

Introduction to Radiology

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Objectives

- 1. Identify when/ how to order radiographs
- 2. Understand basic concepts of radiology
- 3. Develop organized process to evaluate x-rays
- 4. Evaluate normal vs. abnormal findings x-rays

When to order radiographs

- 1. Obtain accurate history
- 2. Perform a detailed physical exam
- 3. Develop a list of differential diagnosis
- 4. Once the above has been completed then you can accurately decide what type of study will assist you in your diagnosis

Physics of Radiology

- 1. X-ray is completed when a beam passes through a patient
- 2. The radiation beams will have varying degree of absorption
- 3. The more dense the object the more absorption occurs (metal / bone)
- 4. The less dense the object the less absorption occurs(air/ lungs)



Densities

- 1. Air: minimal if any absorption (lung) black
- 2. Fat: mild absorption (light gray)
- 3. Liquid: (blood, soft tissue)very light gray
- 4. Muscle: more gray than fat (more absorption)
- 5. Bone: nearly white
- 6. Foreign body: various significantly from very easy to see like a coin to extremely difficult to see like wood splinter

Terminology

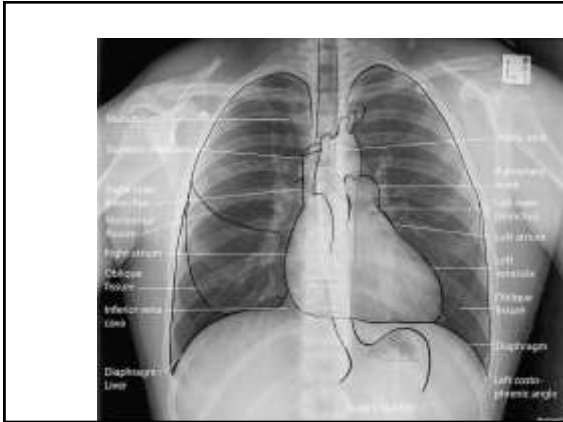
- 1. Density: how bright (white) the object is
- 2. Radiopaque-resist the passage of xrays through them.
- 3. Radiolucent-allow the passage of xrays depending on their radiodensity
- 4. Lucency: black line on the film (fracture line)
- 5. AP: front to back
- 6. PA: back to front
- 7. Lateral: side view
- 8. Oblique: diagonal or 45 degree from object

Key Concepts

- 1. Always look @ name, age, sex, and date of the film
- 2. Know the history of your patient! For example are those body piercings or a foreign body?
- 3. Try to look at films the same way each time to gain a pattern of repetition
- 4. Keep in mind this is a 2 D picture of a 3 D object. Minimum of 2 views

Chest X ray

- Most common radiology study
- Contains many variables: vessels, air, organ, and bone all with various densities
- Diaphragm shadows - slightly higher on the right than on the left side.
- Costophrenic angles - where the diaphragm meets an imaginary line drawn through the lateral edge of the thorax; these should always be sharp.
- Heart shadows - edge to edge width of the heart at its widest point should be less than one-half of the total intrathoracic diameter.



• RIPE FILM

- “R” rotation: the film needs to be straight. The spinous process should be equal distance from the medial heads of the clavicles
- “I” inspiration: a good degree of inspiration should have 6 anterior ribs visible above the right hemidiaphragm
- “P” position: what is the position of the patient? Semi-erect/ upright. Looking at the gas-fluid line in the stomach can help
- “E” exposure: (probably the most important). Too much or too little can lead to incorrect diagnosis. Digital x ray has helped some with this problem. (Consultant, Sept 1, 2007. vol 47)

Chest x ray

- Common findings: heart size, shape, tracheal deviation, lung symmetry, infiltrates, pulmonary vascularity, costophrenic angles, ribs, clavicle, spine fractures, lesions, and tube placement.
- Look at less obvious: posterior heart, lung apices, pneumothorax, and shoulders
- Look @ old films if available for comparison

Chest X ray Pearls

- 1. Acute asthma flare will be hyperinflated, flat diaphragm
- 2. COPD similar findings with blunting costophrenic angles, and increased AP diameter
- 3. Spine sign: T spine vert. bodies get darker as you view caudally. If there is change from dark to lighter look for infiltrate.

Chest x ray pearls cont.

- 4. atelectasis: decreased volume. May be seen post op frequently. Encourage spirometer
- 5. Pneumothorax: air in the pleural space. May be trauma or spontaneous (seen in young, tall, and thin teens/ 20's). Seen mostly in upper lobes.
- 6. Granuloma: less 0.5 cm diameter. Very dense.

Chest Pearls cont..

- 7. Cardiomegaly: measure heart @ widest point. Should be less than half of hemithorax when measured from mid spine to ribs.
- 8. CHF: early finding include presence of Kerley B lines (small horizontal lines found in the very periphery of lung near the rib). These lines represent fluid in the interlobular septa. These should not be mistaken for blood vessels as you should not see lung markings in peripheral ¼ lung

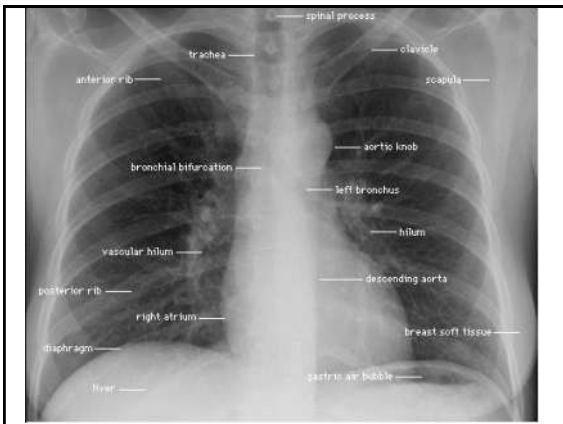
CXR summary

- Is this the correct film
- Is the film "RIPE"
- Look @ bony skeleton: ribs, vert body, scapulae, clavicles (Corne et al, 1998)
- Soft tissue evaluation: compare side to side. Look for symmetry. Examples include breast tissue/ axillary folds
- Look @ diaphragm. The right should be higher (no more 3 cm). Should be smooth. Look for sharp costophrenic angles (Jenkins, 2006)

CXR summary

- Look @ lung fields. Start with one side then the other. Once completed look @ both for symmetry. Be sure to evaluate each lobe on both sides.
- Look @ trachea. Is it midline? Look around the clavicles and retro-cardiac space (areas easy to miss pathology)

• Chest x ray interpretation can be complex but
Corne J, Carroll M, Brom L, Delany D(1998): Chest x ray made easy, Churchill Livingstone, Edinburgh
 if viewed in organized and logical pattern can
Jenkins P(2005): Making sense of CXR a hands on guide, Hodder, Arnold, London



