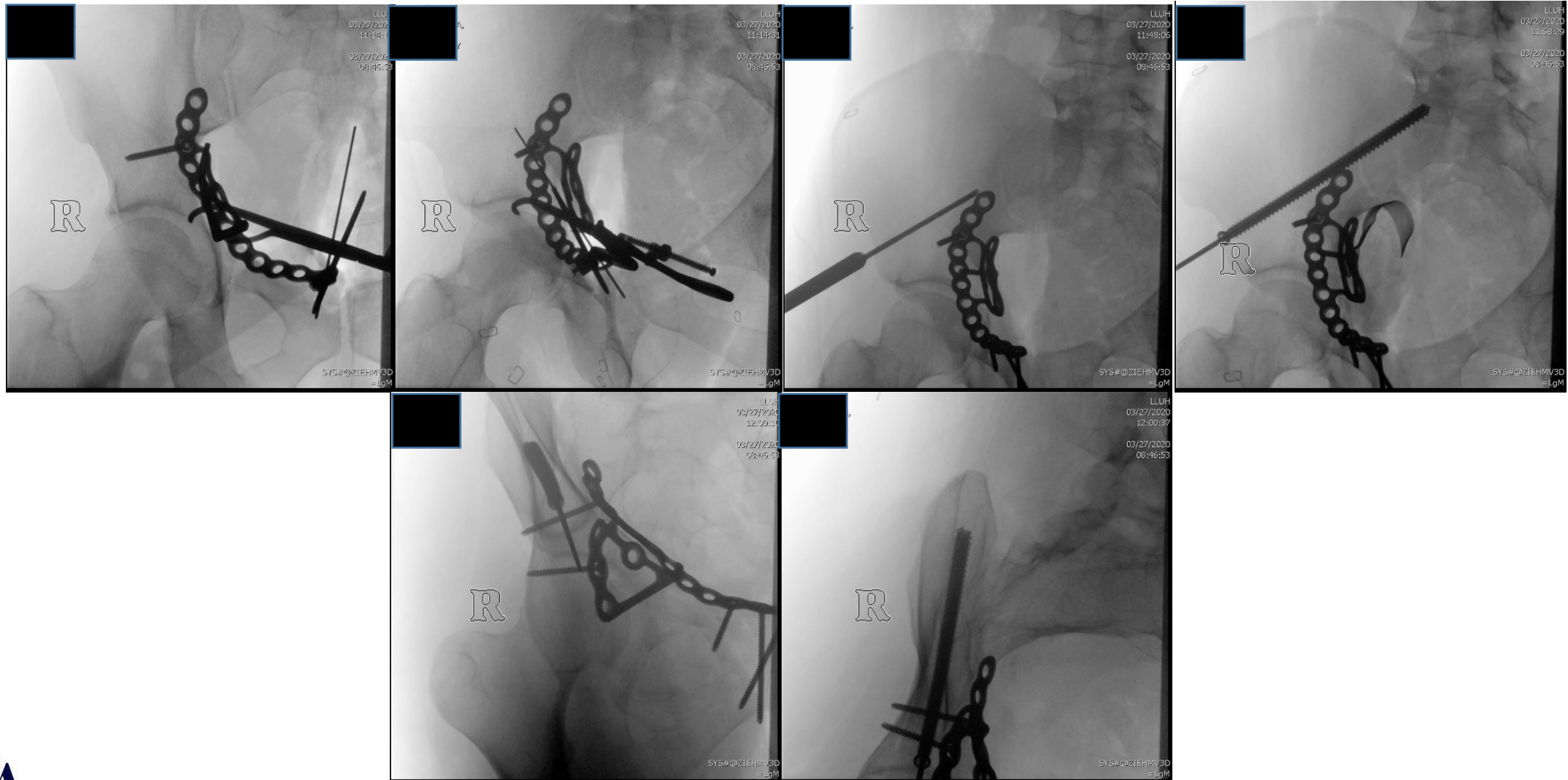


# Cases- Combined Open and Percutaneous



29 yo male with an anterior column fracture  
Femoral head starting to medialize and 5mm diastasis  
at the quadrilateral plate

# Cases- Combined Open and Percutaneous





# Cases- Combined Open and Percutaneous



- Stoppa approach used to visualize and reduce his quadrilateral plate fracture diastasis
- LCII screw used to connect his anterior column to his intact PSIS and support his plate fixation
- This prevented the added surgical approach of a lateral window



# Cases- Combined Fix + THA



- In geriatric acetabular fracture patients with significant marginal impaction, and/or concomitant femoral head fractures, percutaneous column fixation, and acute THA can allow earlier weightbearing, and very good functional outcomes

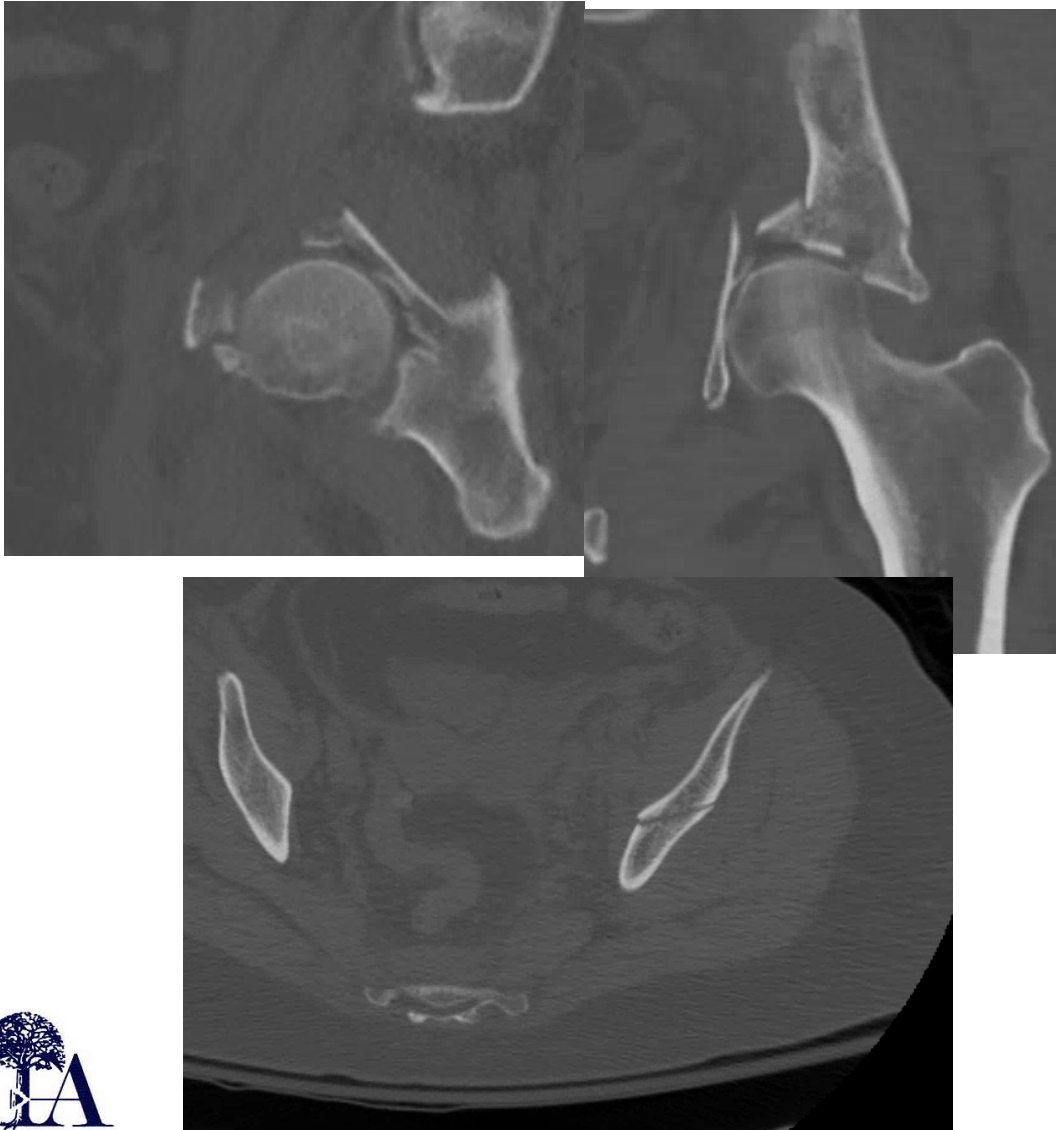
Percutaneous Column Fixation and Total Hip Arthroplasty for the Treatment of Acute Acetabular Fracture in the Elderly. Chakravarty et al. *Journal of Arthroplasty*. 2014. 29 (1) 817-821.

