Back to Basics Part II: More Soft Tissue Stuff

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www.jprad.com

Search Pattern

- Cervical Spine
- Thoracic spine
- Lumbar spine

Search Pattern for Cervical Spine

- Search pattern other than osseous of cervical spine:
  - Right and left carotid arteries
  - Stylohyoid ligament (ossification)
  - Posterior and anterior longitudinal ligament
  - Prevertebral soft tissues
  - Tracheal air shadow
  - Upper lung fields

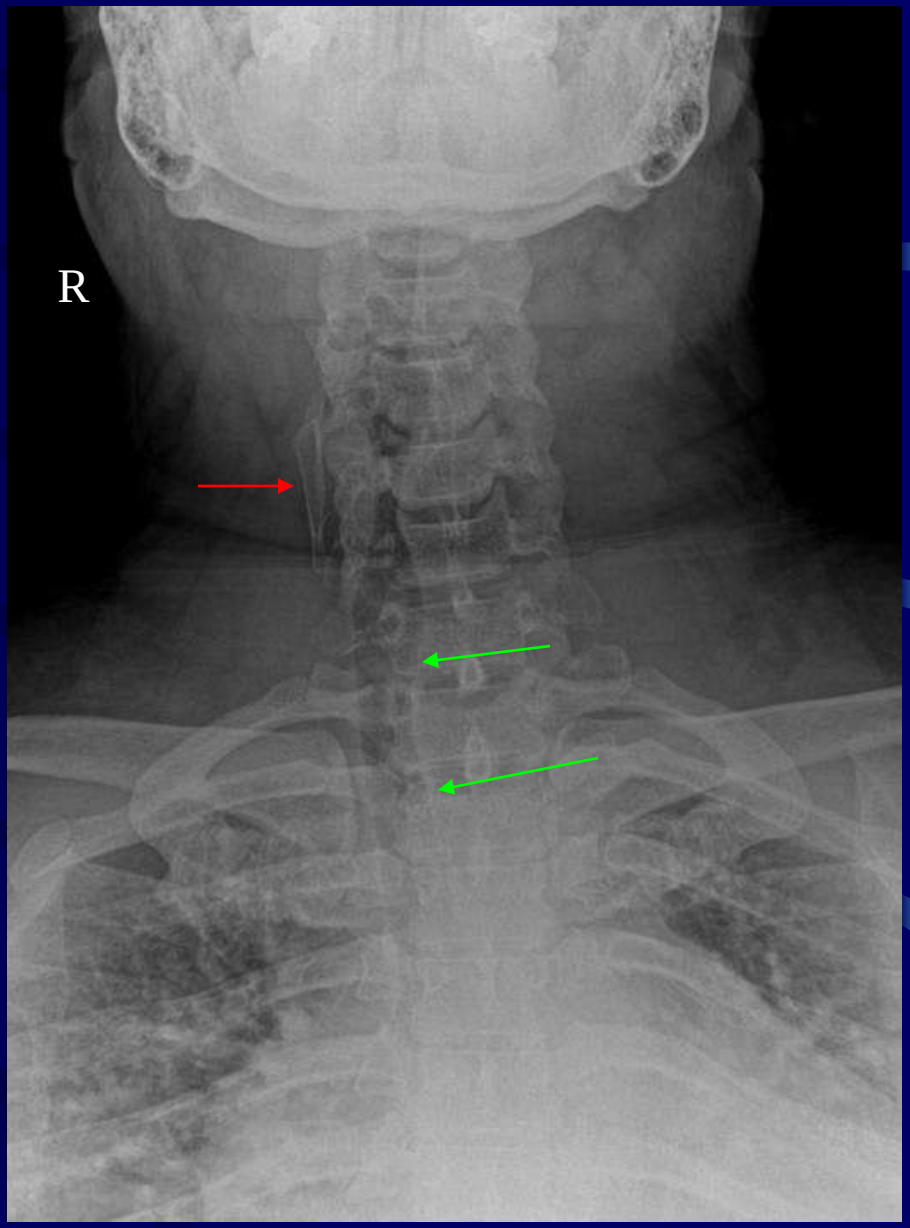
Here we go!

- Case study approach

Case 1: Cervical Spine

- 43 year-old male, neck pain.