Normal CXR



Normal CX
Lateral

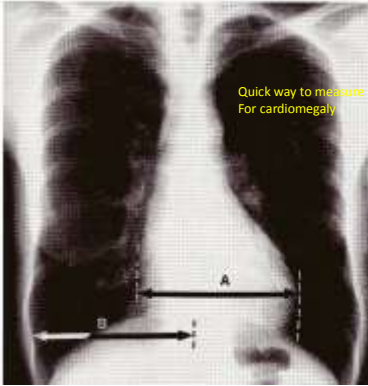


Normal
CXR..Note
calcified
implants



Normal Lateral same
patient with implant



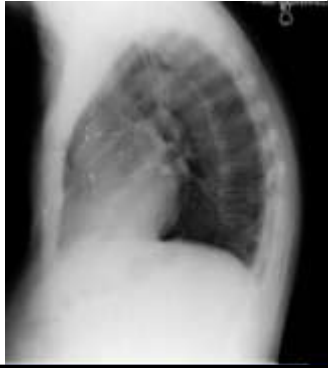


Mettler, F. (1996). Essentials of Radiology (1st ed). W.B. Saunders Company

Cardiomegaly
with vascula
clips



Same patient
with
cardiomegaly
on lateral

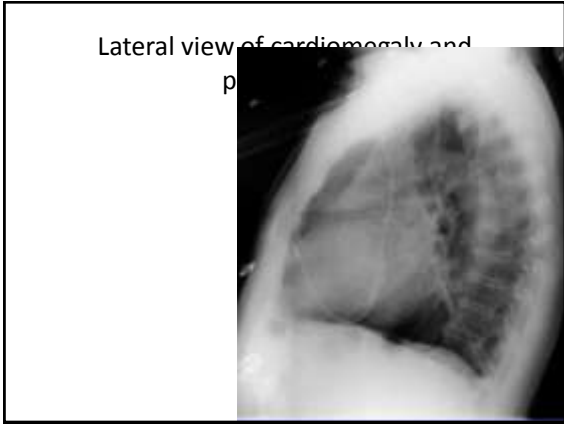


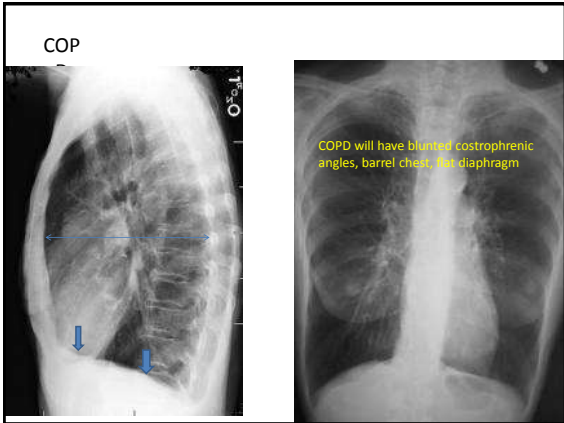
Notice poor technique of the CXR
Notice pacemaker & cardiomegaly

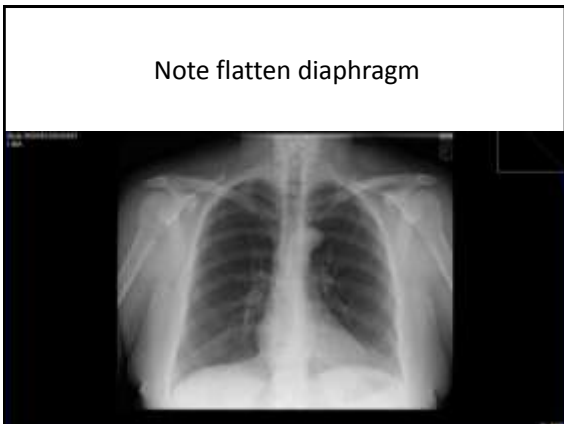


Same patient
with
repeat view..
still poor!







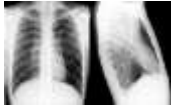


Notice the barrel chest appearance



Asthma flare

Asthma flare: hyper inflated, NO blunting, Mild flattening diaphragm



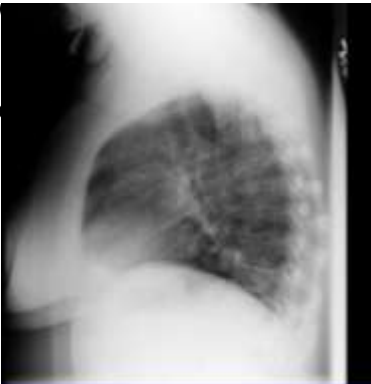


Notice the positive spine sign on the lateral

Notice the patchy infiltrate on the right

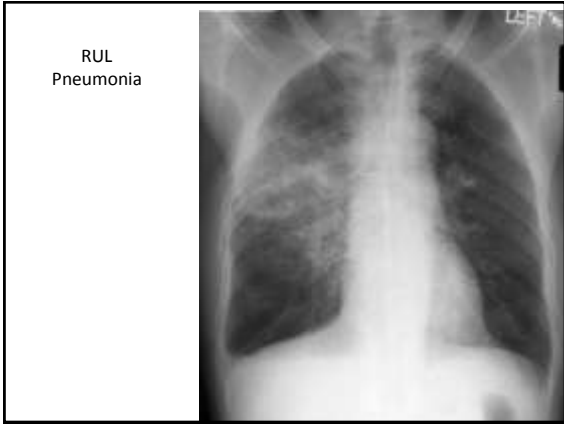


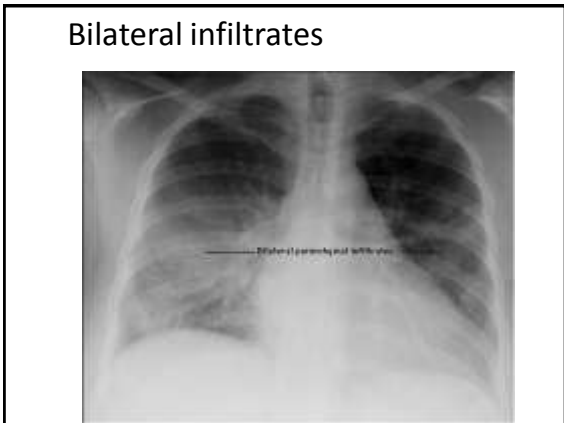
Lateral view
right
mid/lower
lung infiltrate