# Cases- Combined Fix + THA



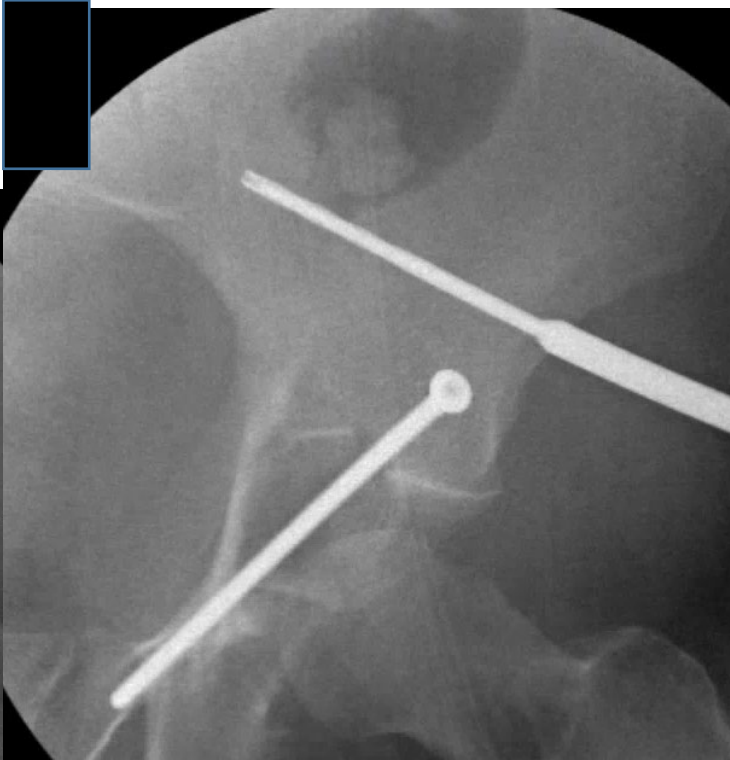
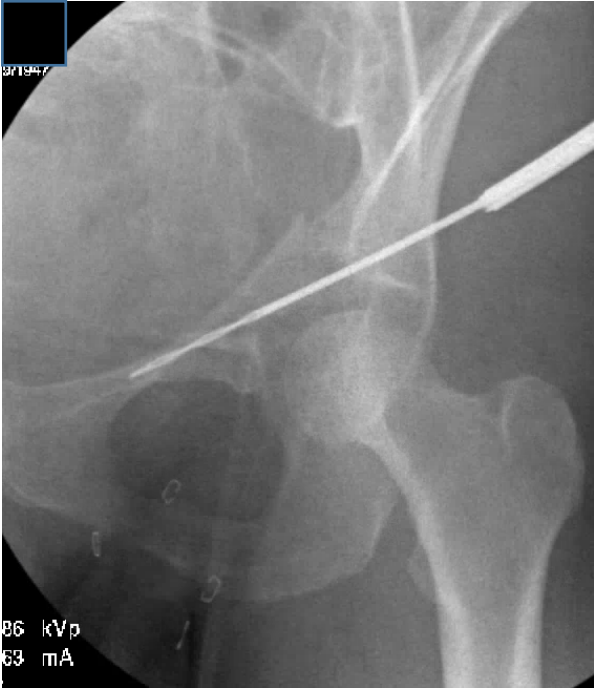
\*Images donated by Dr. Andrew Evans

# Cases- Combined Fix + THA



- 70 yo F, Anterior column fracture with protrusio, significant marginal impaction and a femoral head injury
- Given her age, functional status and fracture characteristics, percutaneous fixation + THA was recommended

