Surgical Radiography

The radiographer can enter any operating room case, whether routine or extraordinary, and, with good communication, be able to perform all tasks well

Review MI 133 OR Information – See Edvance – Learning Units

Merrill's 14th edition, Volume III, Chapter 21

1

OR Zones

Zone 1: un-restricted – may enter in street clothes

Zone 2: semi-restricted – only person in scrubs, hair and shoe covers

Zone 3: restricted – must also have mask on

2

Benefits of Radiography in the OR

- Precision placement of surgical implants
- Less invasive surgery; smaller incisions
- Identification of retained surgical objects like sponges & needles
- Visualization of soft tissue anatomy with contrast (Vascular)

3

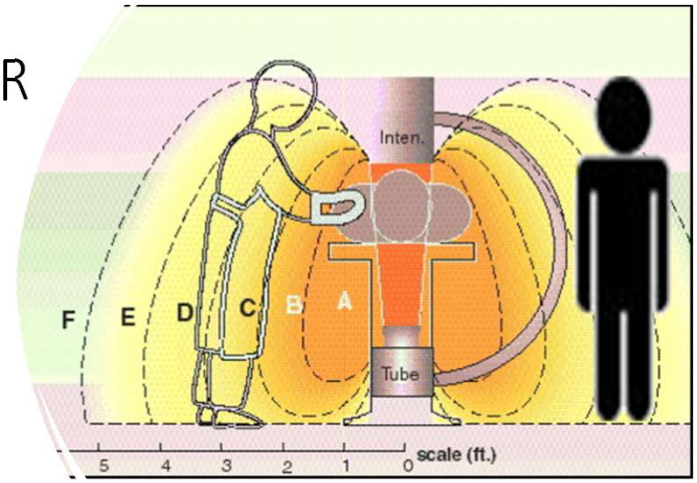
Challenges

- Technologists work under the direction of surgeons
- Necessary skills include aseptic technique, radiation protection, communication, anatomic landmarks and pathologic findings
- Must be able to perform accurately, quickly and competently

4

Radiation Protection in the OR

- Placing the Image Intensifier (II) on top decreases radiation exposure for all staff



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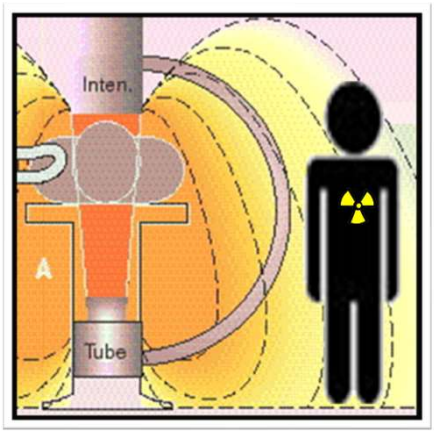

Image Intensifier on the Top

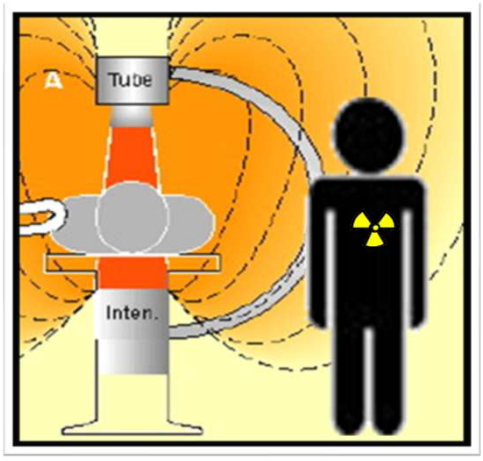

Image Intensifier the Bottom

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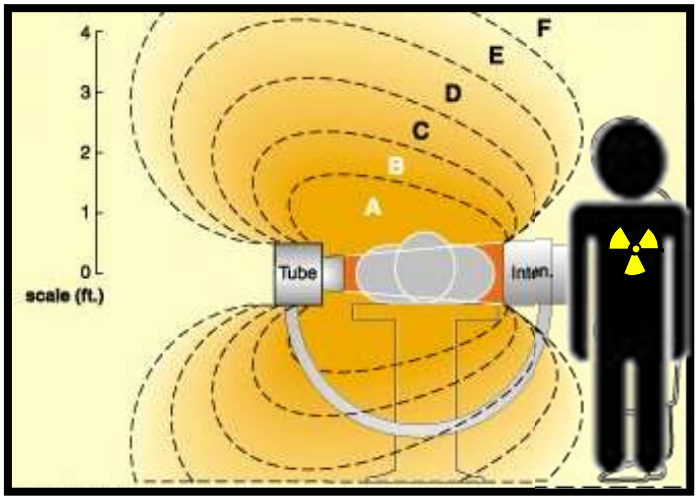

The closer the Image Intensifier is to the x-ray tech, the better it is for the tech.

7

Advantages of II Closet to Patient

- The closer the Image Intensifier is to the patient = the further the tube is from the patient
- Results in:
  - Less magnified image
  - Less radiation (entrance skin dose) to the patient

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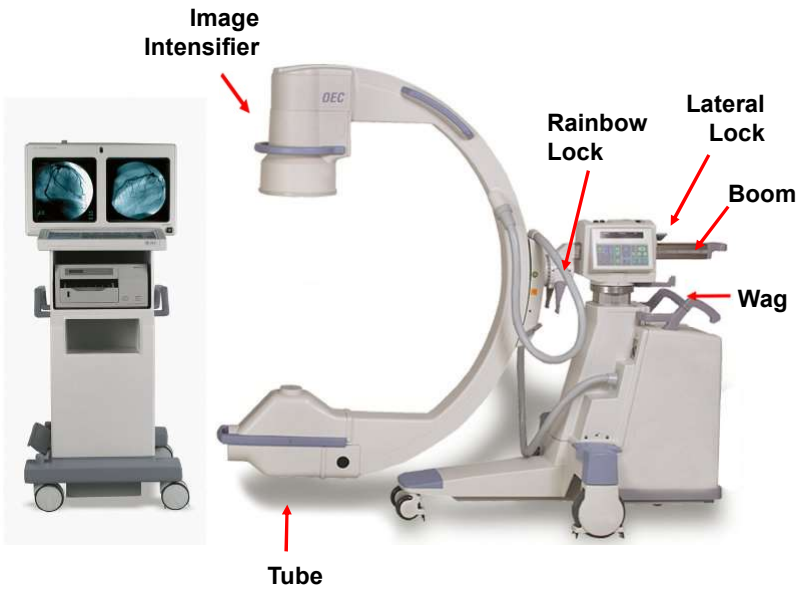


Surgical Equipment Practice Skills Thursday, January 20th. T-Ground Room 6 with Gerard

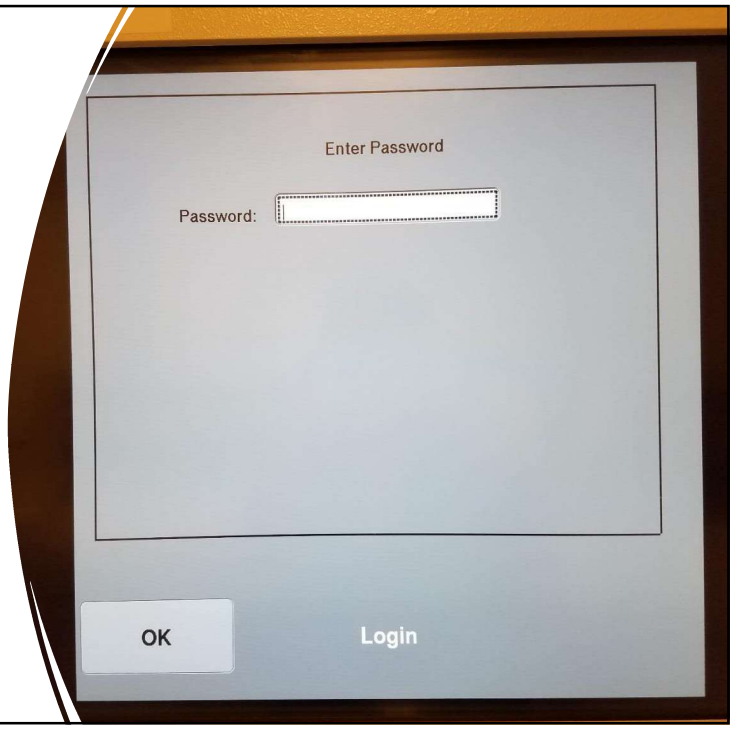
9

C-Arm Controls

10

C-Arm Password

- **U12345**



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Mini C-Arm

- Very compact, mobile fluoroscopic imaging systems designed for real-time imaging of the extremities
- Provides imaging versatility right in the surgical suite, regardless of how challenging the extremity procedure may be

Info from NCBI, Hologic

12

- Located on the image intensifier
  - If standing at base of c-arm, it would appear on right hand side
- Depicts position of patient
  - If smile is at head of patient no orientation needs to occur to your image (coming in from left)
  - If smile is at foot of patient and the patient is supine, you need to orient by selecting both 'R's
  - If smile is at foot of patient and the patient is prone, you need to orient by selecting the head to toe 'R'

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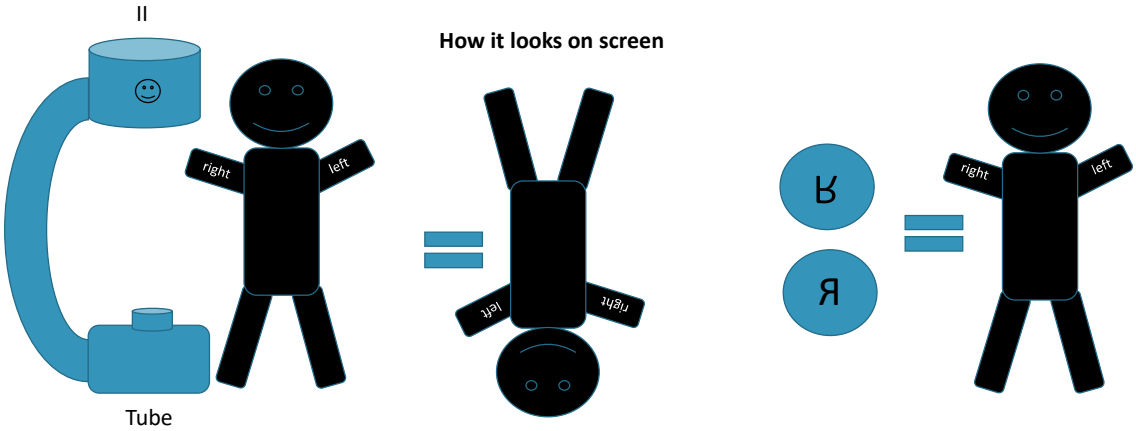

C-Arm Orientation

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Black Diamond Video

- Integrates C-Arm Monitor with OR room monitors
- Tech Responsibilities
  - Connect Black Diamond Video cable to guest port located in towers of operating room
  - Ask OR RN to bring up C-Arm Monitor images on Black Diamond monitors

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C-Arm Jack

- Orange ethernet cable to C-Arm must be plugged into wall jack in order to connect to the internet to pull up worklist and send images to PACS
- Located on side walls of OR rooms

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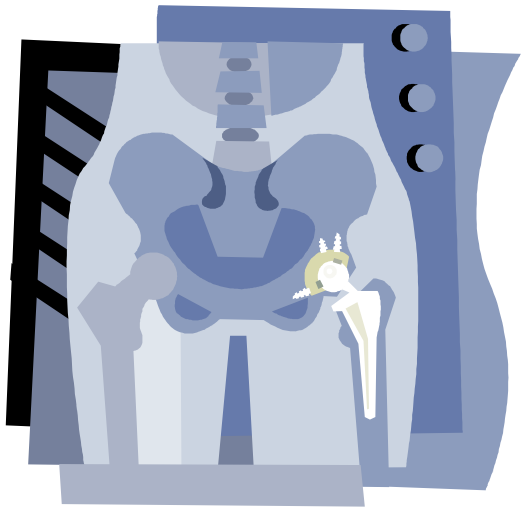
Common Procedures:

- Cystoscopy
- ELC
- ERCP
- Hip Nailing/ Femur Rodding
- Anterior Hip Replacements
- Orthopedic Extremities
- Pain Management
- Portable Abdomen *(for sponge or needle count)*
- Port-A-Cath
- Spinal Fusion
- Vascular Studies



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Restrictions

- RH students may not participate in any case that requires the OR staff to wear a N95 respirator.
  - Ex. Bronchograms or Bronchoscopies (OR RM 5 T-Ground), Enhanced Precautions Patients

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Cystoscopy – "Cysto“

- "A diagnostic procedure that allows the physician to directly examine the urinary tract, particularly the bladder, the urethra, and the openings to the ureters. Cystoscopy can assist in identifying problems with the urinary tract, such as early signs of cancer, infection, strictures (narrowing), obstruction (stones), and bleeding."
- Charge: XR CYST ROOM ND - NC

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Cystoscopy – "Cysto"

- Usually performed in a “Cysto room” or suite with a stationary fluoro table (OR Room 15)
- The Urologist performs the actual fluoro exposures using a foot pedal
- **Technologist responsibilities**:
  - Initialize the fluoro table, monitors and generator
  - Enter patient information
  - Save images & send to PACS

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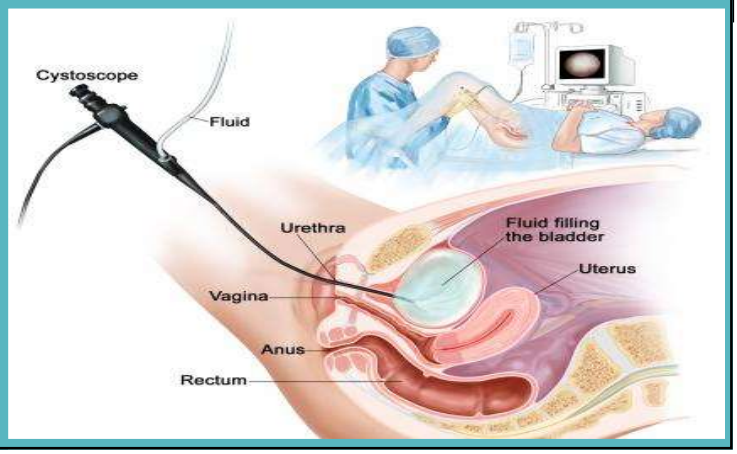

Rigid Flexible Ureteroscopy - Insertion of a semi-rigid ureteroscope - YouTube

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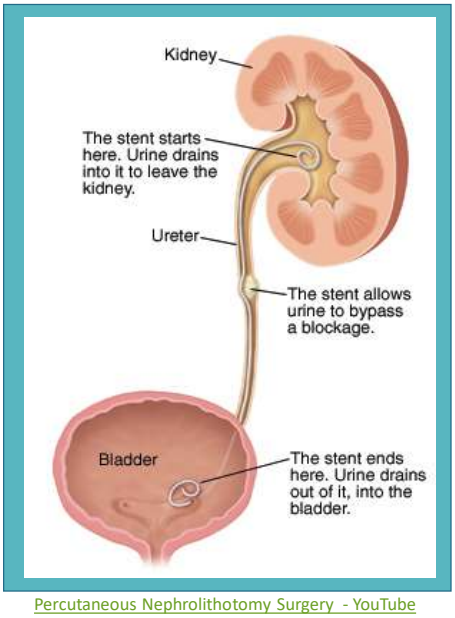
Laser fragmentation of large stone in the kidney - YouTube



Percutaneous Nephrolithotomy Surgery - YouTube

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Pathologies

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Adenocarcinoma of Prostate

Type of cancer that develops in gland cells

- **Cause**: Idiopathic
  - Risk factor – inherited gene mutation, inflammation of prostate
- **Complications**: Erectile dysfunction, urinary incontinence, and severe pain if the cancer spreads to the bones.
- **Radiographic appearance**:
  - Elevates and impresses the floor of the contrast-filled bladder in an irregular pattern
  - US – hypoechoic (darker area)
- **Technical**: Typically, do not have to change
- **Prognosis**:
  - Local stage – No sign that the cancer has spread outside of the prostate. The relative 5-year survival rate for local stage prostate cancer is nearly 100%.
  - Regional stage – Cancer has spread from the prostate to nearby areas. The relative 5-year survival rate for regional stage prostate cancer is nearly 100%.
  - Distant stage – Includes the rest of the stage IV cancers – cancers that have spread to distant lymph nodes, bones, or other organs (M1). The relative 5-year survival rate for distant stage prostate cancer is about 29%.

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Benign Prostatic Hyperplasia

Enlargement of the prostate gland

- **Cause**: Disturbance of hormone secretions from the sex glands
  - Risk Factors – Age, family history, diabetes and heart disease, lifestyle
- **Complications**: Bacterial infection, pyelonephritis
- **Radiographic appearance**: Elevates and impresses the floor of the contrast-filled bladder in a smooth pattern
  - J –shaped or fish-hook appearance of distal ureters
- **Technical**: No changes, Ultrasound used to visualize
- **Prognosis**: Good

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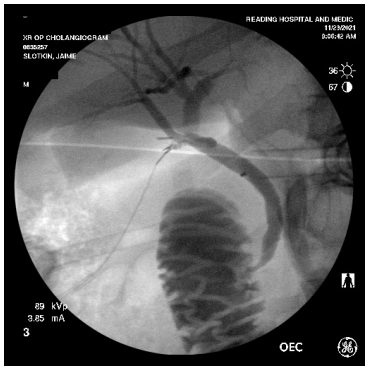
Surgical Cholangiography

- AKA Interoperative Cholangiogram
- Investigates the patency of the bile ducts and the functional status of the sphincter of the hepatopancreatic ampulla to reveal the presence of calculi that cannot be detected with palpation
- After exposing, draining, and exploring the biliary tract, and frequently after excising the gallbladder, the surgeon inject contrast (cholangiogram)



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Early Laparoscopic Cholecystectomy (ELC)

Surgical C-Arm Procedure

- Surgical removal of the gallbladder using a tiny camera inserted through the navel for guidance (laparoscopic)
- When imaging is used during an ELC it is referred to as an Operative Cholangiogram *(can also be done using the portable and a cassette)*
- Approximately 20 million people in the United States have gallstones. Of these people, there are approximately 300,000 cholecystectomies performed annually.

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ELC

- The surgeon locates the common bile duct and inserts a catheter to introduce x-ray contrast
- Technologist responsibilities:
  - Move the C-Arm to directly over the patient's gallbladder *(right upper quadrant)*
    - *The patient is supine on the table*
    - *You will be obtaining a PA projection (tube under patient)*
  - Fluoro while the surgeon pushes contrast through the bile duct and biliary tree
  - Images PACS

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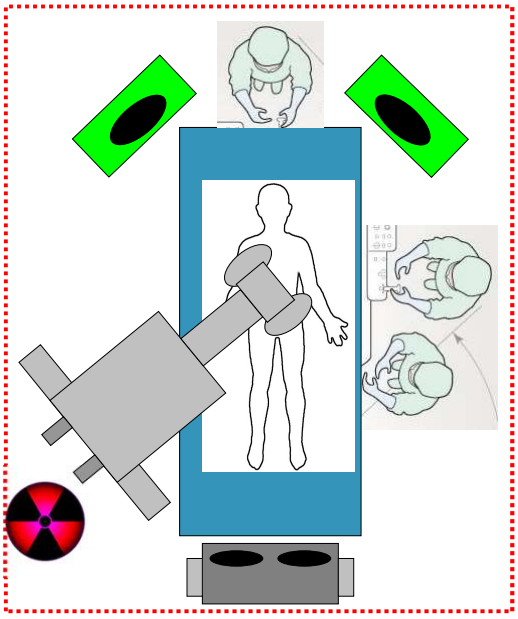
RH ELC

- The C-Arm remains parked against the OR wall until the surgeon places the catheter into the bile duct.
- After fluoroing the C-Arm is parked back against the wall and cleaned.



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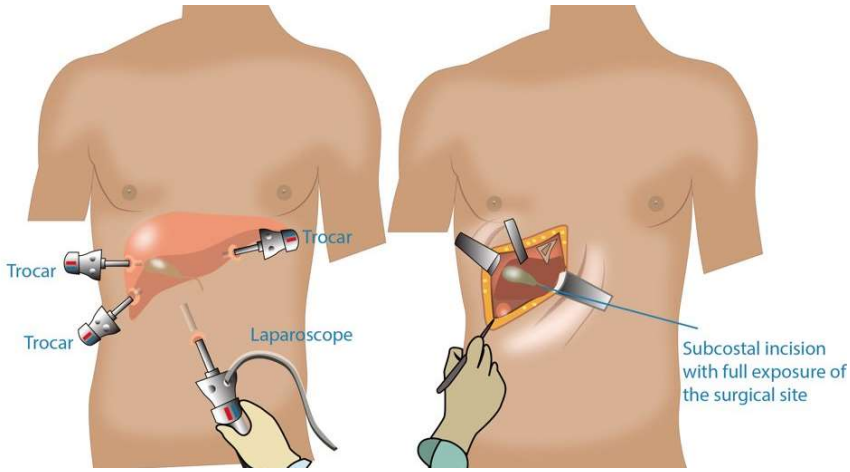
Laparoscopic vs. Open



Gallbladder Removal Surgery

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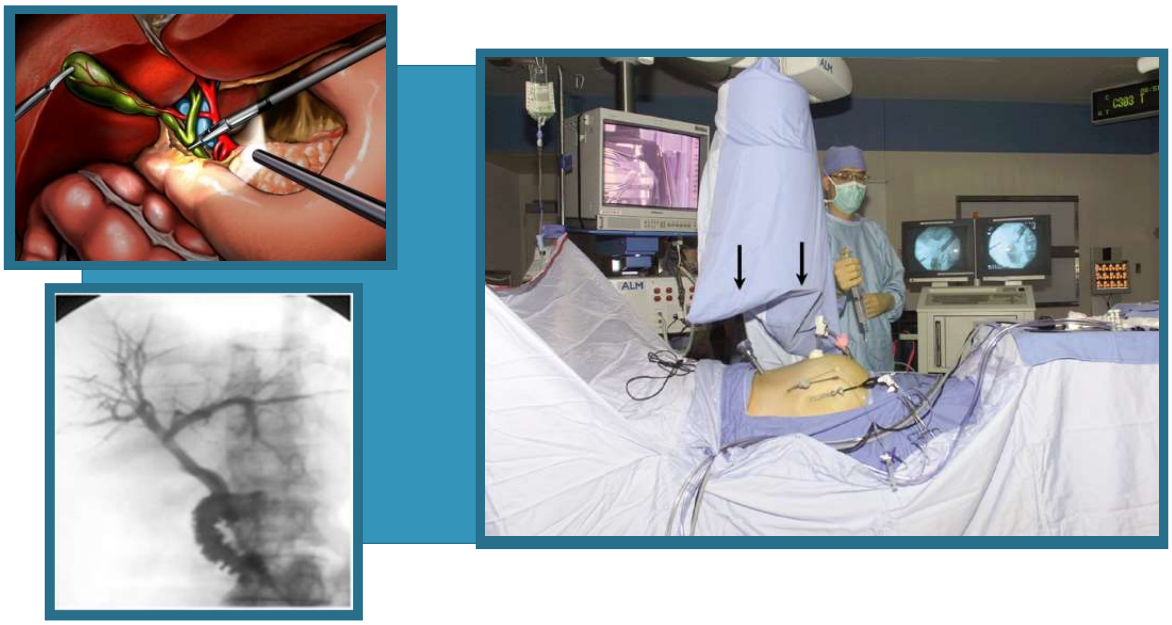