- Right tracheal deviation
- Normal thyroid cartilage calcification



Deviation of the tracheal air shadow- QUIZ #12

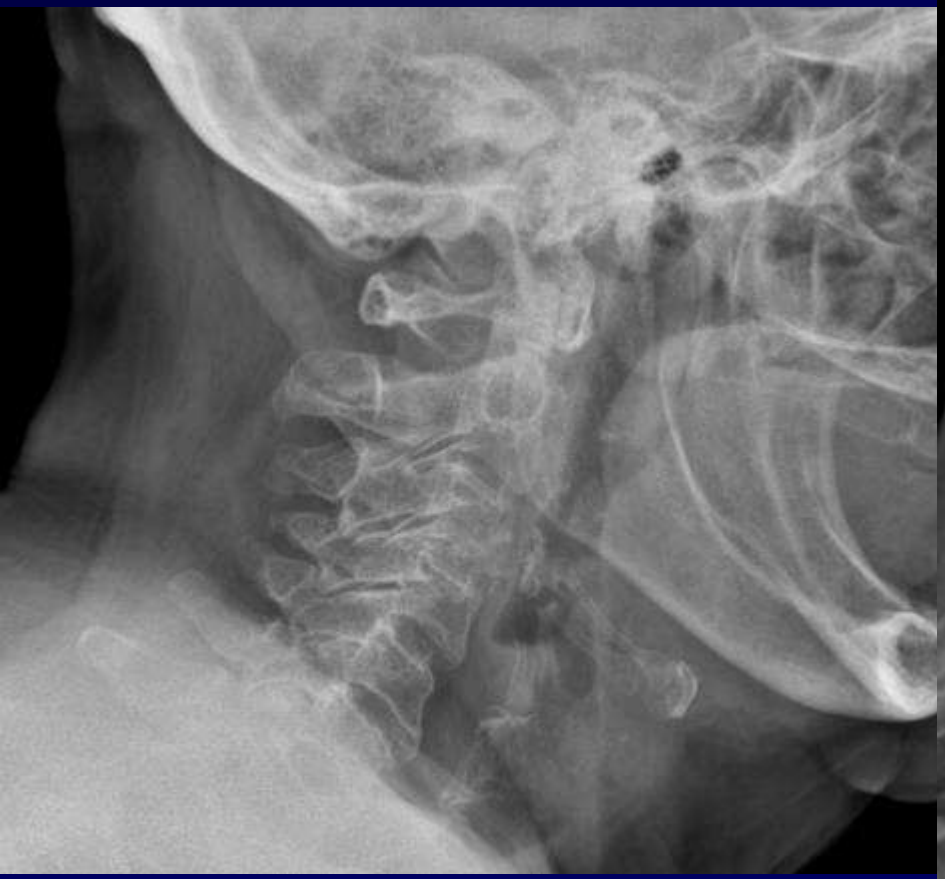
- Differential Diagnosis: (QUIZ #12)
  - Lymphoma
  - Teratoma
  - Goiter
  - Tumors of thymus or thyroid

Follow-up

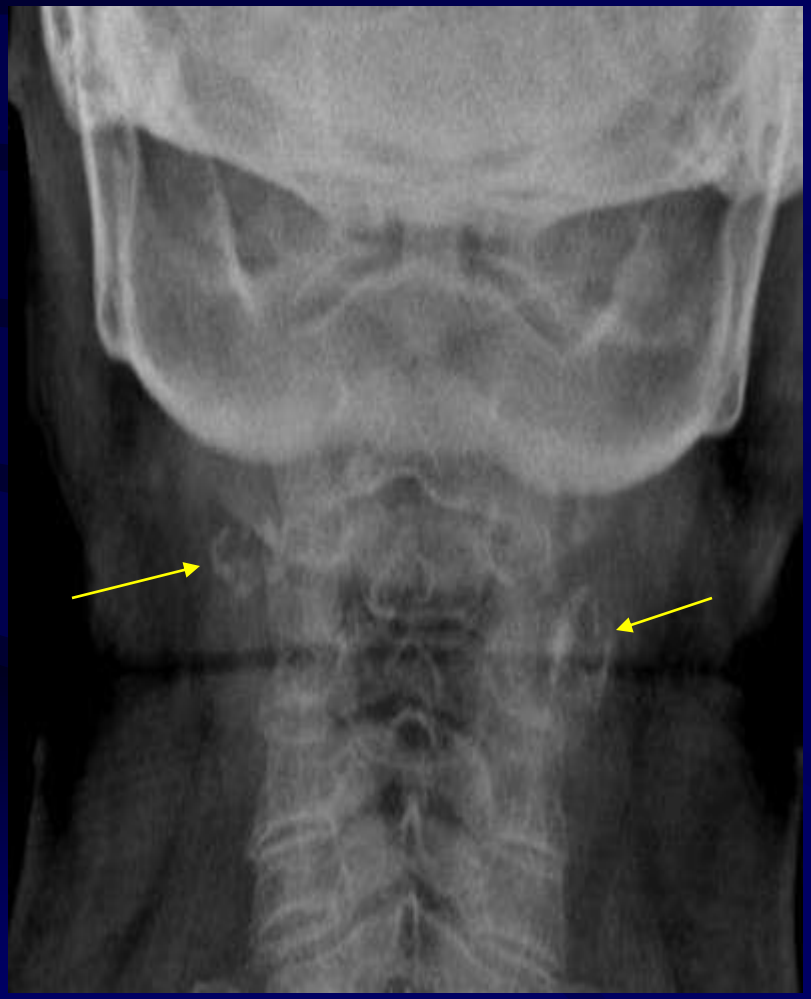
- Chest radiographs: PA and lateral with full inspiratory effort
- CT imaging of the chest