# Cases- Combined Fix + THA





# Cases- Combined Fix + THA



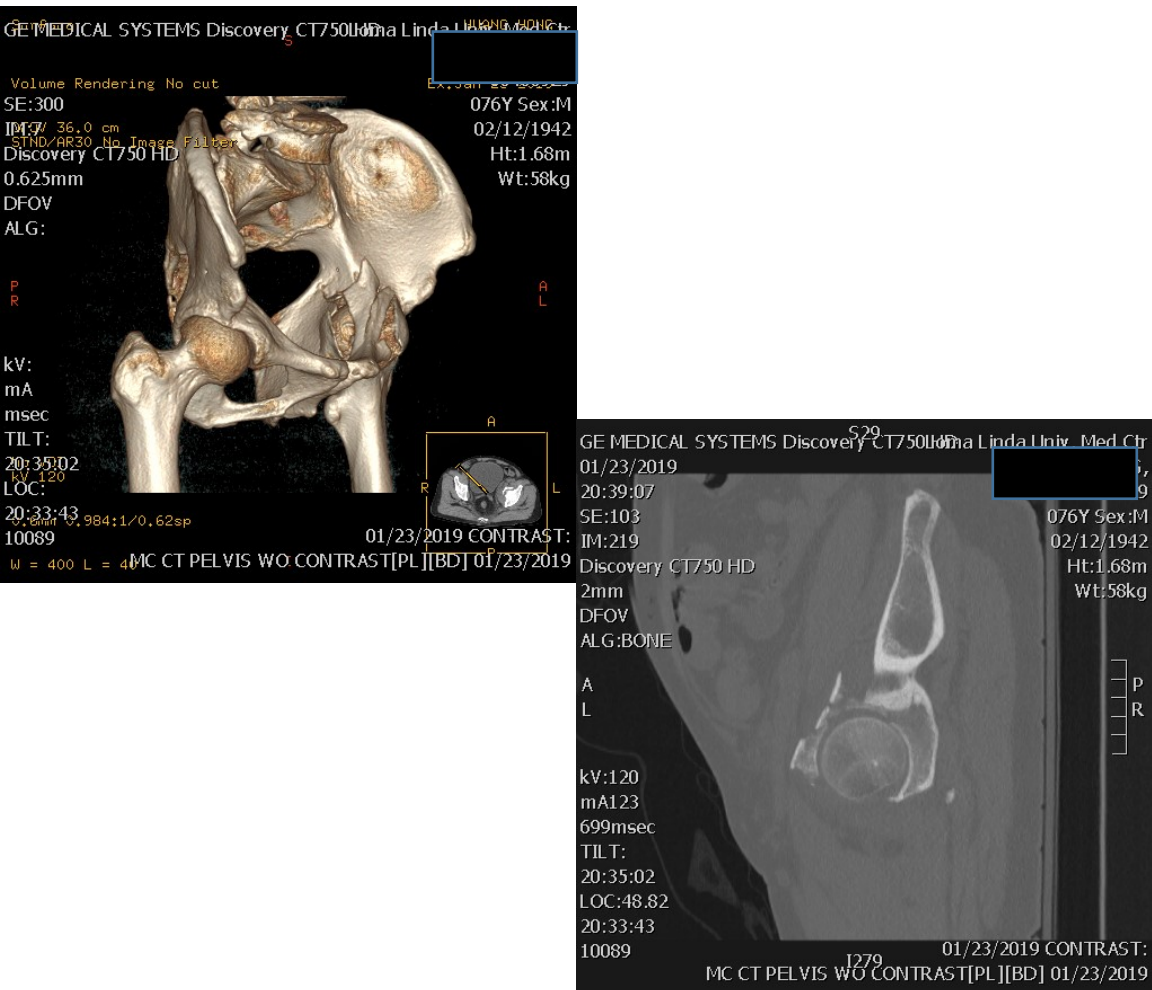
- A 4.5 screw was used for the anterior column screw to be more malleable and an LCII screw was used to connect the anterior column to the PSIS
- This allowed for her columns to be connected and allow cup placement
- Femoral head was used to back graft and a multihole cup was used for her acetabular component

# Cases- Combined Fix + THA

- 76 yo male s/p fall off of a ladder who was transferred with protrusio of his AC+PHT fracture 2 weeks after injury

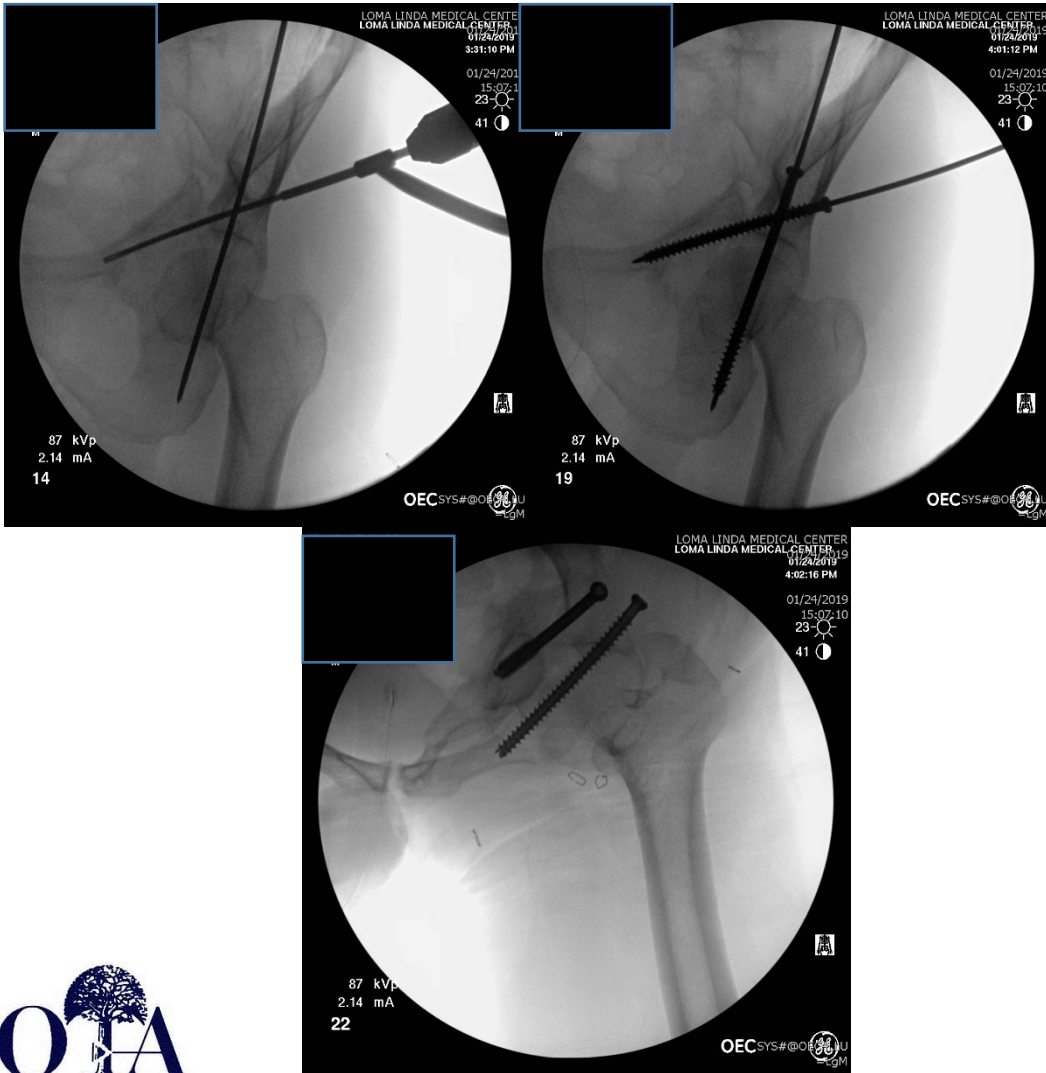


# Cases- Combined Fix + THA



- Given the time from injury with medial dislocation, bone quality, patient age and functional status, percutaneous column fixation and THA was recommended