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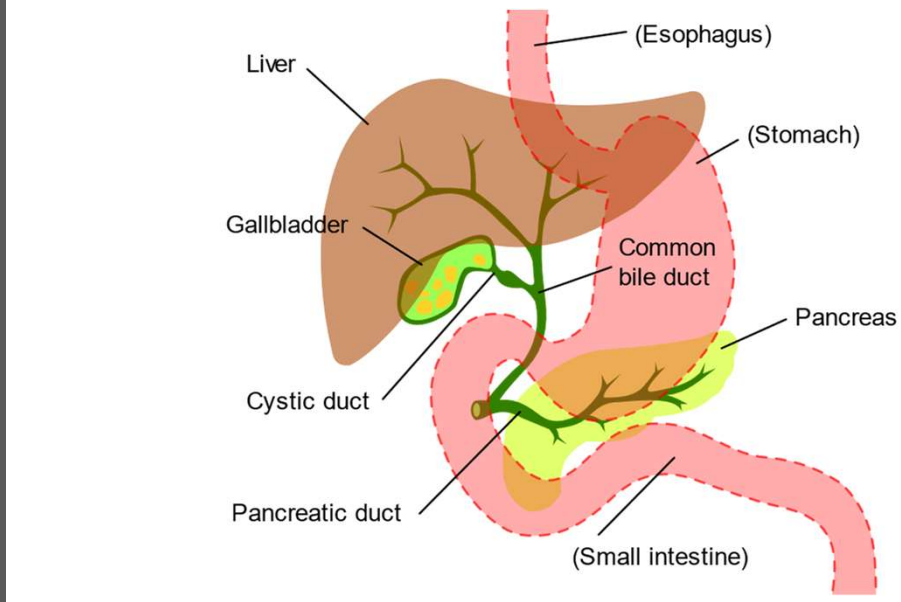

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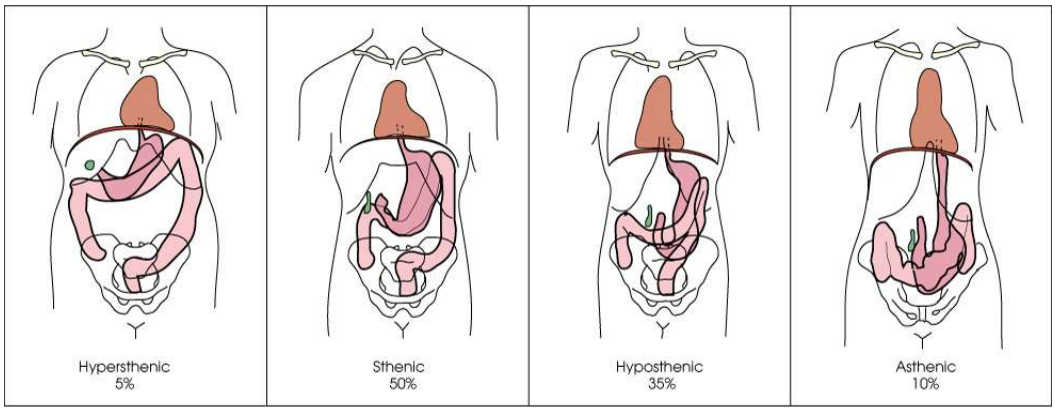
Take note how the gallbladder moves



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At RH, ELCs have 3 different charges:

- "OP Cholangiogram" – Any initial laparoscopic injection of contrast
- "OP Cholangiogram ADL SET" – Charge for *additional images*, usually after the placement of a "T" tube done in an open cholecystectomy
- "OP Cholangiogram ND – NC" – If no images saved since contrast was not successfully injected.

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Endoscopic Retrograde Cholangiopancreatography (ERCP)

- Used primarily to diagnose and treat conditions of the liver, gallbladder, bile ducts, and pancreas including gallstones, inflammatory strictures (scars), leaks (from trauma and surgery), and cancer
- Combines the use of x-rays and an endoscope
- Through the endoscope, the physician can see the inside of the stomach and duodenum, and inject contrast into the ducts in the biliary tree and pancreas so they can be seen on x rays

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ERCP

- Performed by a Gastroenterologist (RH – Procedural Suites RM 8 T Ground)
- Technologist Responsibilities:
  - Fluoro over the patient's biliary system
  - Save and send images to PACS
- RH Charging:
  - **ERCP –** If biliary ducts and pancreatic duct visualized
  - **ERC –** If only biliary ducts
  - **ERP –** If only pancreatic duct

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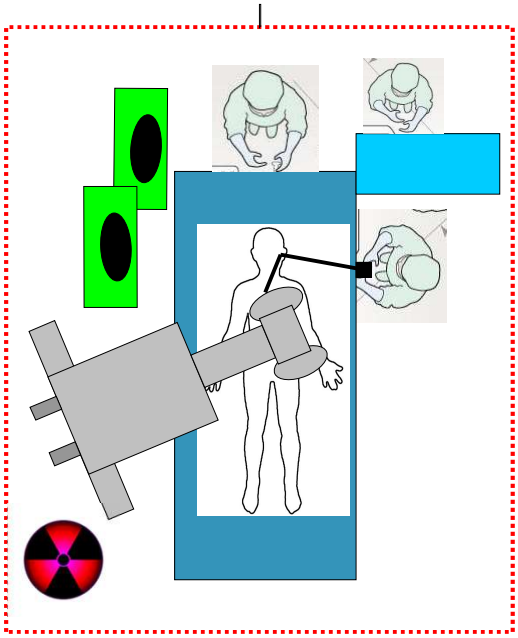
RH ERCP (C-Arm)

- The patient is in LAO position on the GI table.
- The C-Arm approaches from the patients left and centers over the right upper quadrant.
- Technologist will fluoro or provide doctor with fluoro pedal



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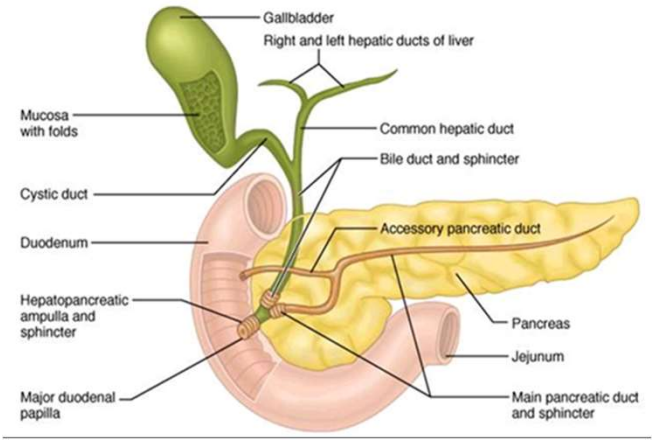

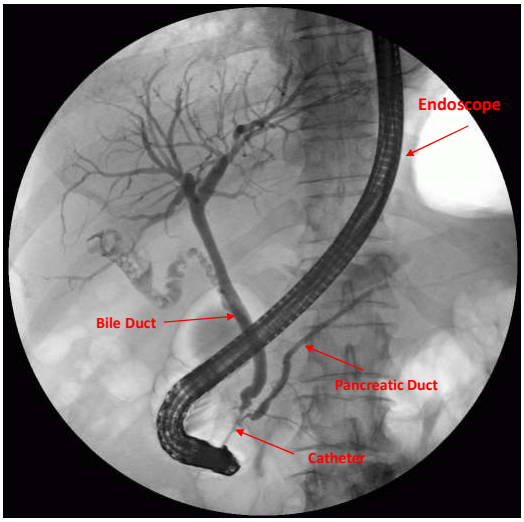

Pediatric ERCP | Cincinnati Children's - YouTube

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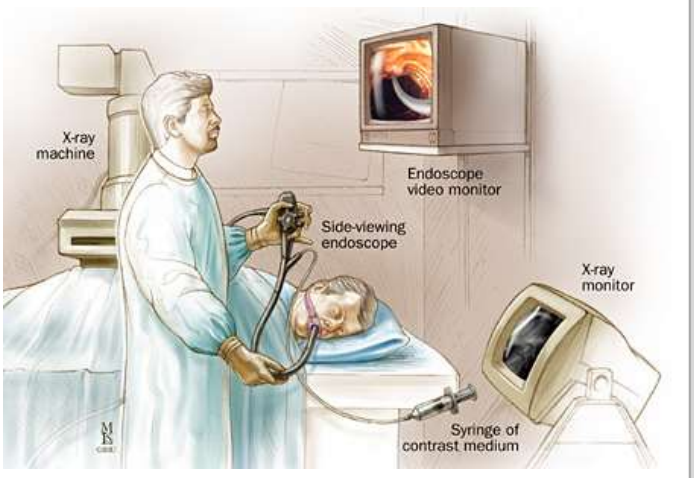

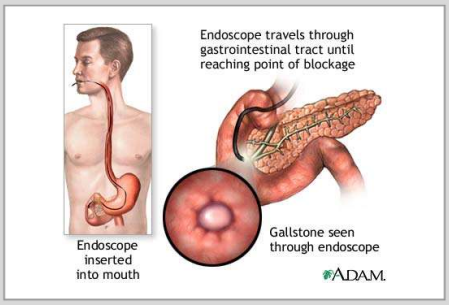

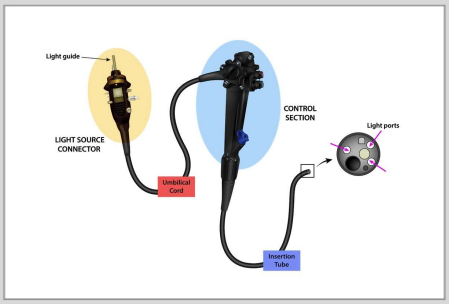

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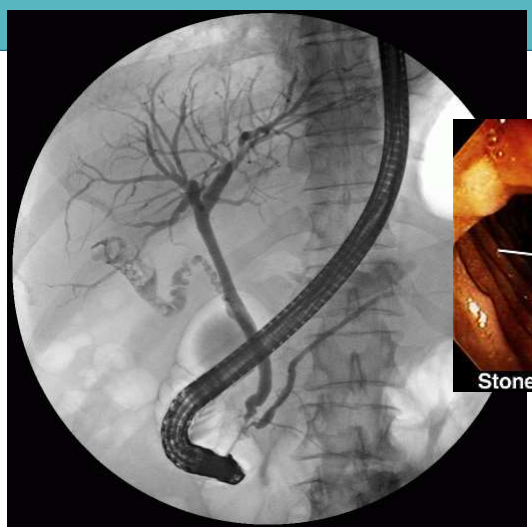