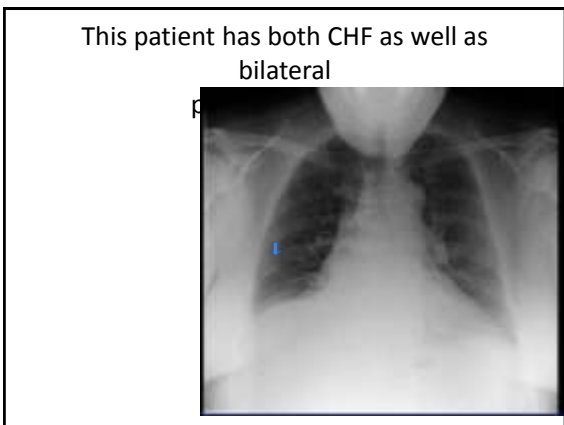


Pneumonia

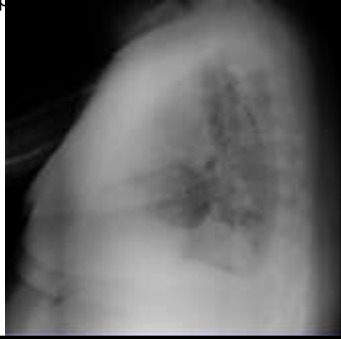








Lateral view same patient notice how pre cardiac space is full 2nd to CHE



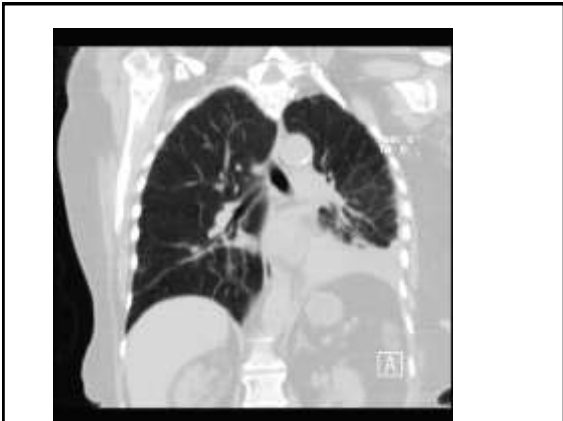
Good Example "kerly B" Lines



Large Pleural effusion

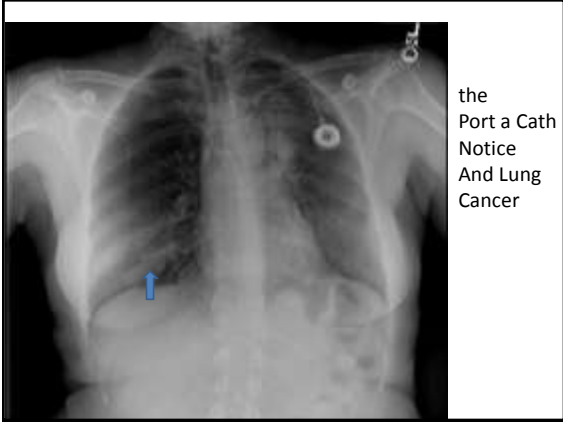




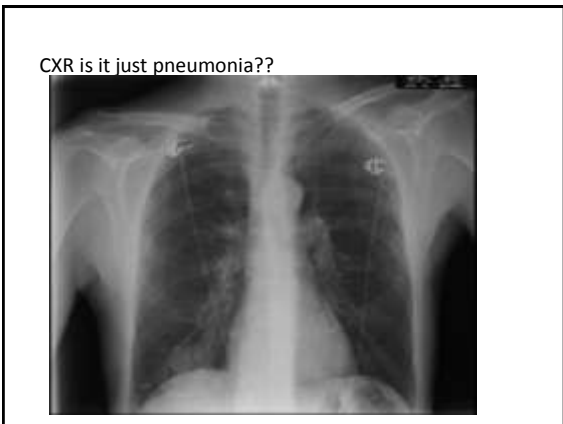


Pericardial effusion...Not CHF









Same patient 4 months



Metastatic lung cancer to spine...Not just pneumonia!!
Remember to get follow up CXR to document resolution



RUL Tumor



Right Hilar Mass



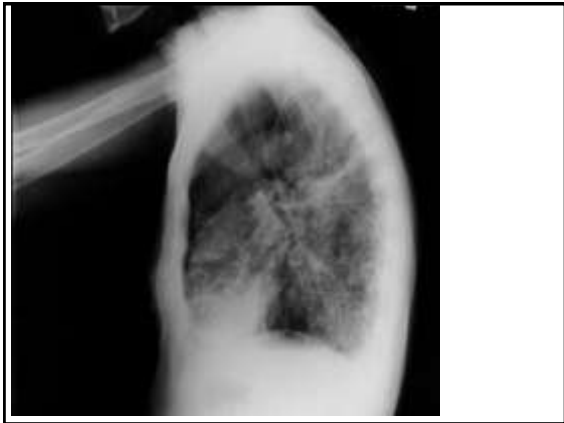
This patient had a total left pneumectomy 2nd to Cancer

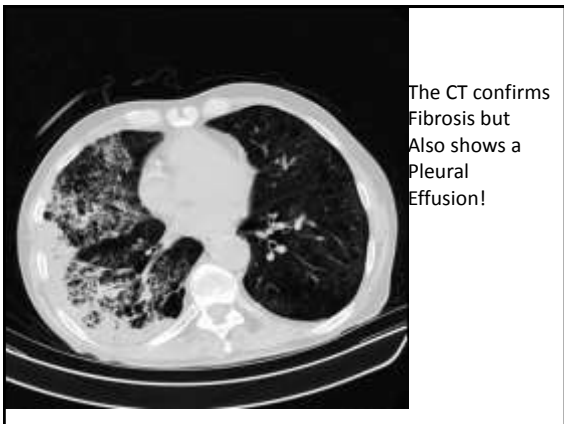


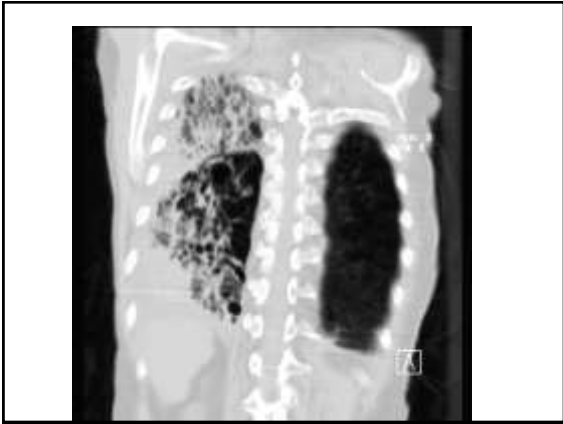
Same patient lateral











Atelectasis (RML)

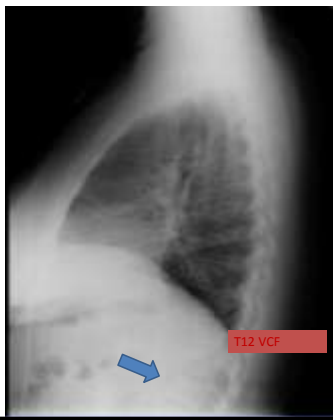
- Turn, cough, and deep breath
- Incentive spirometry
- Percussion
- MDI's
- Bronchoscope

A frontal chest X-ray. The right middle lobe (RML) shows a wedge-shaped opacity, characteristic of atelectasis. Labels with arrows point to the 'Loss of cardiac border' and 'Crescentic opacity'.