# Cases- Combined Fix + THA



- Percutaneous fixation of the posterior column with a posterior column screw (antegrade) and the anterior column with an anterior column screw (antegrade)
- The anterior column screw was likely intra-articular at this time, but it was left in place and could be removed during the THA if it prevented seating of the cup

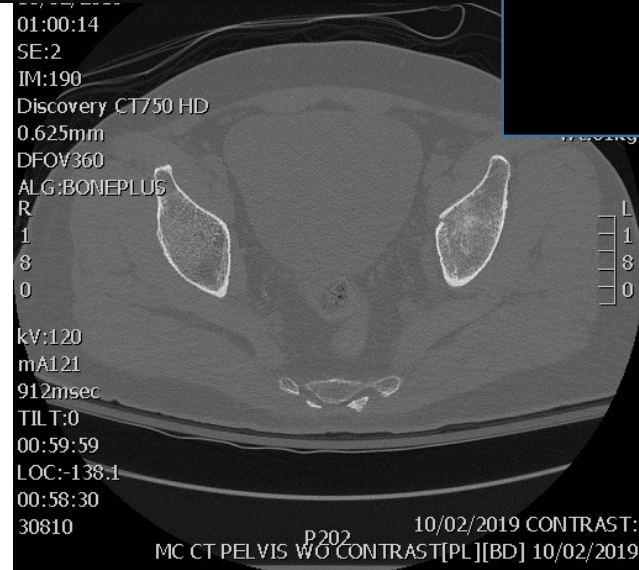
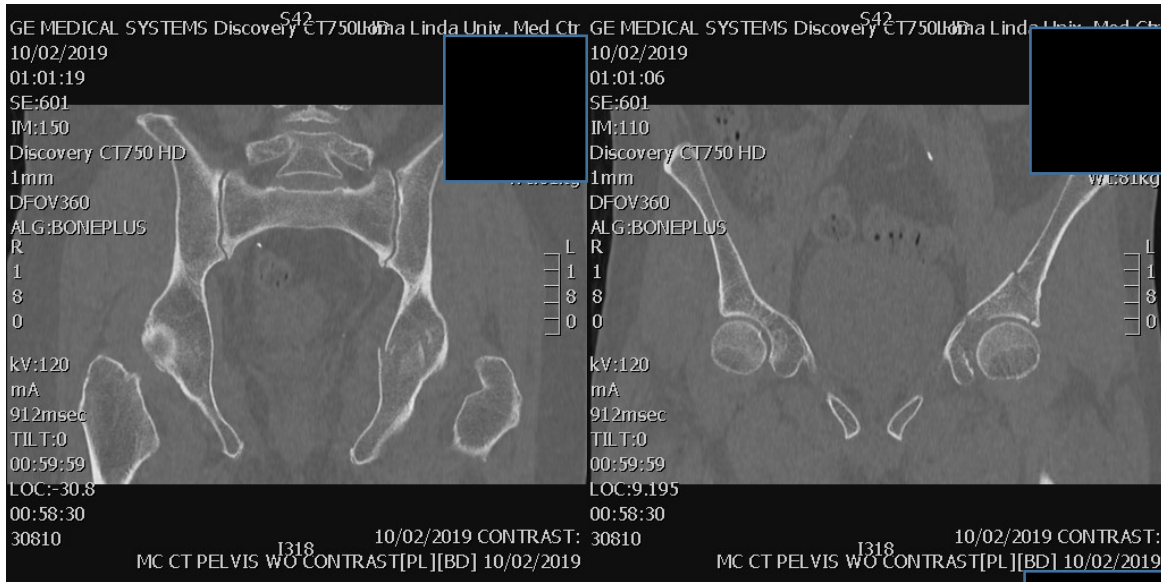


# Cases- Combined Fix + THA



- The anterior column screw prevented seating of the cup and it was removed, this necessitated the use of a multi-hole locking cup that locked into the fixated posterior column
- Patient was allowed full weightbearing at 6 weeks and had returned to all activity at 5 months

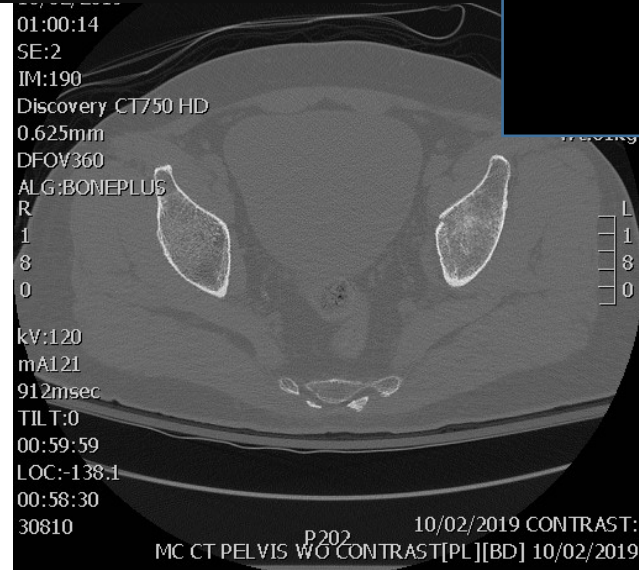
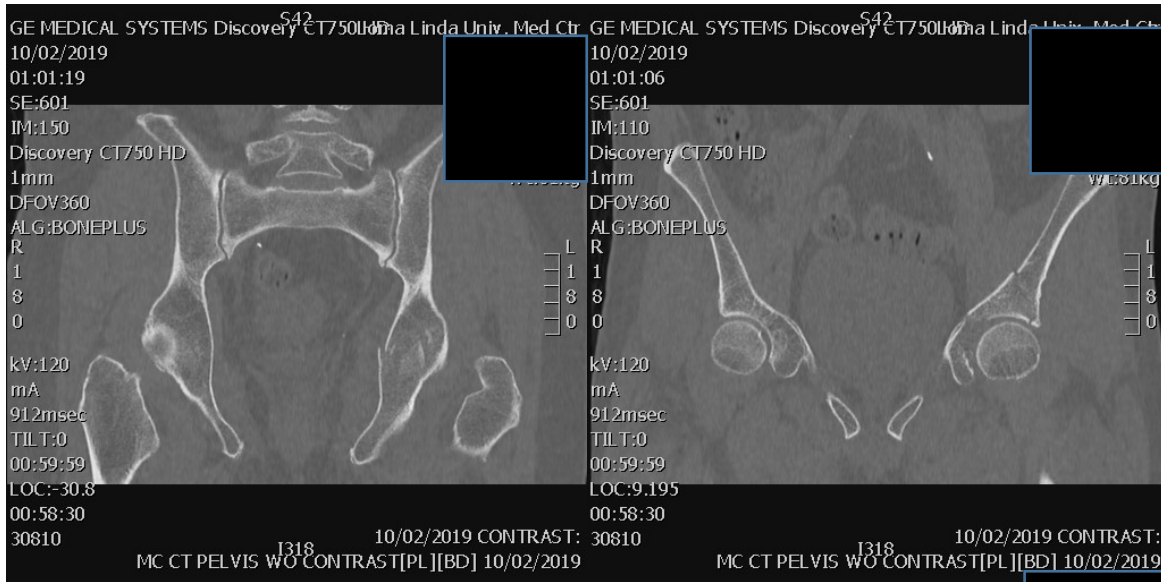
# Cases