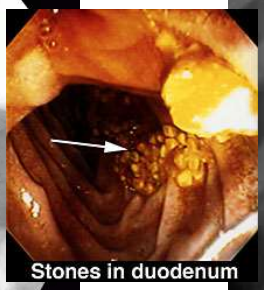

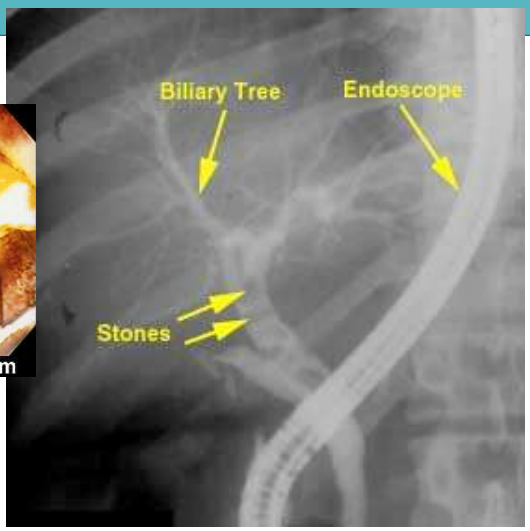

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Pathologies

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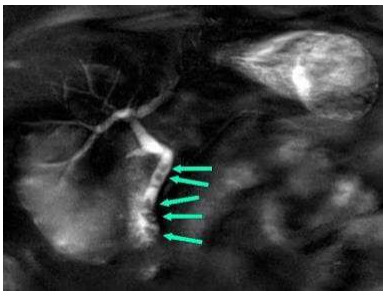
Cholelithiasis

Gallstones

- Made of cholesterol or pigment

- **Cause**: idiopathic
  - Genetic predisposition, excess weight, female
- **Complications**: Obstruction of the common bile duct. Inflammation or infection of the gallbladder or common bile duct
- **Radiographic appearance**:
  - Most gallstones are radiolucent and visible only on contrast exams or US
  - Alternating opaque and lucent rings
  - Can have a Mercedes-Benz sign – if gas fissure is present inside it
- **Prognosis**: Good



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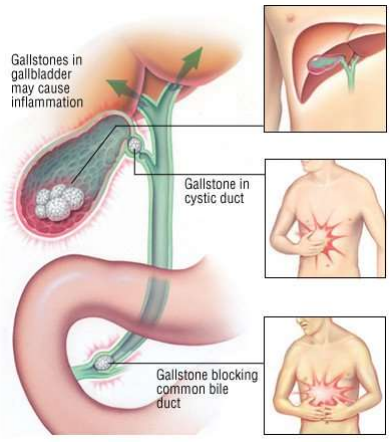
Cholecystitis

Inflammation of the gallbladder

- **Cause**: 95% of cases occurs after obstruction of the cystic duct
- **Complications**: Gangrene and rupture
- **Radiographic appearance**:
  - US – distended gallbladder with gallstones with edema
  - Radionuclide cholescintigraphy – failure to accumulate radioactivity in gallbladder
- **Prognosis**: Complete remission within 1-4 days



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Anterior Hip Replacement

Surgical C-Arm Procedure

- Surgeon makes a four-inch incision through the front of the leg
- Benefits of Anterior Approach:
  - Frontal entry makes it possible to reach the joint by separating rather than cutting and then reattaching muscles
  - Recovery time is faster
  - Less risk for hip dislocation after surgery

Direct Anterior Approach Hip Replacement Surgery and Recovery - YouTube

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Anterior Hip Replacement

- C-Arm enters on opposite side hip of interest
- At RH: images of the affected hip and pelvis are taken to see the trochanters and obturators
  - AP views only
- Radlink may be used depending on physician
  - There is a cable that connects the C-Arm to the Radlink tower so that the rep can pull images from the c-arm

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Performed on a Hana Table

https://www.youtube.com/watch?v=5gcd8oB216U

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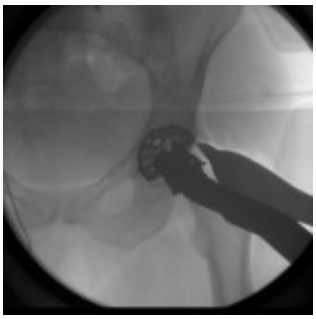

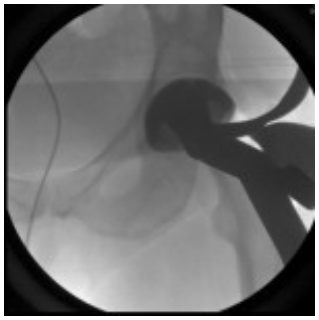

Acetabular Reaming | Acetabular Implantation | Final Fit

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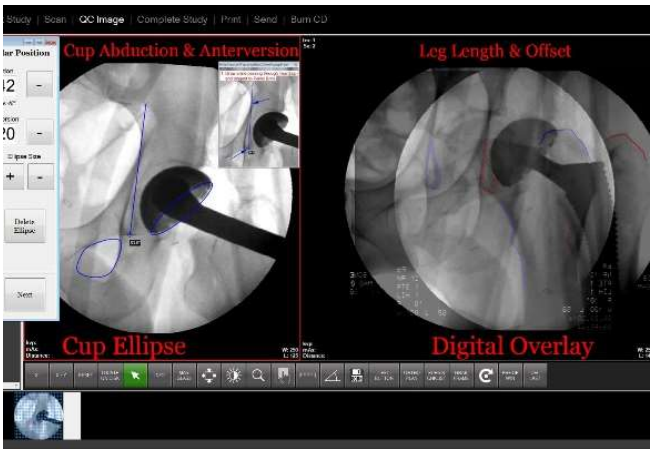
Radlink at RH

- Radlink software allows a live image to be grabbed from the C-Arm or portable monitor and shown on the Radlink monitor.
- The doctor or equipment rep can perform different manipulations to the image on the Radlink monitor.
  - Examples: road mapping, sizing
- Always ordered as No Dictation with Radlink order
- Dr. Slotkin, Dr. Longenecker, and Dr. McAlpine are the doctors who may use this equipment



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Hip Nailing

C-Arm Procedure

- Open Reduction Internal Fixation (ORIF) of a fractured proximal femur
- An Orthopedic surgeon uses x-ray to guide the placement of hardware into the femur
- Fixation hardware may end in the proximal femur (nailing) or extend down to the knee (rodding)
- Patient may be placed supine with legs crossed, supine with unaffected leg frogged, or in lateral position laying on unaffected side

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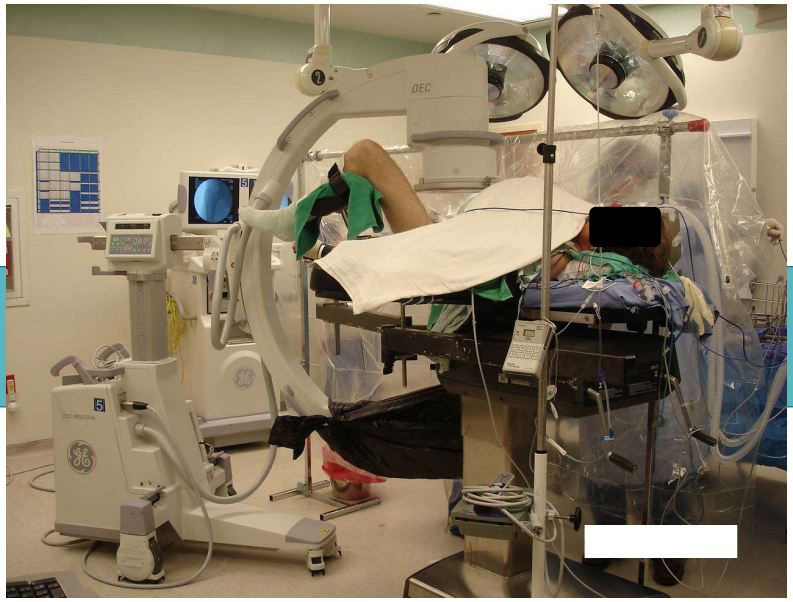

A bag is usually placed over the C-Arm tube (bottom) due to the high level of vascularity of these cases

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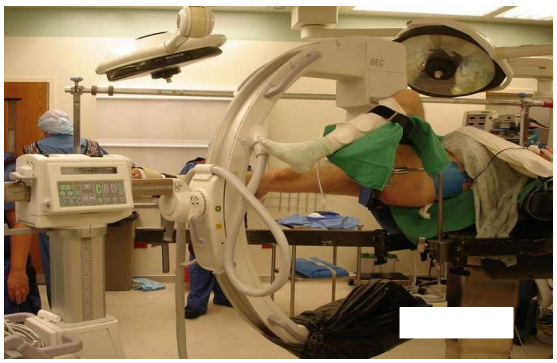

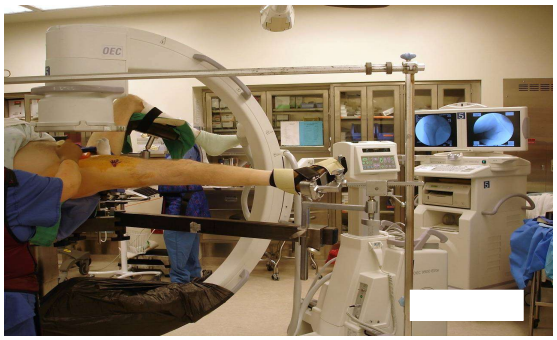

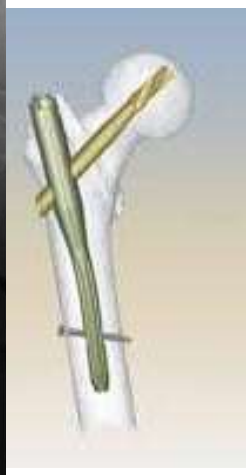

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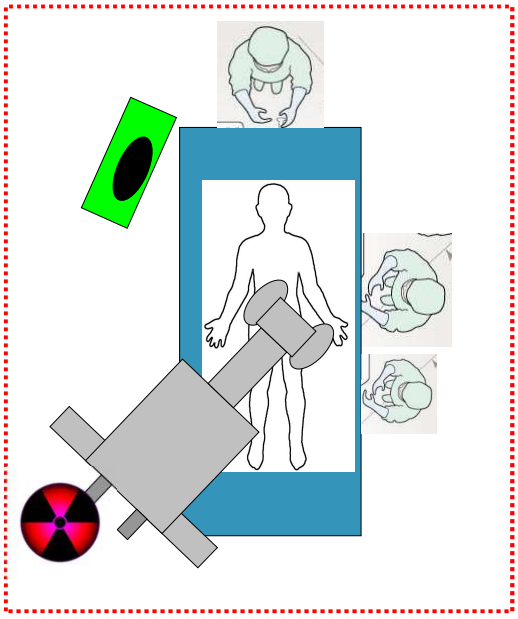
Hip Nailing

- The C-Arm approaches from unaffected side
- Sterile team on affected side side.
- Ensure Black Diamond Video cord is plugged in and C-Arm images are on room monitor for surgeon



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Hip Nailing

- Technologist Responsibilities:
  - Center and position the C-Arm appropriately over the patient's affected h
  - Take pre-sterile AP and lateral images (scout)
  - Assist in maintaining a sterile field while rotating the C-Arm between AP and lateral projections
  - Maintain AP and lateral views of the hip on the monitors at all times
  - Save images and send to PACS

Sliding Hip Screw Surgery For Hip Fracture – YouTube

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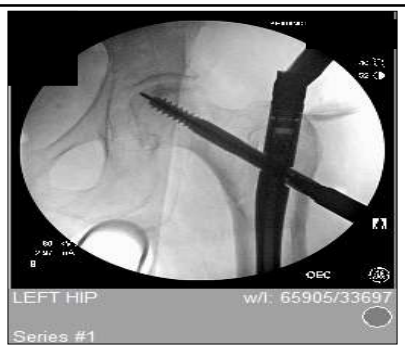
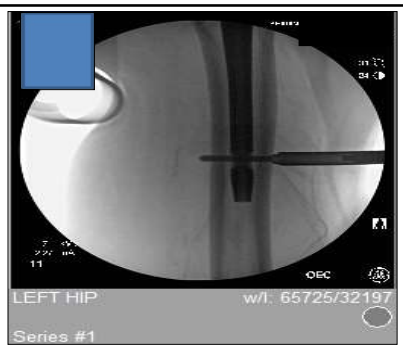
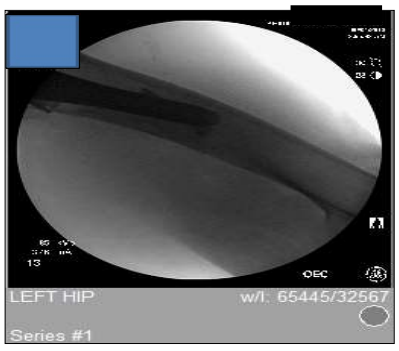