CXR with a lady with back pain
Lungs a

A frontal chest X-ray. The lungs appear clear with no significant consolidation or effusion. The heart size is within normal limits. The diaphragm is well-defined. There is a small 'a' marker on the right side of the image.

Remember to look at all structures including the vert bodies



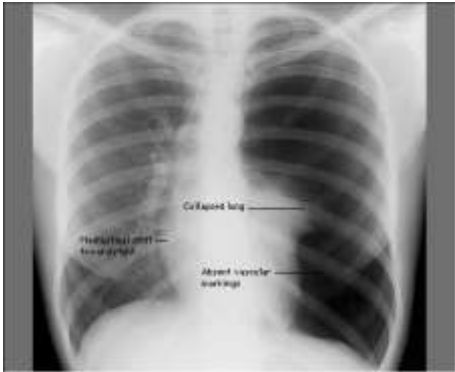
Remember to look at whole x ray not just lungs.. Notice the large hiatus hernia

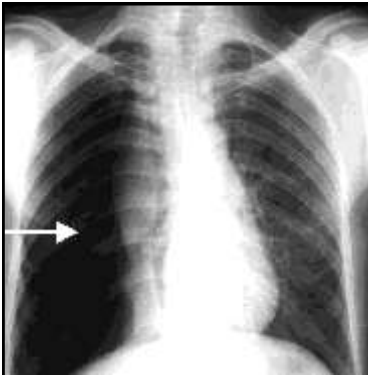


Same patient with hiatus hernia



Large left PTX





www.szote.uszeged.hu/radiology



Patient with pneumopericardium, Pneumomediastinum, And free air in apices

www.aic.cuhk.edu.hk

Abdomen

- Many names: KUB, flat plate, 1 view abdomen. Primarily looks @ bones, lung bases, gas pattern, some soft tissues.
- May be helpful in the early workup for: bowel perforation, rupture ectopic pregnancy, ileus, ovarian cysts, AAA, ischemic bowel, bowel obstruction, or foreign body.

Abdomen

- Evaluate the following: gas pattern, organ shape & size, calcifications, skeleton, lung base infiltrates (can mimic abd pain), asymmetric psoas margins.
- Asymmetric psoas can be pathologic in 25 % cases.
- Skeletal: eval for hip symmetry, SI joints, and the thorolumbar vert. bodies.

Abdomen

- Organ size: very difficult to DX on plain film unless it's extreme.
- Most common use is to eval gas pattern. Normal to have gas pattern from stomach, small bowel, colon, sigmoid, and rectum.
- Small bowel should not exceed 3 cm. Mostly found in found mostly left mid and lower central abd. SB mucosa has very fine lines cross the lumen described as "stack thick coins"

Small bowel has been described as a stack of coins



abdomen

- The cecum/ colon have a bubbly appearance from mix of gas/ feces.
- Colonic air has been describes as “clover leaf” shape because haustra (short longitudinal bands) of the colon.
- Common to see “cloverleaf” air collections from hepatic flexure(RUQ), transverse colon, splenic flexure(LUQ), descending colon, sigmoid

• Colic band

• Haustra of colon

• Epiploic appendices



Abdomen red flags

- Free air under diaphragm
- Free air on supine films
- Small bubbles (focal) may be abscess but abscess vs. air in the bowel is very difficult.
- Many times in the presence of an ACUTE problem i.e... Less 24-48 hours, severe pain, fever, elevated labs, or strong clinical concern a CT will be very helpful.

Basic abdomen radiographic anatomy

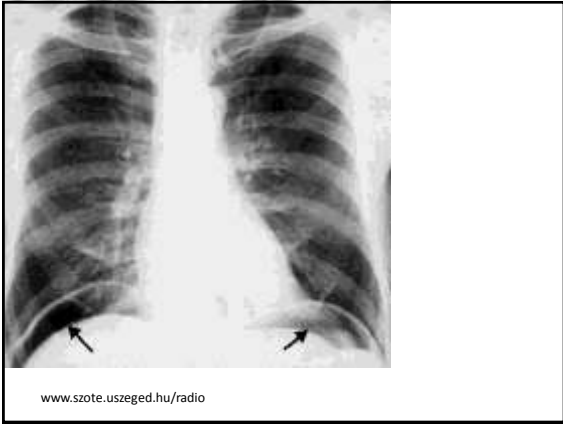


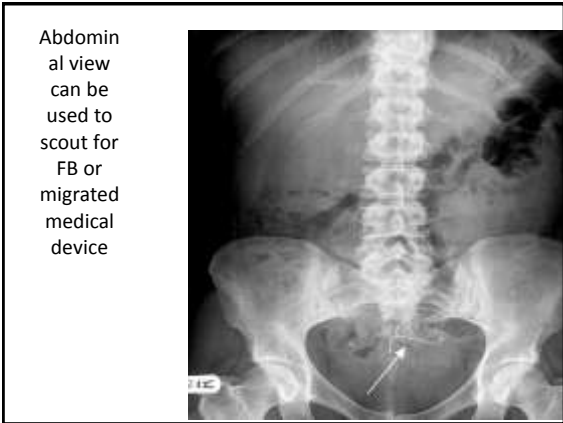


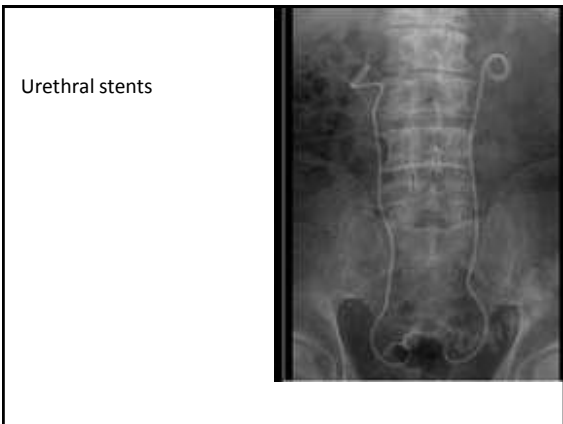










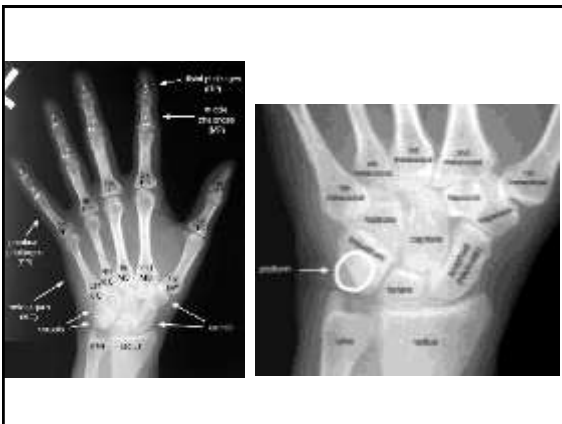


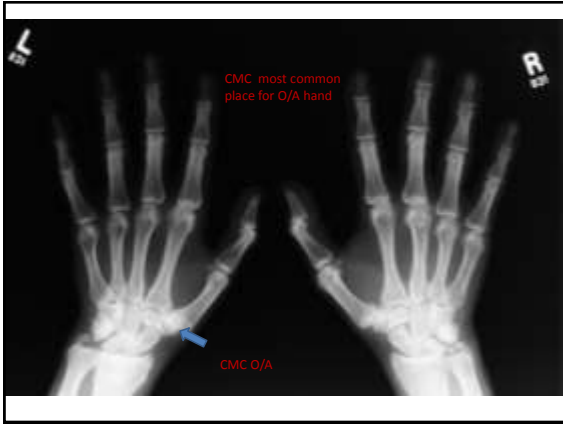
Rectal
FB



Skeleton Hand/ wrist

- Good clinical exam/ hx
- Generally order 3-5 view
- Look for symmetry carpal rows.
- Get scaphoid view if patient has snuff box tenderness. Have high index of concern due to risk AVN
- When in doubt splint!