- Short term functional outcomes with appropriately selected fracture patterns are similar to open treatment of acetabular fractures

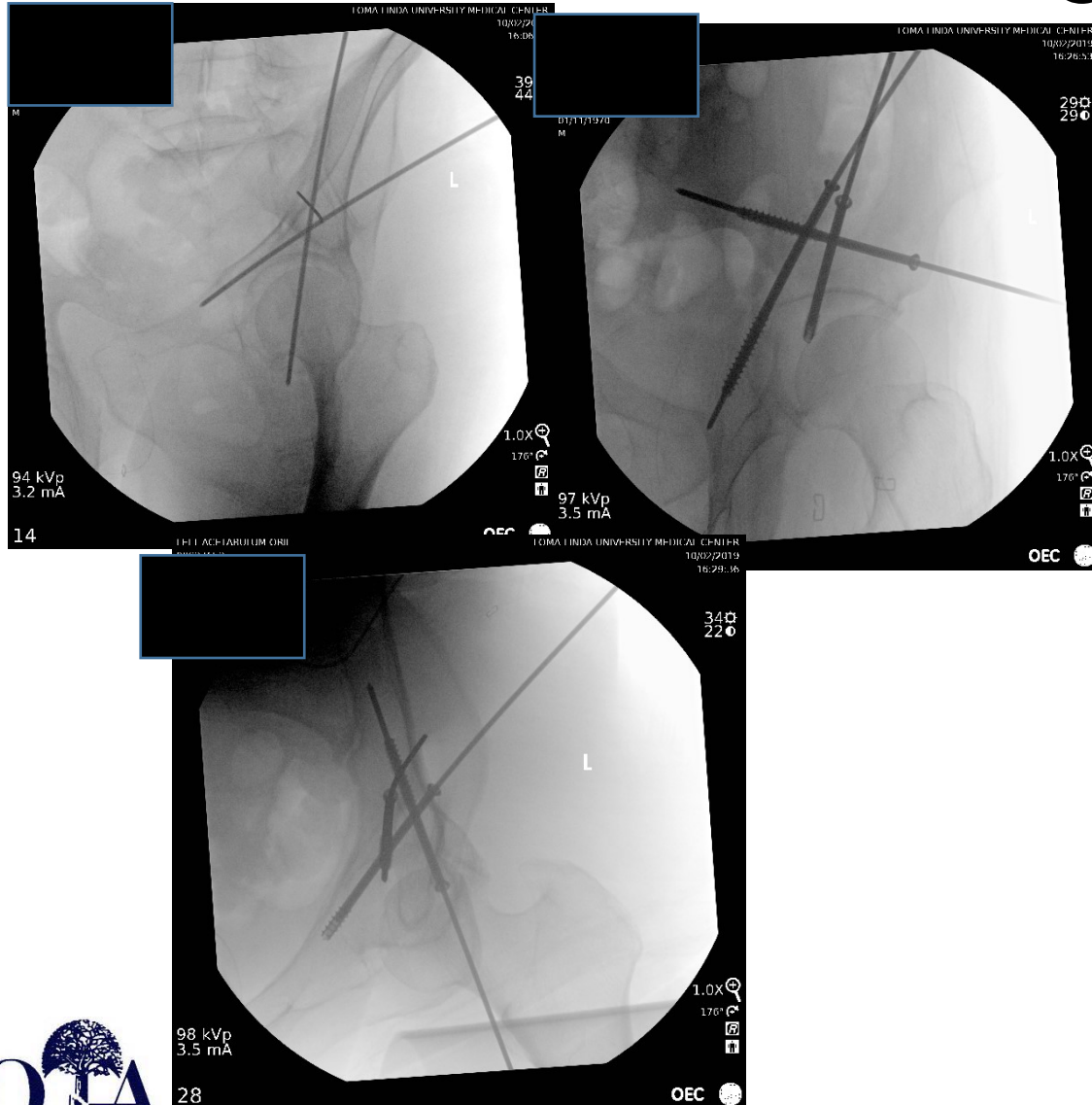
Short-term results of percutaneous treatment of acetabular fractures: functional outcomes, radiographic assessment and complications. Bozzio et al. International Orthopedics. 2016. 40. 1703-1708

# Cases



- 49 yo s/p pedestrian struck, a1C of 12.5, minimally displaced but comminuted AC + PHT fracture, mild pre-existing OA
- Bony corridors amenable to anterior column, posterior column and LCII fixation