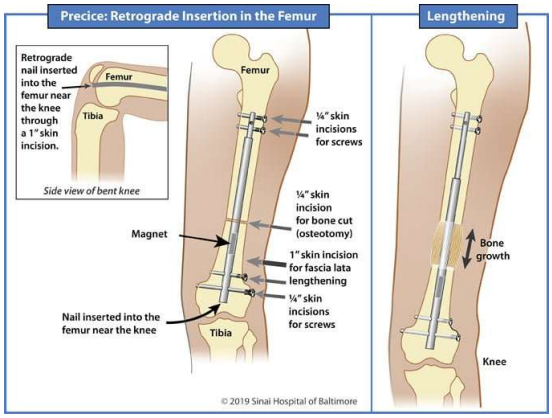


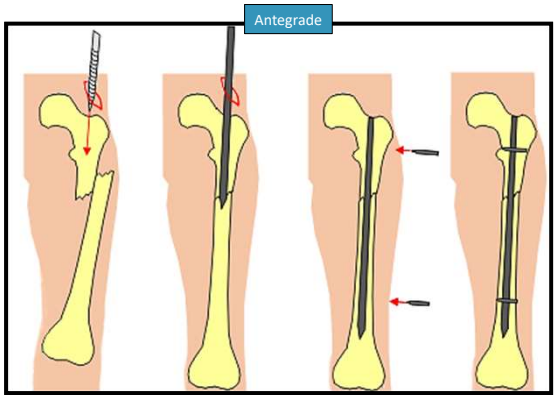
56

Femur Rodding

- Intramedullary rod inserted into femur to correct fracture
- Can be done with antegrade (from hip) or retrograde (from knee)
- Very vascular, just like hip nailing

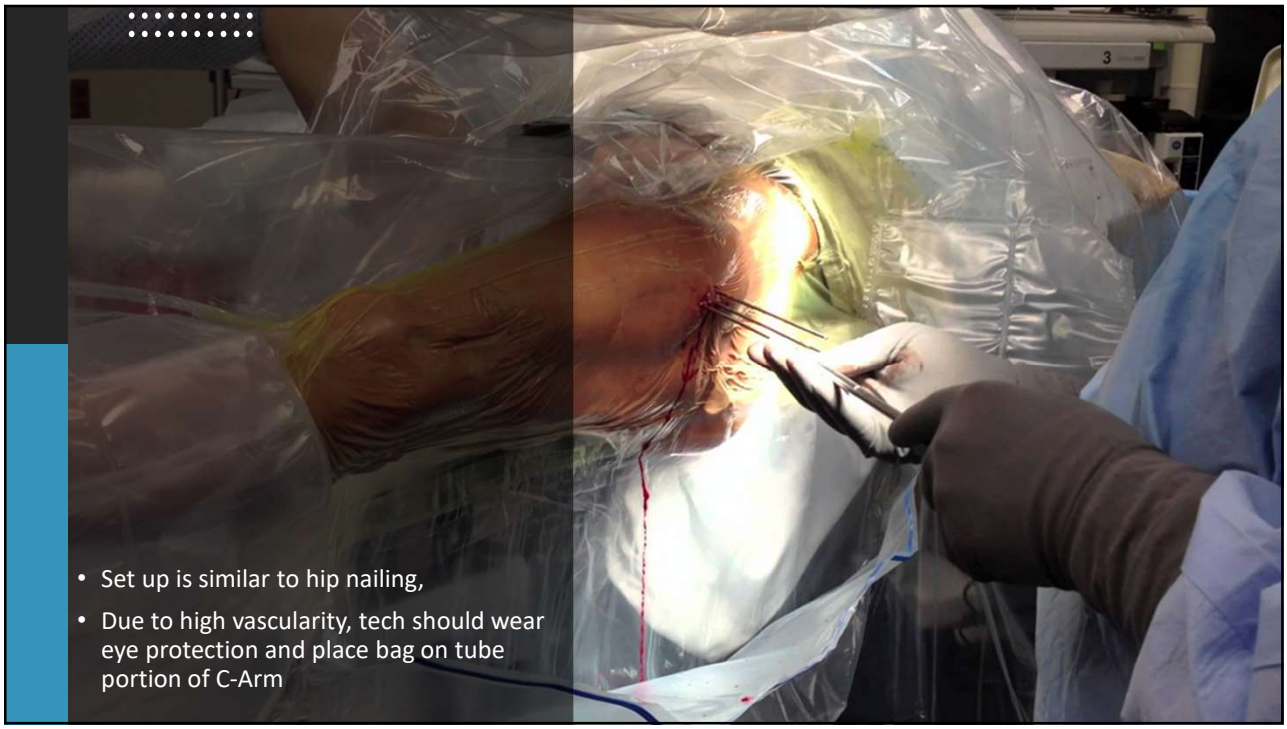
57





Intramedullary Nailing of Right Femur Fracture - YouTube

58



59


- Screws to insert into rod must be imaged laterally to form 'perfect circles'
- Tech's responsibility to make sure circle is 'perfect' and adjust C-Arm if not.
- Save and send AP and lateral images.

Femoral Shaft Fracture Intramedullary Nailing (Femur Fracture Surgery) - YouTube

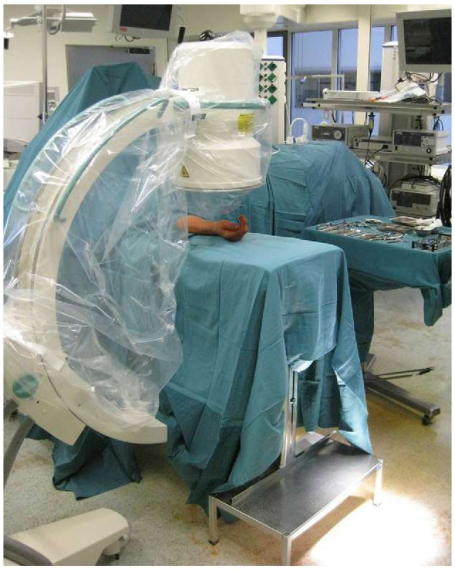
60

C-Arm Procedure

Orthopedic Extremities

- Surgical repair of **any** extremity with fluoro guidance
  - Open or closed repair
- C-Arm and monitor position vary with each body part and surgeon preference
- Technologist and OR staff must communicate to allow C-Arm placement without interrupting sterile fields.
- Technologist Responsibilities:
  - Arrange equipment based upon body part and physician preference
  - Maintain **AP and lateral** images on the C-Arm monitor
  - Communicate with OR staff to maintain the sterile field
  - Save images and send to PACS

61



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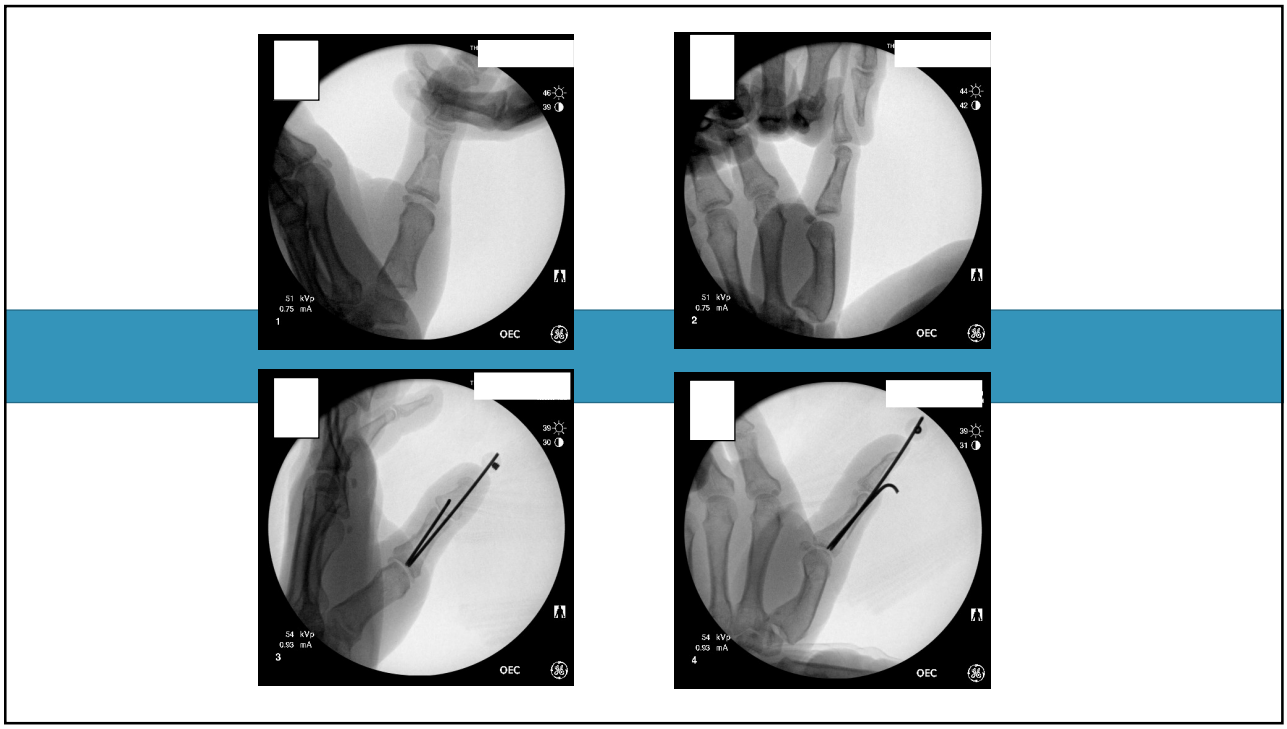