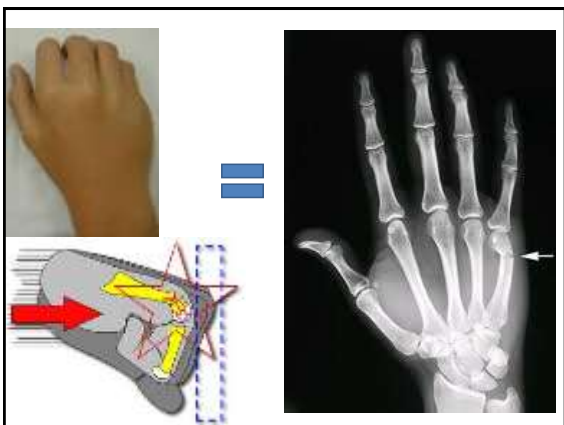






































Skeleton elbow

- Good clinical exam / HX
- Generally 2-3 views
- Look for “sail sign” (elevated fat pad can be ant / post or both. Tx as fracture if this is seen.
- Radial head fx will have pain w/ extension/ supination (generally from fall out stretched arm)
- Don’t forget to look other injury.. i.e. wrist/ shoulder













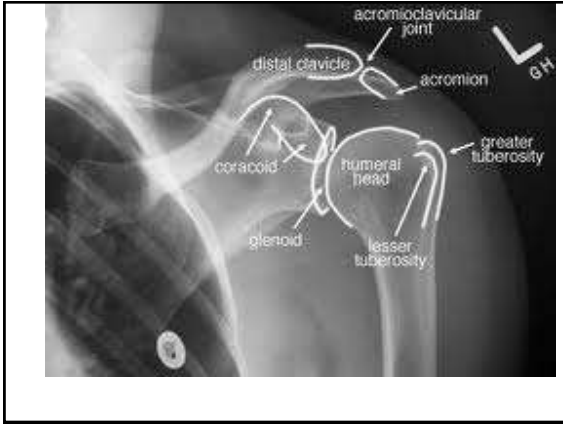






Skeleton Shoulder

- Good exam/ hx
- Generally 3 view
- 95% shoulder dislocation will anterior. Can be associated w/ glenoid chip fx
- Look @ AC joint for asymmetry
- Look for clavicle fracture (generally mid shaft)
- Scapula body fx very rare. High velocity trauma