# Cases

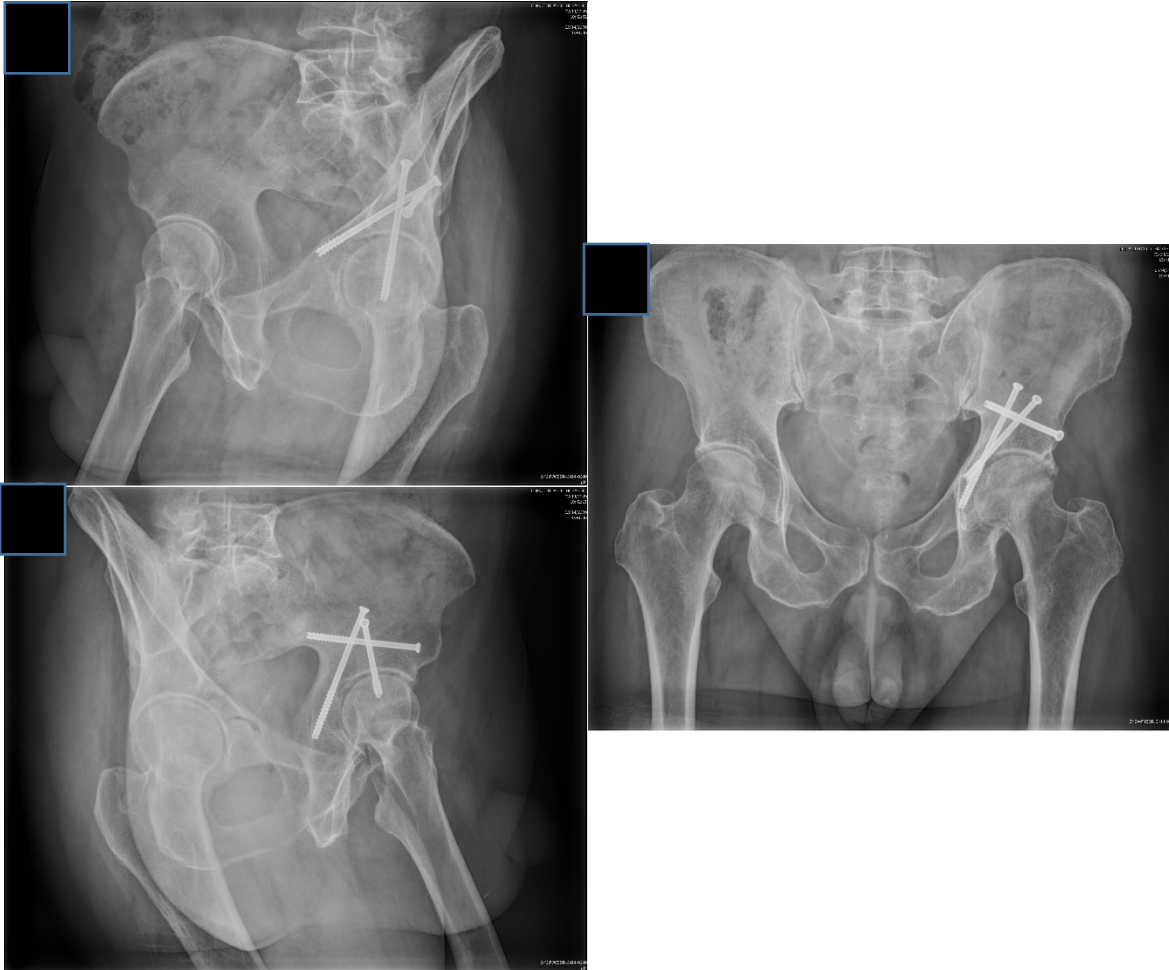


- Anterior column screw has the smallest corridor, if using cannulated screws, place this guidewire first, if using solid screws, place this screw first
- Following this posterior column and LCII/supra-acetabular fracture fixation can be carried out



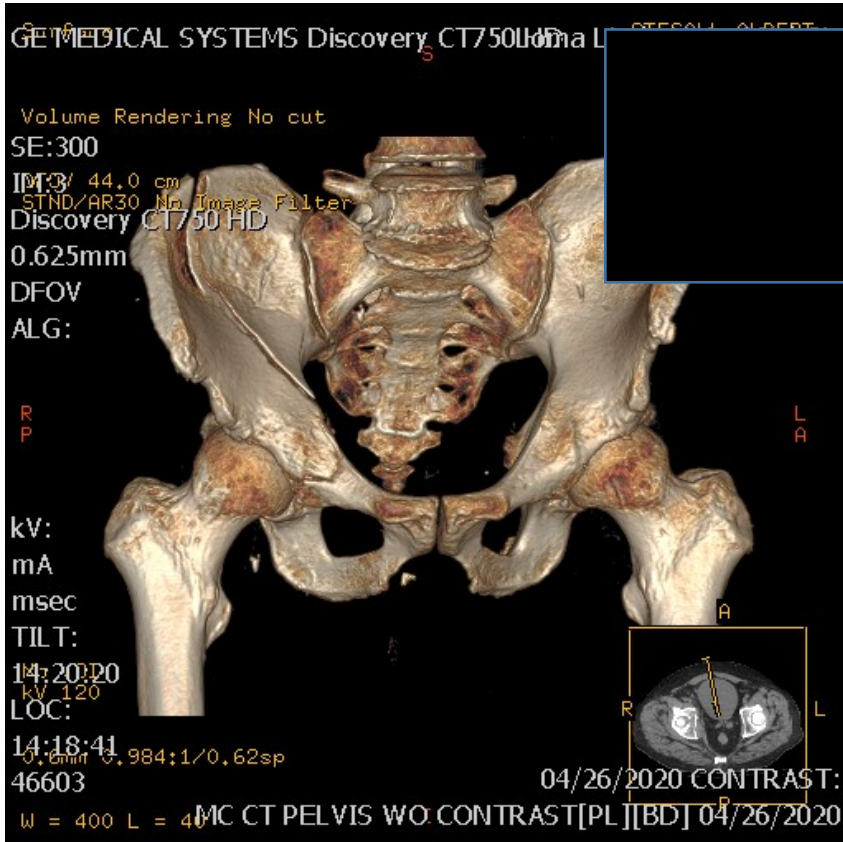
# Cases

- At 6 months he was ambulating without pain and had returned to work



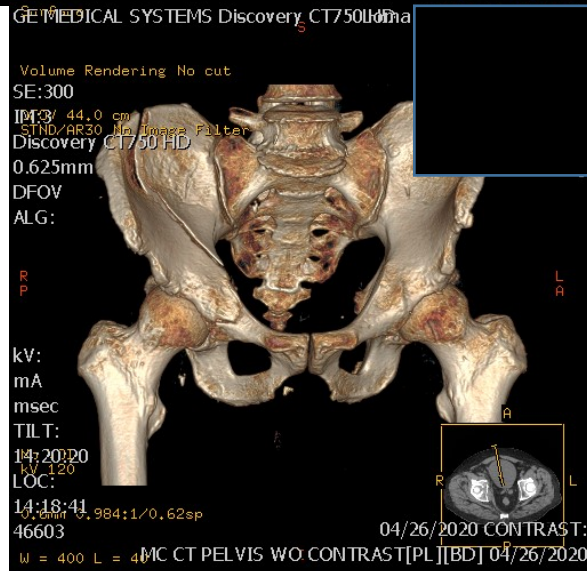
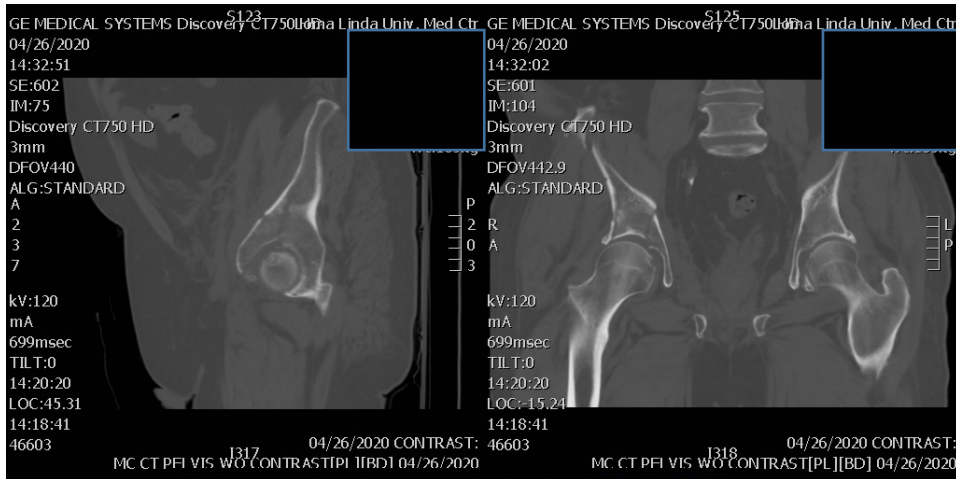
# Cases