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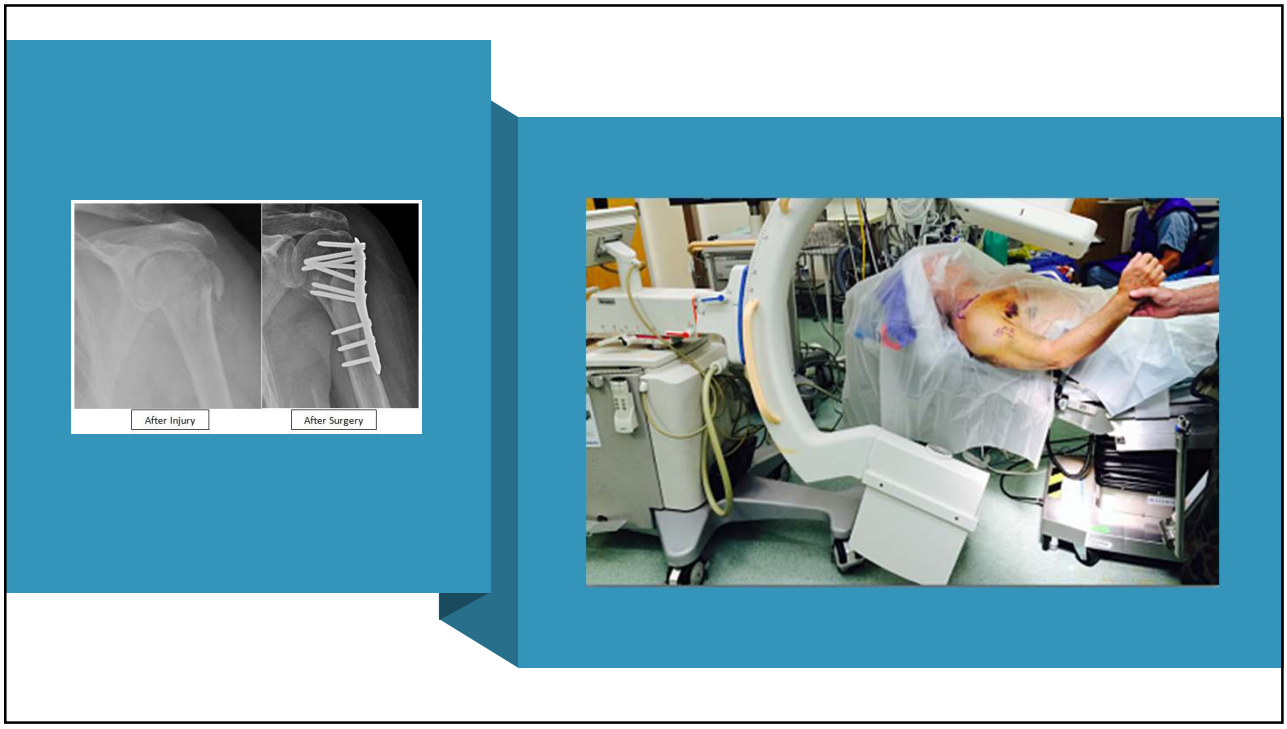
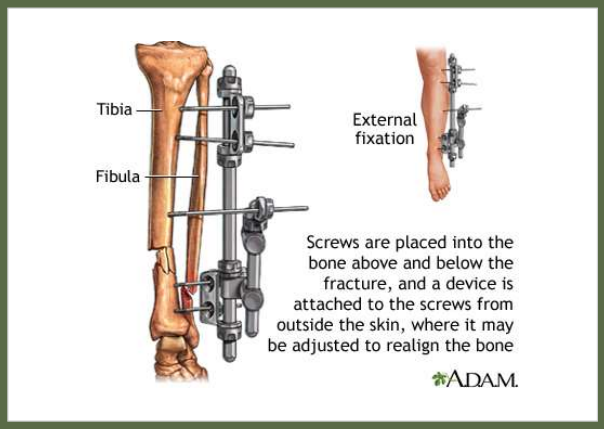


64

External Fixation



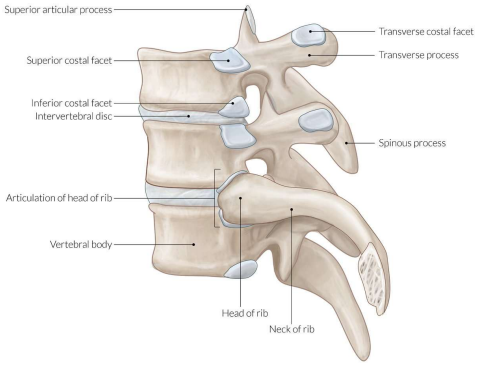
65

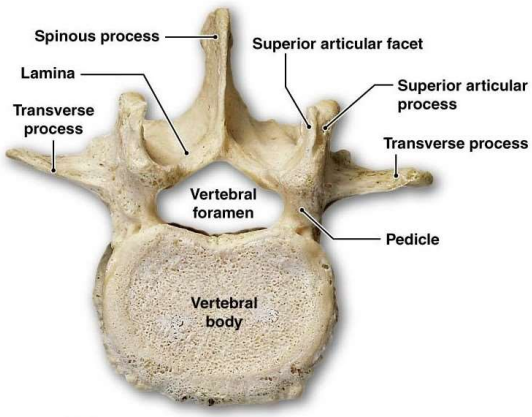
Spinal Surgery

C-Arm Procedure

- **Fusion:** Permanent fixation of 2 or more vertebrae using metal screws and rods
  - Takes away some flexibility but may stop the progress of deterioration, such as scoliosis
- **Discectomy**: Removal of a portion of a herniated disc or complete disc removal during a spinal fusion
  - Herniated discs can irritate surrounding nerve branches and cause severe lower extremity pain
  - The disc is replaced by a "cage" during fusions
- **Laminectomy:** Surgical operation to remove the back of one or more vertebrae, usually to give access to the spinal cord or to relieve pressure on nerves

66

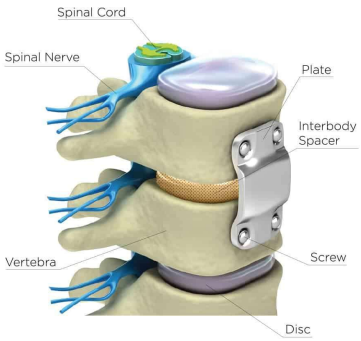




67

Spinal Surgery

- Cervical surgery is usually done with the patient laying supine
- Thoracic and lumbar surgery is done with the patient laying prone
- Either a C-Arm or portable machine can be used
  - Based on surgeon preference

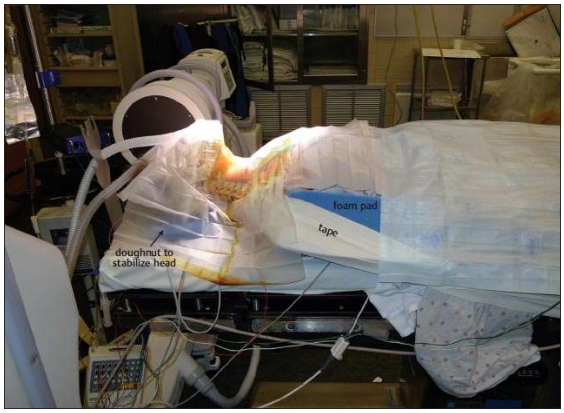


68

C- Arm for Spinal Surgery

- Most surgeons will take preliminary images prior to draping the patient to help position equipment
- AP/ PA images should be marked with L or R
- The tube should be **perpendicular** to the patient's spine to ensure true lateral image
- Tech may need to angle C-Arm to open spaces

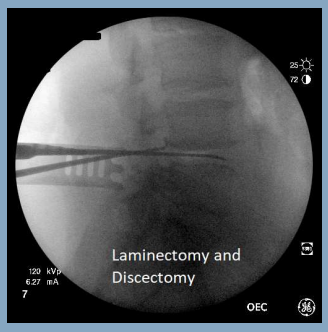
69

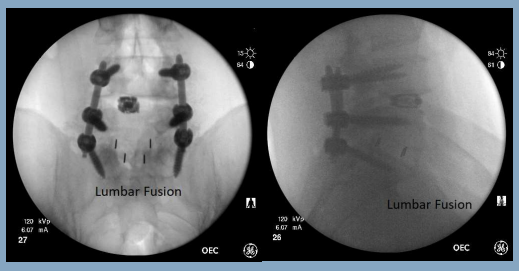


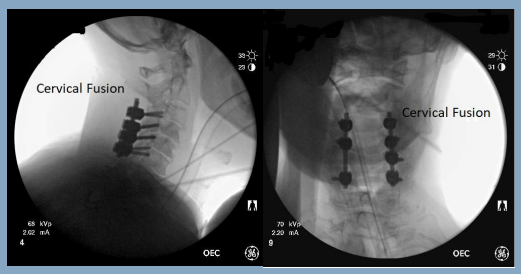
Curvature to aid in straightening out disc spaces

70

Spinal Surgery Image Examples





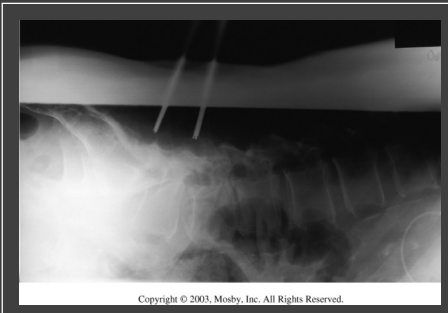


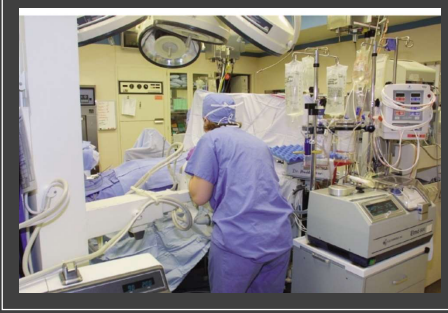
71

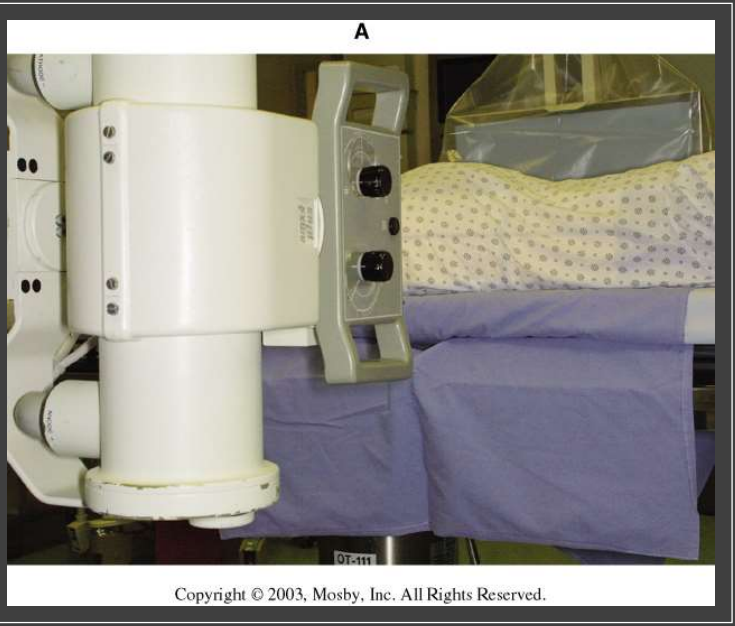
Portable for Spinal Surgery

- A grid holder holds a detector in position for a **x-table lateral** image
- The detector and grid holder are covered in a sterile drape and placed tightly against the patient
- Everyone except the anesthesia nurse leaves the room during the exposure
  - Have an extra lead apron ready to give anesthesia
- The tech must communicate with anesthesia to have the patient's respiration held during the exposure

72







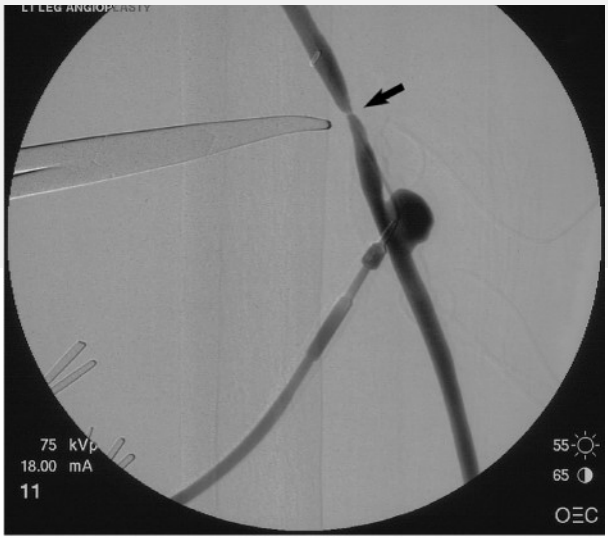
http://www.youtube.com/watch?v=_lUhQLFHriw

73

Surgical C-Arm Procedure

Vascular Studies (Arteriograms)

- Use injections of contrast under fluoro to evaluate blood vessels for strictures or ruptures
  - Intra-operative Arteriograms
  - Venous bypasses in extremities
  - Aortic stent placement for abdominal aneurysms