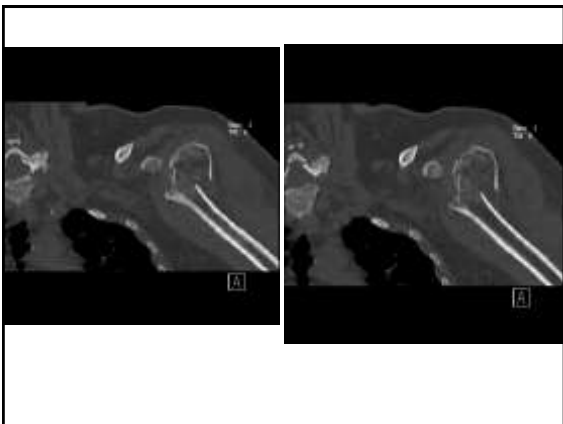


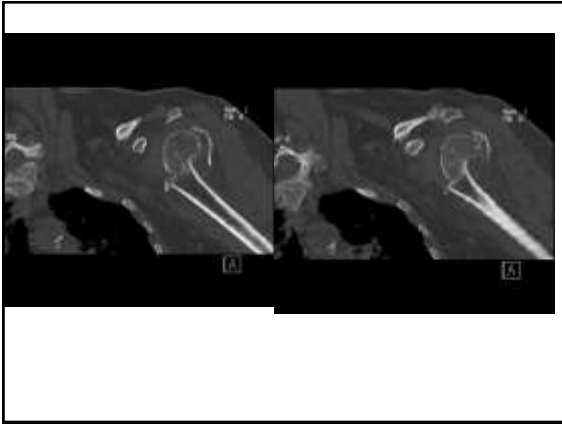


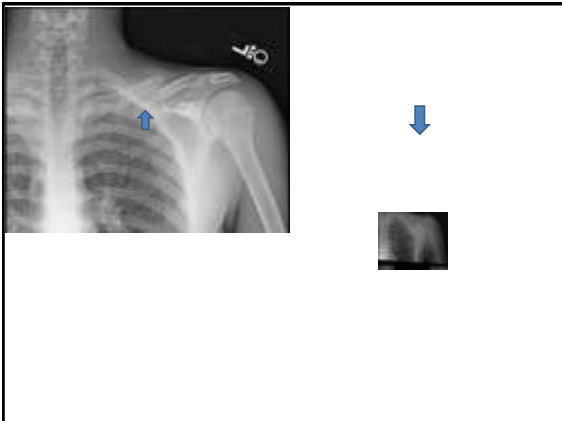










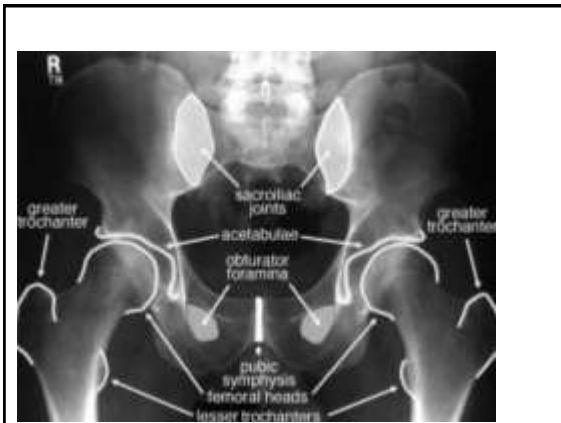


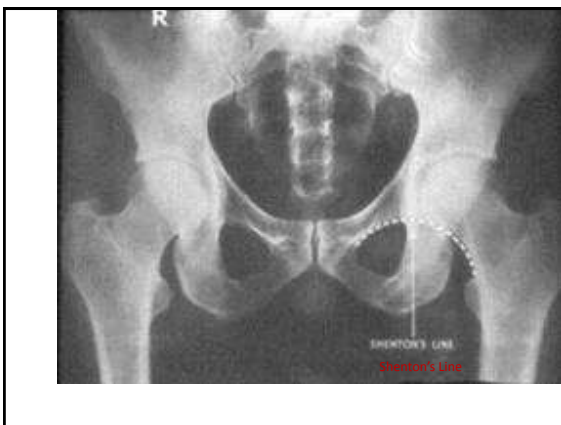
Skeleton hip/pelvis

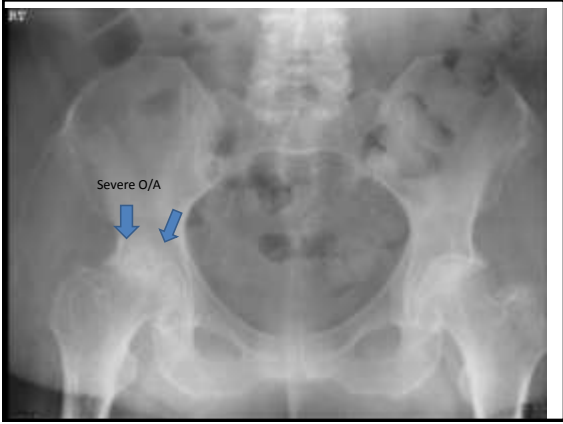
- Pelvis is always 1 view
- Look for widening pubis greater 1 cm. If present look @ SI joint for widening i.e. unstable pelvis (high velocity trauma)
- DON'T be fooled. People can walk in with hip fx's!
- Most hip fractures occur in the femoral neck. These patients will complain of groin pain/ ant thigh/ knee pain

Skeleton hip cont

- High index concern with older patient who cannot weight bear due to hip/ groin pain. look for insufficiency fracture (this x ray will look normal).. Again good exam & hx
- Look at Shentons Line for fracture evaluation
- Patients can also present with pubic rami FX with similar complaints to above. OK to weight bear with these.

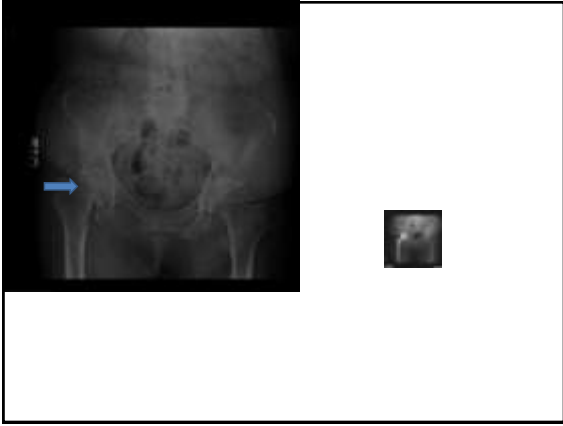












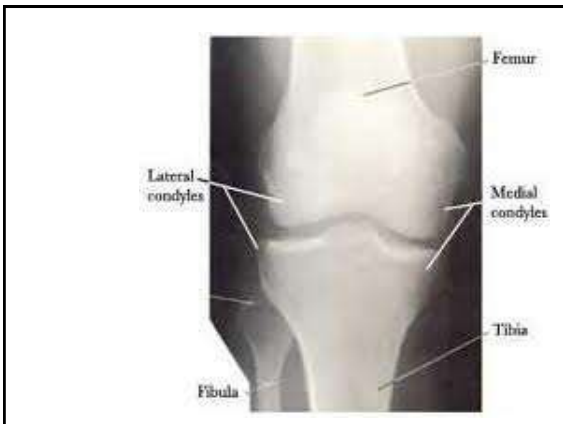




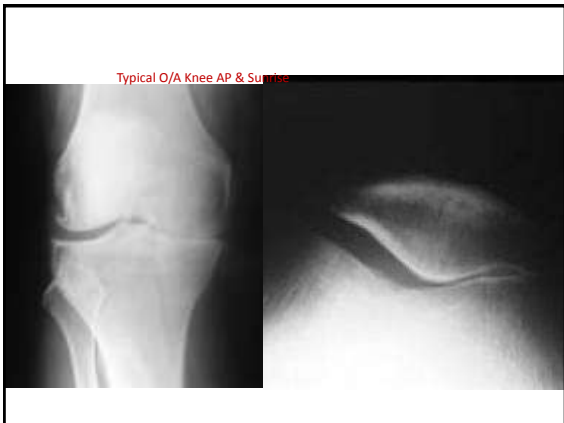
Skeleton Knee

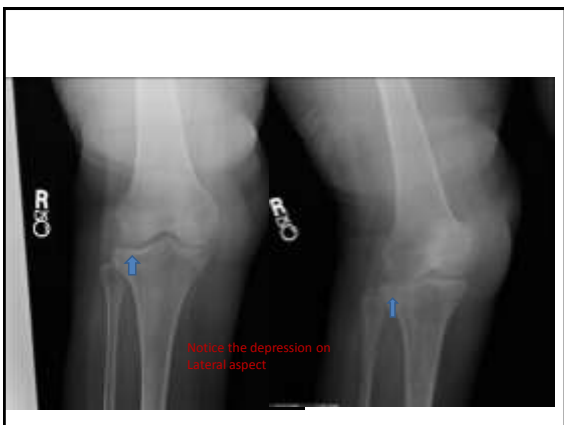
- Good exam / hx (trauma or chronic)
- Look for effusions on lateral view
- Watch for tibial plateau fracture (hx trauma, usually pretty swollen, does not want to bear weight or range knee)
- Sunrise view helpful for evaluation in chronic knee complaints for patella femoral syndrome