- Percutaneous treatment of geriatric acetabular fractures allows for decreased surgical morbidity, and similar functional outcomes to open fixation in many fracture patterns

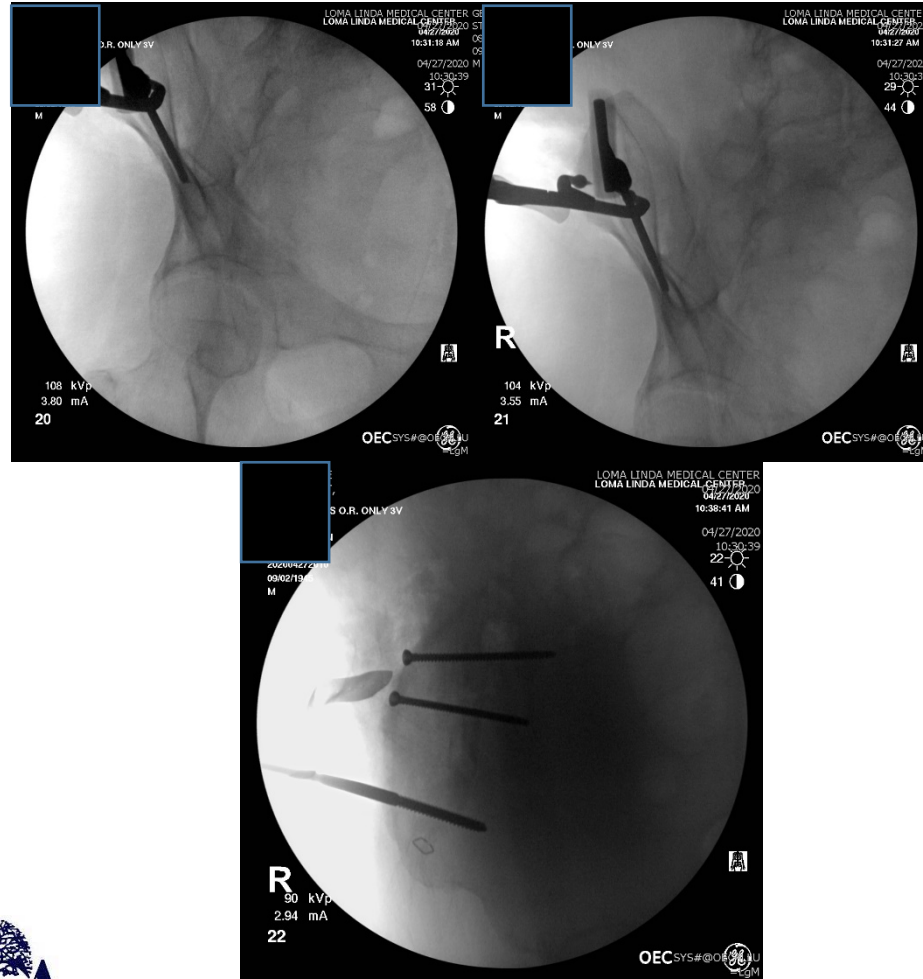


# Cases

- 74 yo m, s/p fall off of a horse with a right sided Anterior column fracture; PMHS: DM, radical prostatectomy, obesity
- Fracture pattern amenable to percutaneous fixation, and reduction through a lateral window



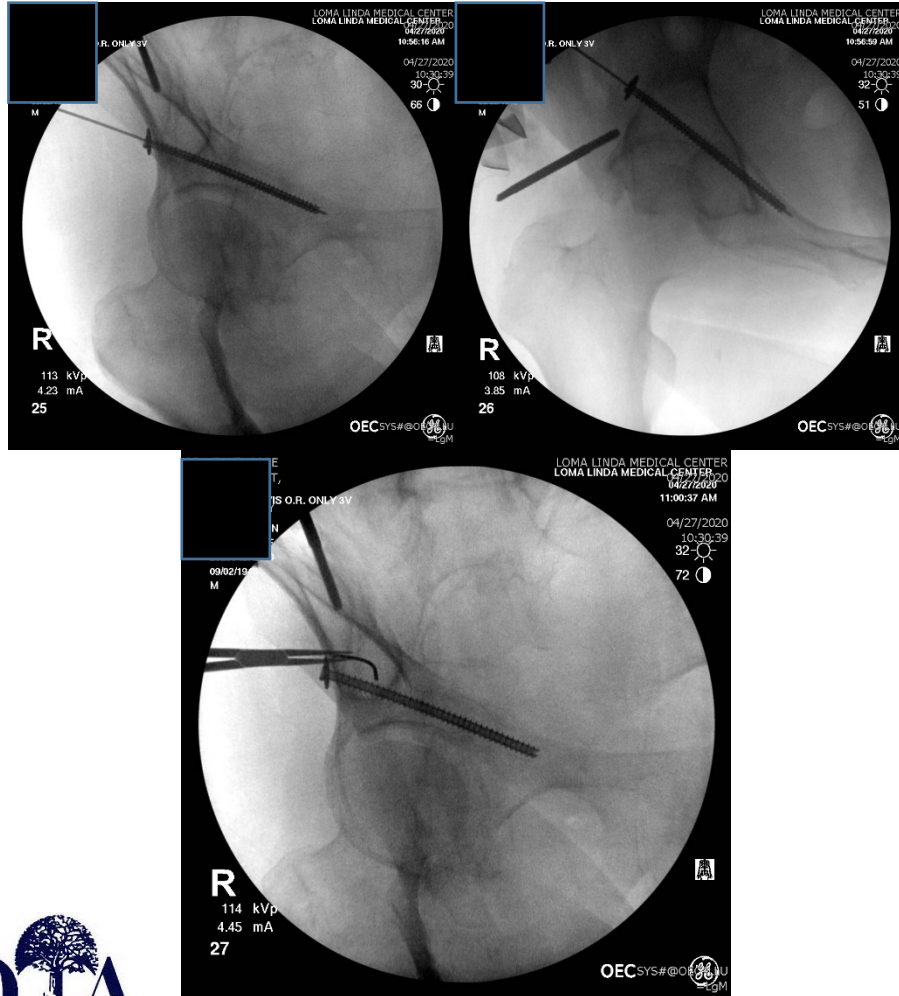
# Cases



- Lateral window used to visualize fracture, a shanz pin in the medius pillar, ball spike and a reduction clamp used to reduce fracture
- Two intracortical screws placed to provisionally hold the reduction