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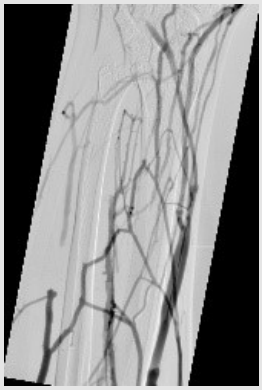
Vascular Studies - Subtraction



- Removal all bone or other artifacts from an image for better visualization of contrast-filled vessels

75

Vascular Studies - Roadmapping

- A type of imaging in which contrast is injected ONCE, but the image of that contrast is superimposed over subsequent images that are not contrast injected resulting in less radiation exposure and contrast use

How to Use a C-arm: Roadmapping | GE Healthcare – YouTube

Diagnostic Arteriogram

76

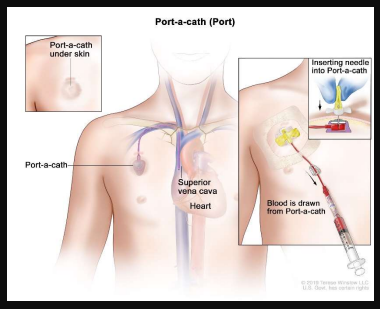
Vascular Studies (Arteriograms)

- Technologist Responsibilities:
  - Must be proficient in the vascular capabilities of a C-Arm
    - Subtraction; roadmapping; cine runs
  - Ensure the C-Arm does not move once it is centered over the area of interest
  - Provide proper lead protection for all present OR staff
    - Vascular studies are among in the highest in fluoro times
  - Be prepared to mark anatomy and make annotations on images

77

Port – A – Cath

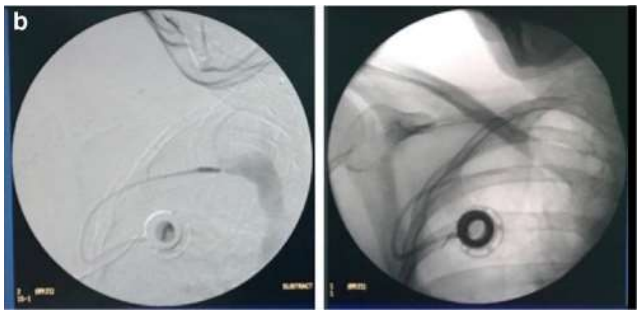
- A reservoir connected to a catheter that is inserted into a vein near the heart.
- Designed to permit repeated access to the venous system for the parenteral delivery of medications, fluids, and nutritional solutions and for the sampling of venous blood.



78

Port – A – Cath

- A C-Arm is used to guide the placement of the catheter into the veins around the heart
- Technologist Responsibilities:
  - Center over the shoulder of interest and the heart
  - May need to pull the C-Arm in and out of the sterile area multiple times
  - RH: Most surgeons do not save any images, so only send the last image on the screen and the Dose Summary



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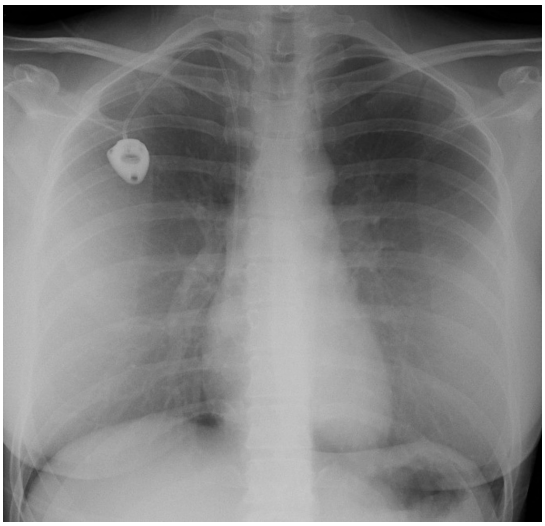
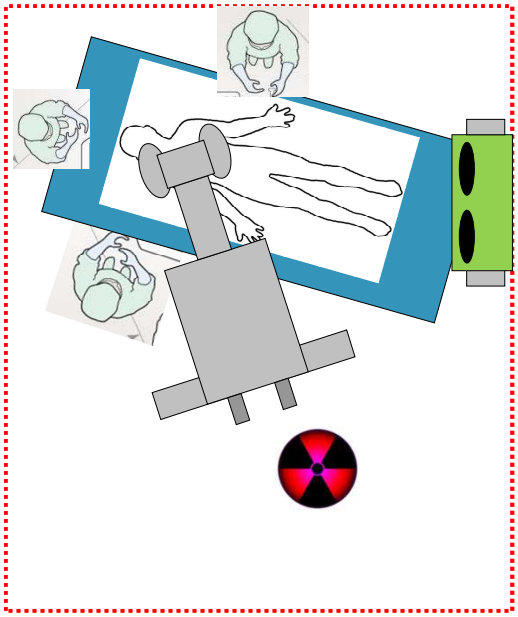


80

Port – A – Cath

- The C-Arm stays away from the sterile field until needed
- Technologist positions the C-Arm over the incision at area of heart and SVC and fluoros when directed.
- Send images to PACS as directed by physicians



81

Name
Patient ID
Procedure XR PAIN MANAGEMENT ND – NC
Accession # 13049814
Date 02/05/2020
Physician

Generator Mode	Time	Cumulative Dose
Fluoro/Roadmap	14.8 s	100.0 %
HLF/Dig. Spot/Subtr	0.0 s	0.0 %
Film	0.0 s	0.0 %
Totals	14.8 s	
		5.55 mGy

Field of View	Time	Cumulative Dose
Normal	14.8 s	100.0 %
Mag 1	0.0 s	0.0 %
Mag 2	0.0 s	0.0 %

Mode	Time	Cumulative Dose
Continuous	14.8 s	100.0 %
Pulsed	0.0 s	0.0 %

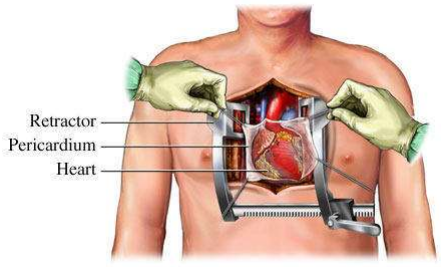
Dose Summary

If patient is under 18 or is pregnant must complete a dose summary form located in fluoro.
- note the kVp and mAs after first exposure

82

Open Heart Surgery (OHS)

- Open heart surgery is any surgery where the chest is opened, and surgery is performed on the heart muscle, valves, arteries, or other heart structures.
- A portable CXR is used to confirm line and tube placement upon arrival to ICU but can also be done in OR room after the case



Open Heart Surgery | Inside the OR - YouTube

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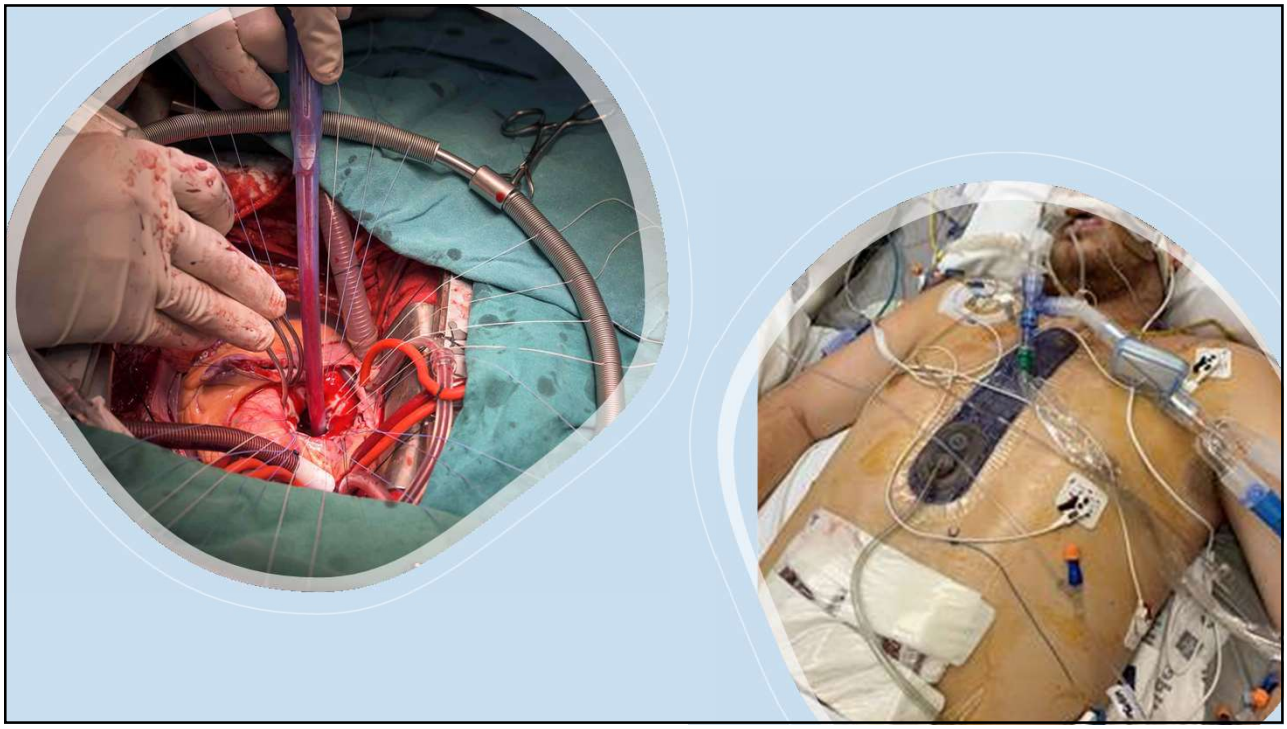


84

Evaluation Criteria: 3 lines

1. Swan-Ganz

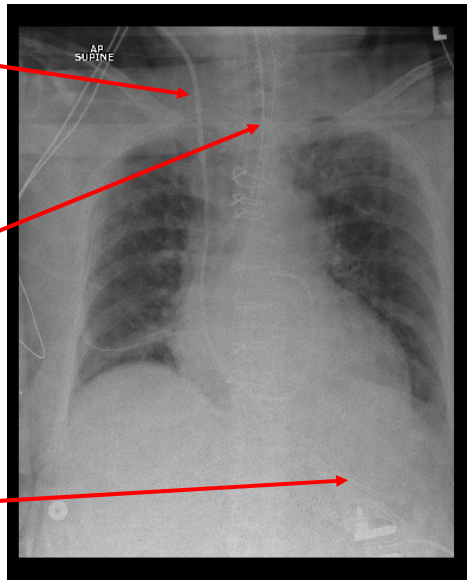
   Inserted in the right side of the neck and coils in heart to the pulmonary artery.

2. Endotracheal tube

   Enters the patient's mouth and ends just proximal to the bronchial bifurcation.

3. Nasogastric Tube

   Enters through the nose and ends in the stomach(usually under the patient's left diaphragm).