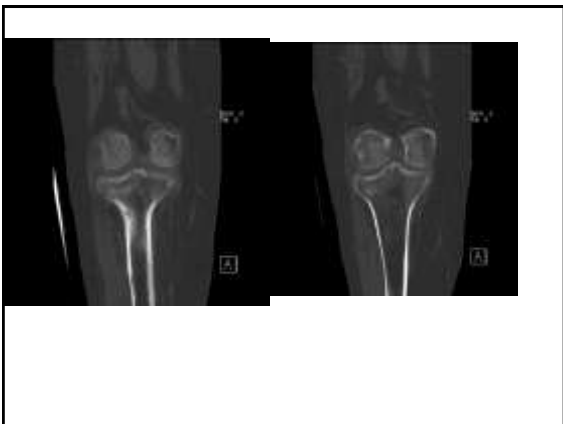




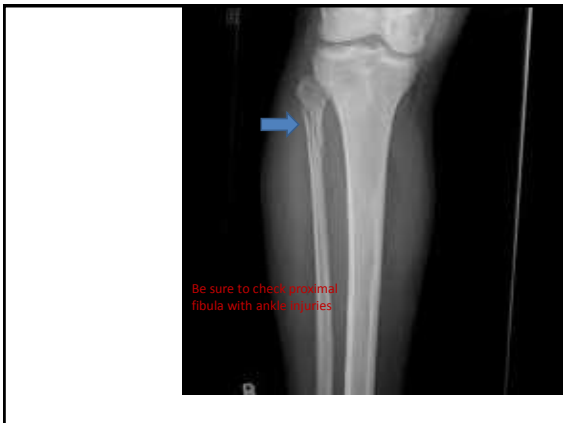












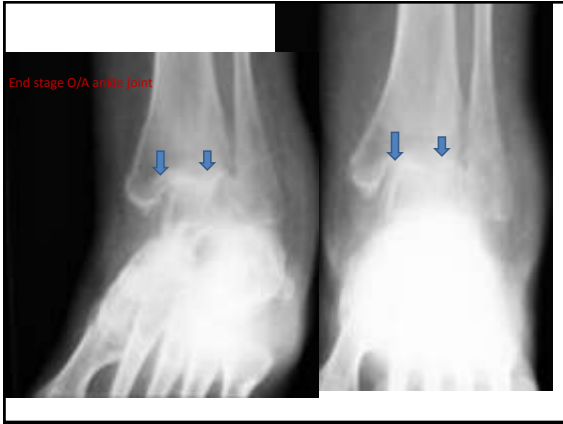
Skeleton ankle / foot

- Good exam/ hx .. Where are they tender?
- Oblique view very helpful on both foot/ ankle
- Always look at ankle mortise (oblique view) this can suggest ligamentous injury
- Get a calcaneal view if concern of a heel fracture (fall landing on feet)
- Even if x-ray is negative splinting is OK with significant soft tissue injuries

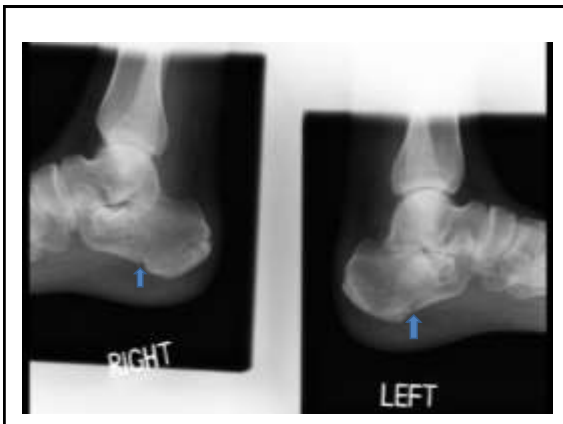


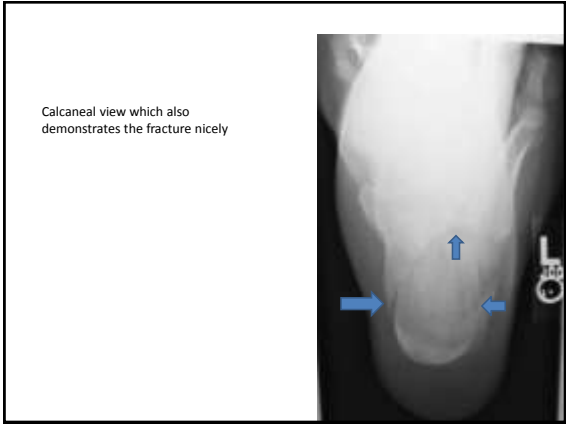
























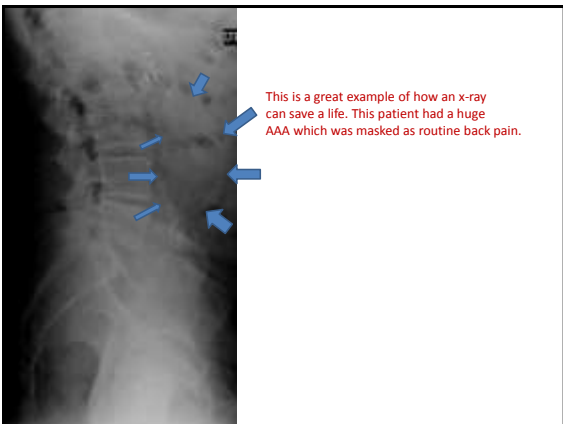


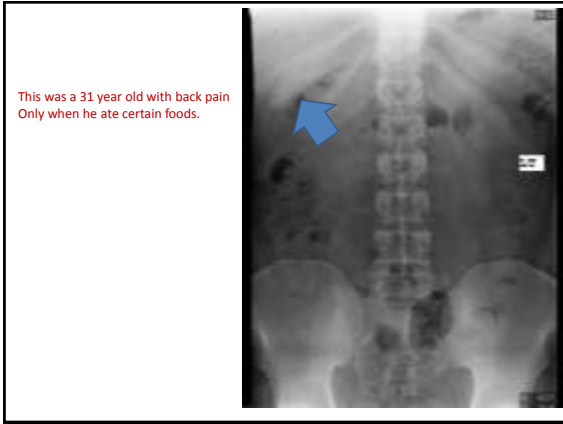
Skeleton Spine

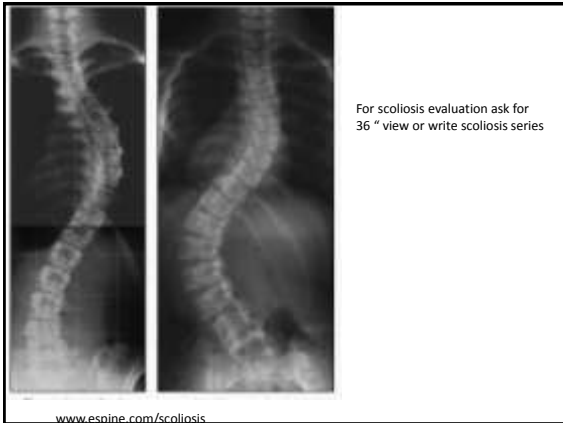
- Good exam/ Hx again chronic vs. acute
- Lumbar 5 vert bodies
- Look for asymmetry (spondylolisthesis)
- Look for pars fx (oblique views Scottie dog)
- Look for compression or wedge fx
- Eval lordosis / kyphosis