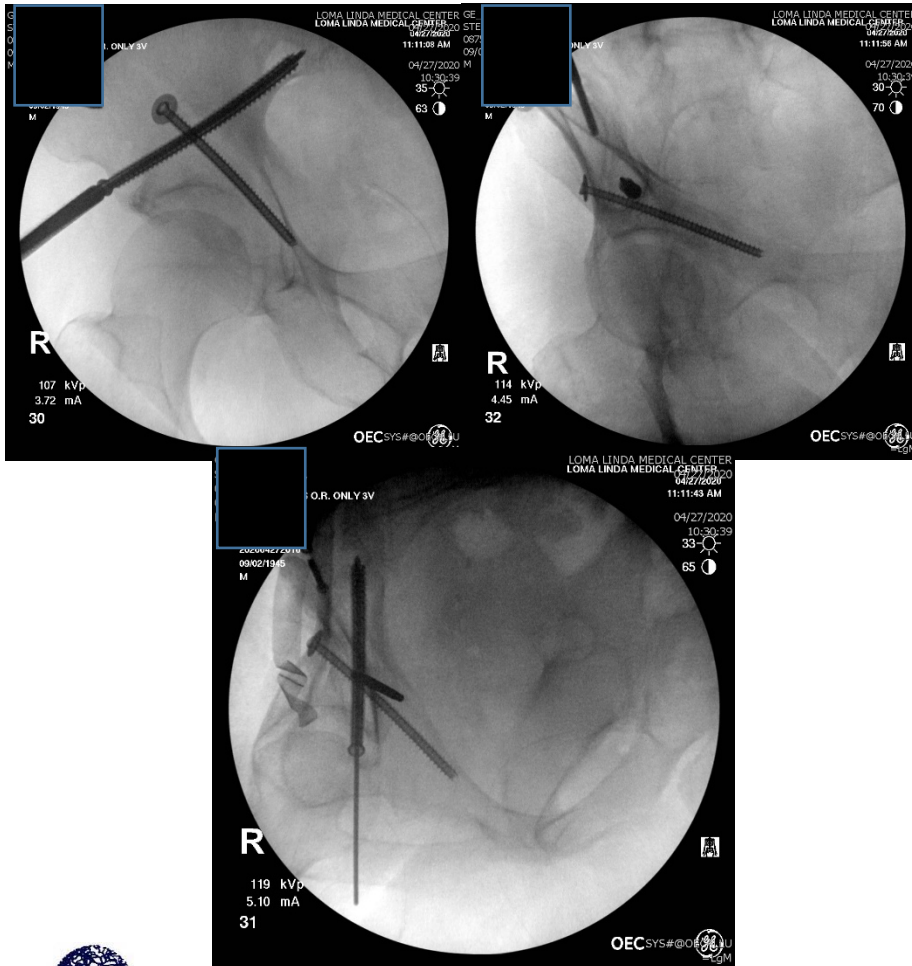


# Cases



- Given corridor size, an anterior column screw was placed first
- Obturator outlet views confirm extra-articular placement
- Inlet confirms in bone- given bone quality a washer was used to prevent lateral cortical penetration
- Screw sizes from 3.5-7.0 can be used for this based on patient anatomy (5.5mm in this case)

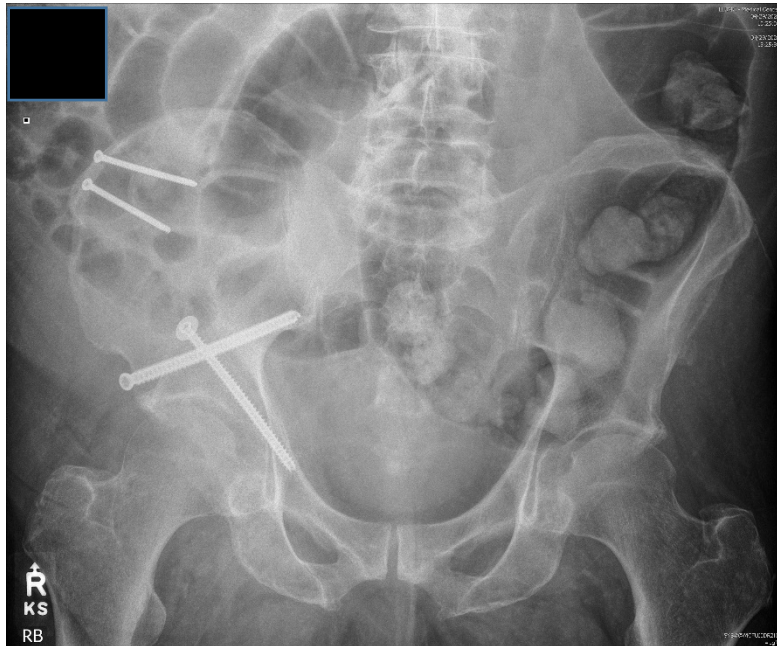
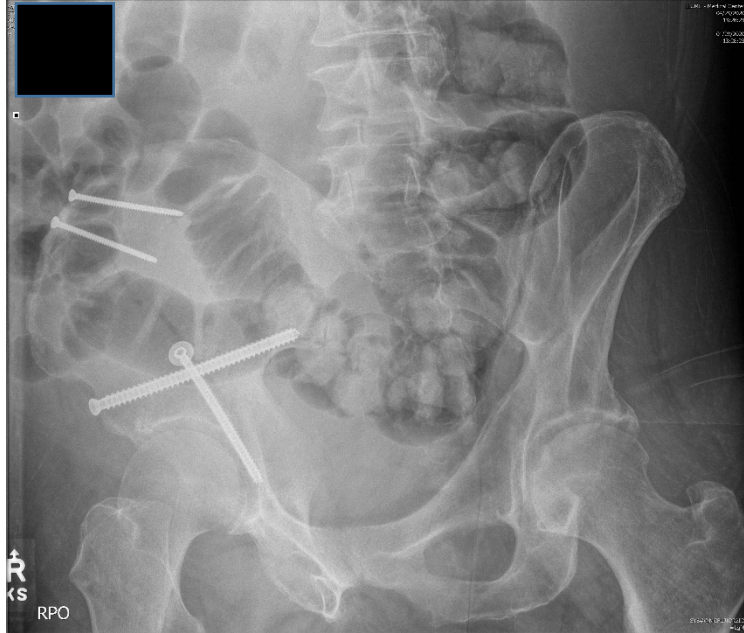
# Cases



- Once the anterior column screw was placed, an LCII/Supraacetabular screw was placed
- Iliac oblique confirmed superior to sciatic notch, obturator outlet gives the starting point and the screw was advanced on obturator inlet to confirm it was between the cortical tables

# Cases

- Patient had returned to horseback riding at 6 months



# Sources

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