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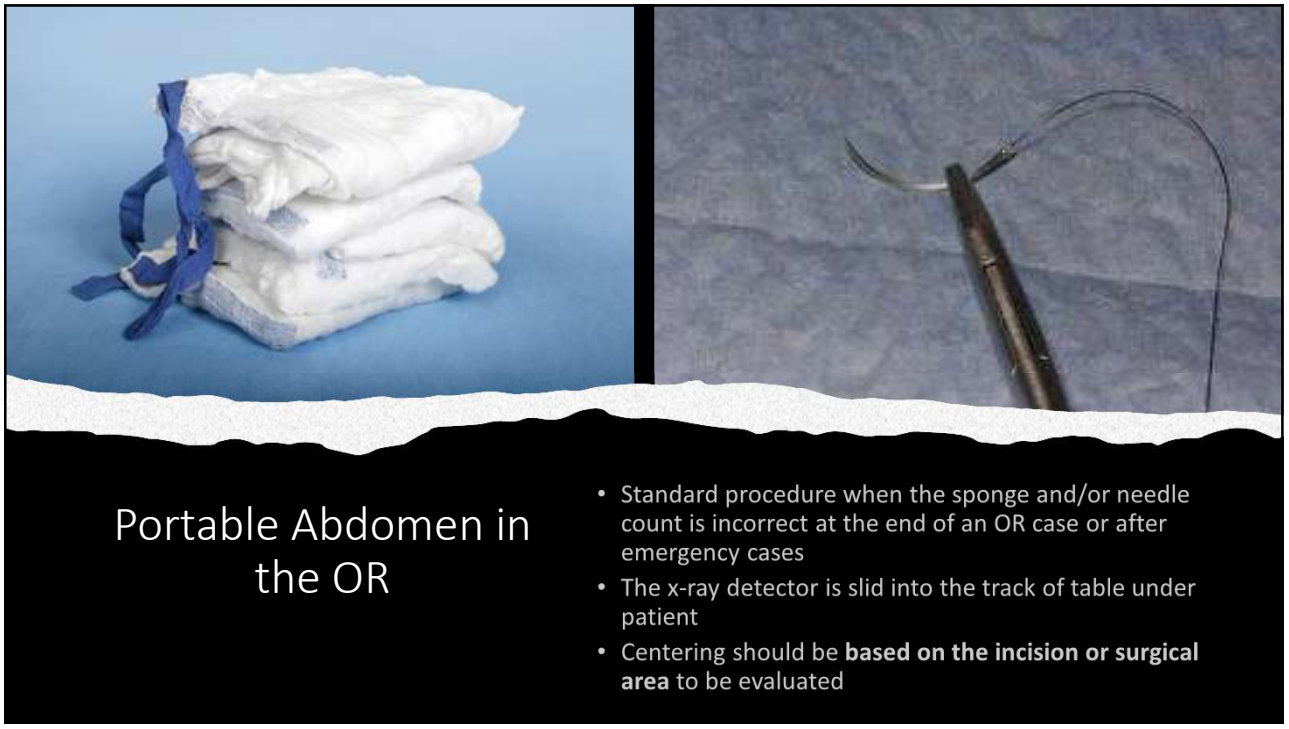


Portable Abdomen in the OR

- Standard procedure when the sponge and/or needle count is incorrect at the end of an OR case or after emergency cases
- The x-ray detector is slid into the track of table under patient
- Centering should be **based on the incision or surgical area** to be evaluated

86

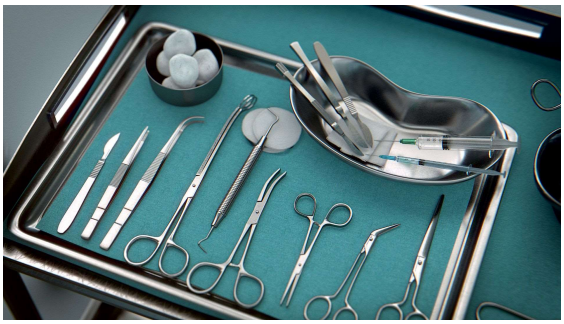
Where to place the IR

87

Portable Abdomen in the OR

- RH: The procedure is marked as an "OR STAT READ" so the results can be called to the OR room before the patient goes to PACU.
- Technologist responsibilities:
  - Maintain the sterile environment when trying to position the cassette under the patient (if sterile)
  - Follow steps for obtaining image as directed by surgeon
  - Obtain image of missing item
  - OR will wait for verbal from Radiologist to wake the patient up

88



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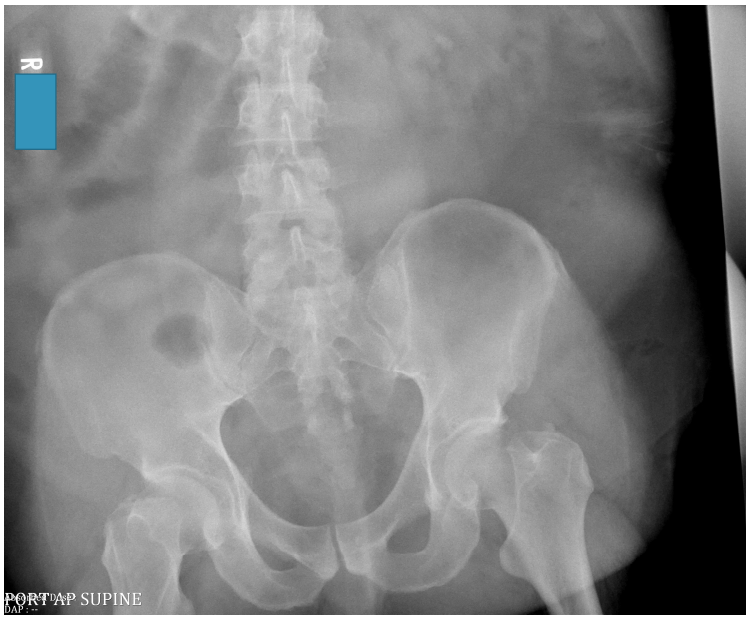

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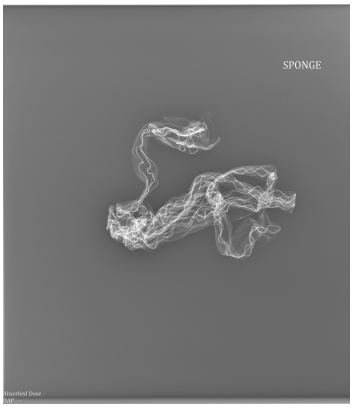
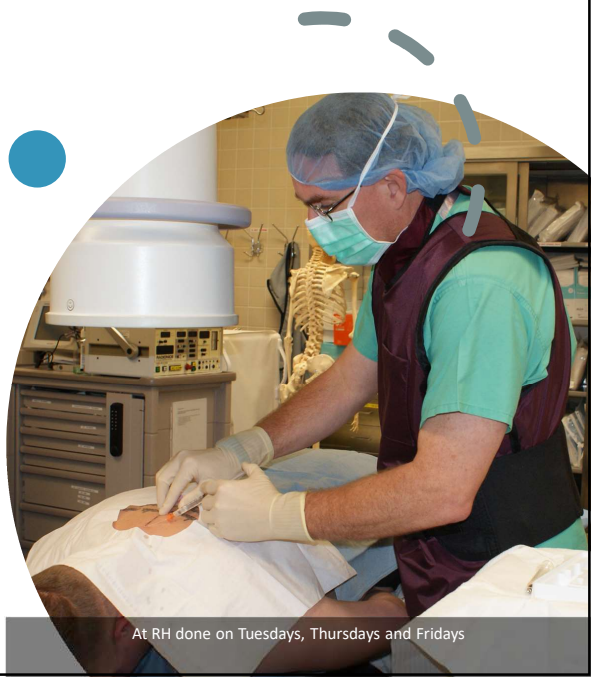


91

Pain Management

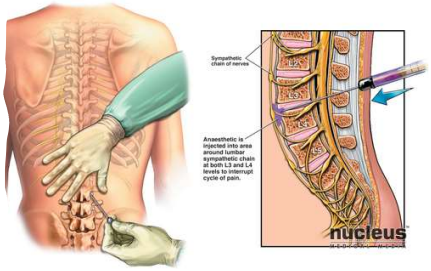
- Fluoro-guided injections of analgesics and/or steroids to alleviate chronic pain
- Done in the semi-sterile environment of a Pain Management suite
- Performed with or without sedation

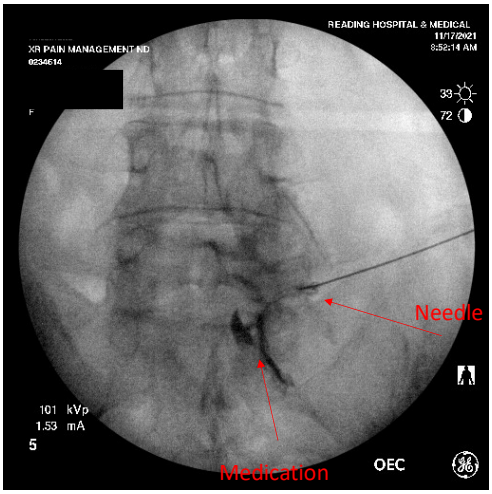


92

Pain Management

- Nerve Blocks - relieve pain by interrupting pain sensory pathways and preventing them from reaching the brain.

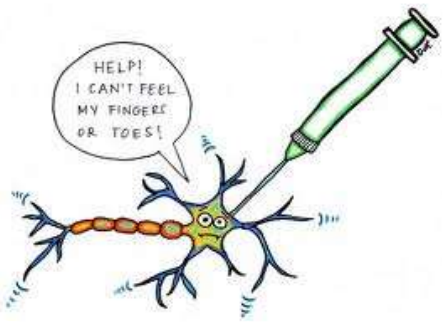




93

Pain Management

- Technologist's Responsibilities:
  - Knowledge of pain management protocols in order to visualize the area of interest for each procedure
    - Transforaminal's
    - Facets
    - Epidurals
    - Cervical epidurals
  - Save and send images to PACS
  - Assist with patient safety



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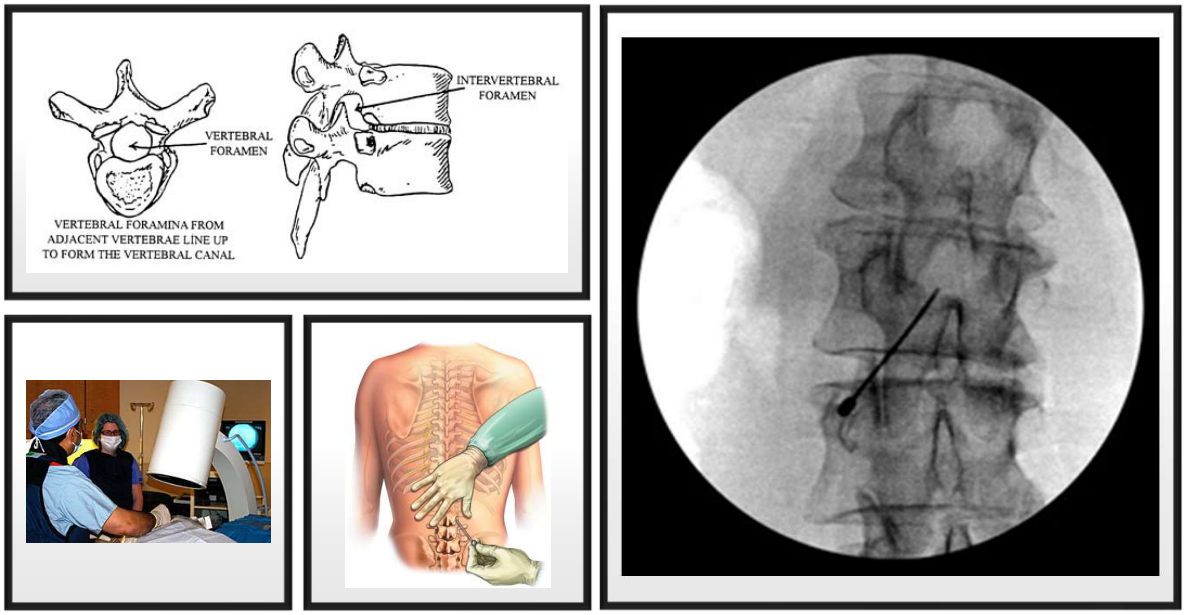

95

Maintaining Equipment

- X-ray equipment must be cleaned after every case – in the room (to prevent spreading contaminates).
  - Clean with hospital approved cleaning solution
  - DO NOT use on screen
- *Best* practice is to clean equipment prior to bringing into the room.
- Clean once per week, even unused equipment

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Questions?

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