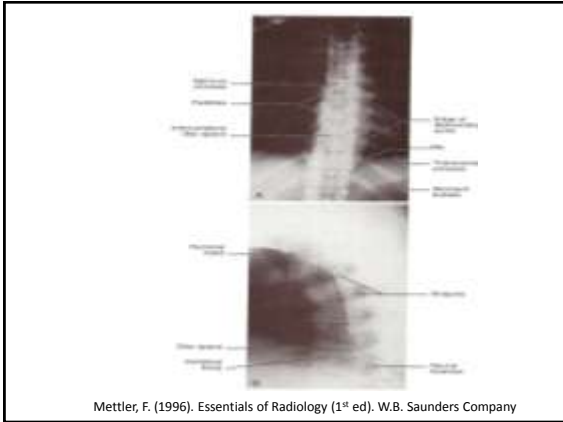




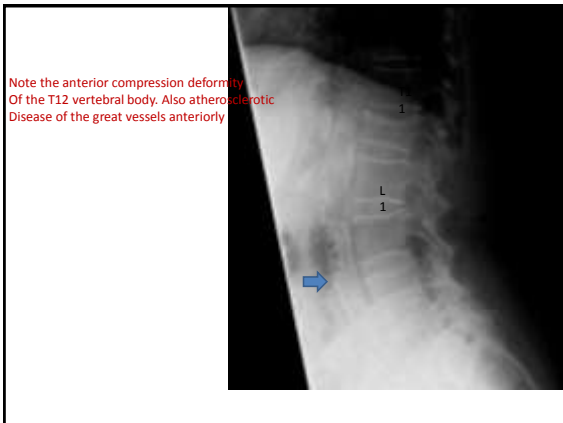


Skeleton T spine

- Degenerative O/A and comp fracture the most common pathology.
- Look at the pedicles.. The should go from medial to lateral as the move caudally
- Look for exaggerated kyphosis
- Chronic form acute comp fx difficult with plain films additional imaging i.e...bone scan, CT, or MRI may be helpful

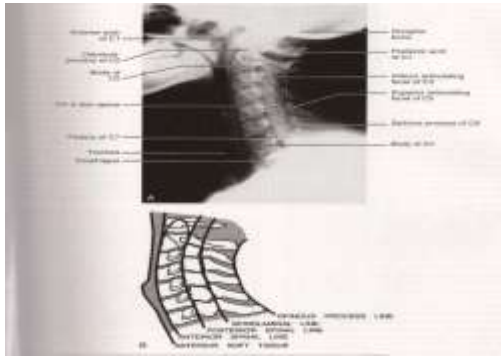


Mettler, F. (1996). Essentials of Radiology (1st ed). W.B. Saunders Company



Skeleton C spine

- Good hx/ exam is this acute or chronic
- Look at anterior soft tissue line in acute injury on lateral view. 5mm or less.
- Look for symmetry in the ant/ post vert bodies
- Look for widening of the spinous process.
- Flex/ ext view may be of help for ligamentous injury
- Look at open mouth view for symmetry of lateral mass and odontoid. Be sure teeth are not mistaken for odontoid fx



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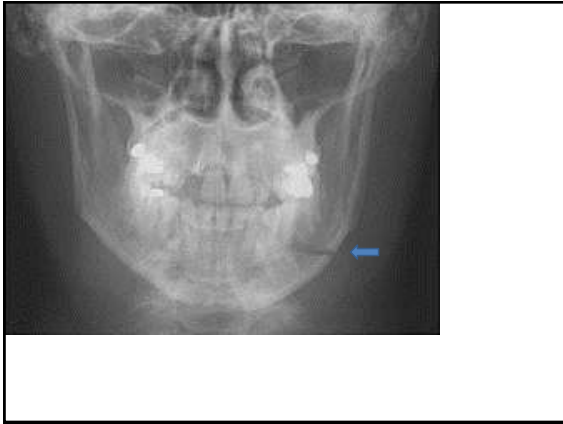


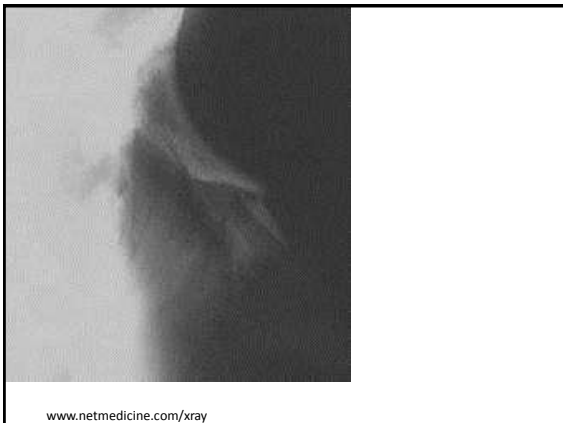


www.learningradiology.com (this is a good site)

Skeleton general


- Most agree skull x ray are waste!
- Facial bones better eval on CT . CT can help look for orbit fx, zygomatic arch fx, or muscle entrapment form fx. Nasal bone evaluation in reasonable on plain x ray.
- Use imaging to support your dx.
- Avoid "body grams"





Advanced imaging CT

- CAT (computer aid tomography)
- Uses radiation.
- Lots of pictures compiled by computer
- Commonly available
- Not very expensive
- Excellent bone detail
- Poor soft tissue & neuro detail
- Air=black
- Bone=white
- Soft tissue="shades of gray"





Advanced imaging MRI

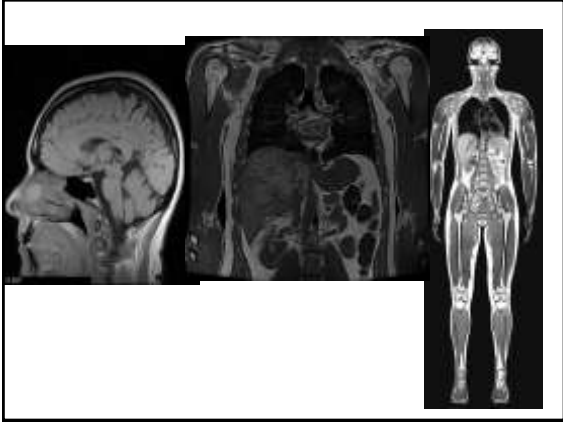
- No radiation exposure
- Great soft tissue and neuro imaging
- Cannot use with most pacemakers
- Claustrophobia big issue
- Cost significantly more than CT imaging
- Good for tumor, infection, spine work up
- **T1: water is dark**
- **fat is bright**
- **T2: water is bright**



MRI T1 and T 2



- T1: water is dark**
- fat is bright**
- T2: water is bright**



Advanced imaging Bone Scan

- Radioactive isotope used for evaluating uptake
- Good for metastases, fracture, and some tumor (Not good MM)
- May get a false negative if trauma is less than 48-72 hours old
- Takes a few hours

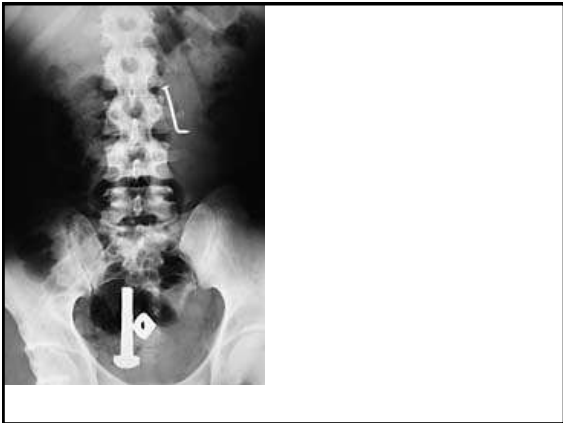


Unusual pictures



Nail in skull







Questions???



Thank you