Case 2: Cervical Spine

- 85 year-old female chronic neck pain



Calcification within the right and left lateral soft tissues of cervical spine



Diagnosis

- Atherosclerosis of the right and left carotid arteries.
  - In the lateral soft tissues, at the level of C3, C4.

- Contraindication for soft tissue work/massage; treatment of ultrasound.

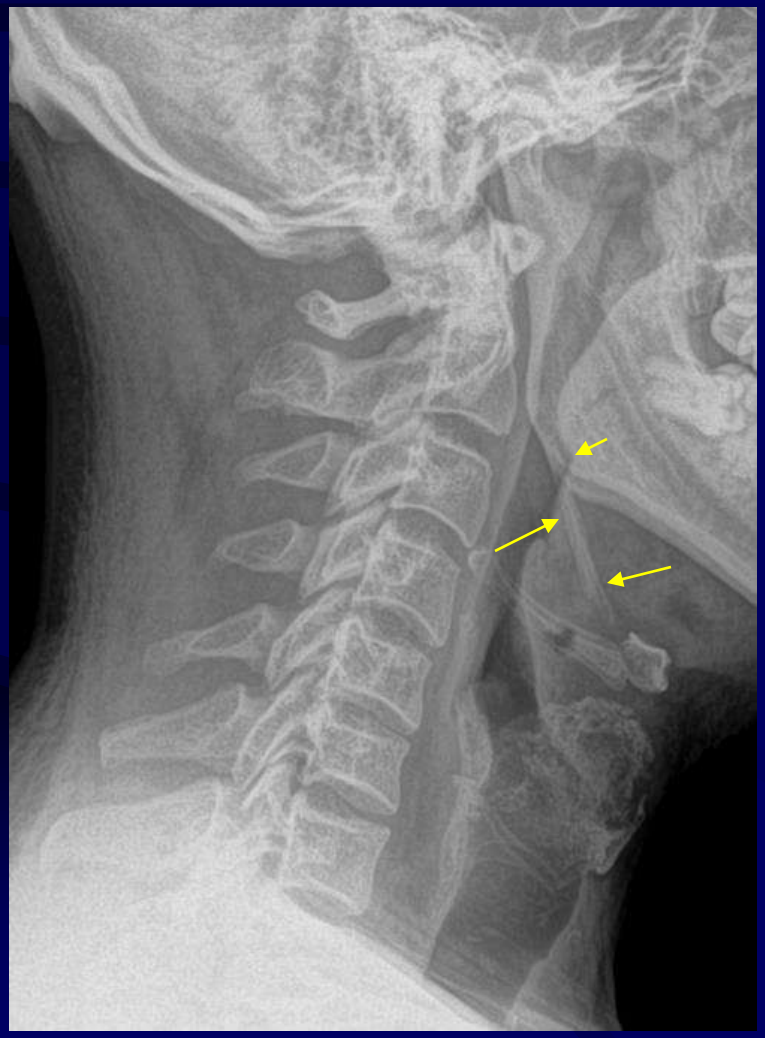
Follow-up

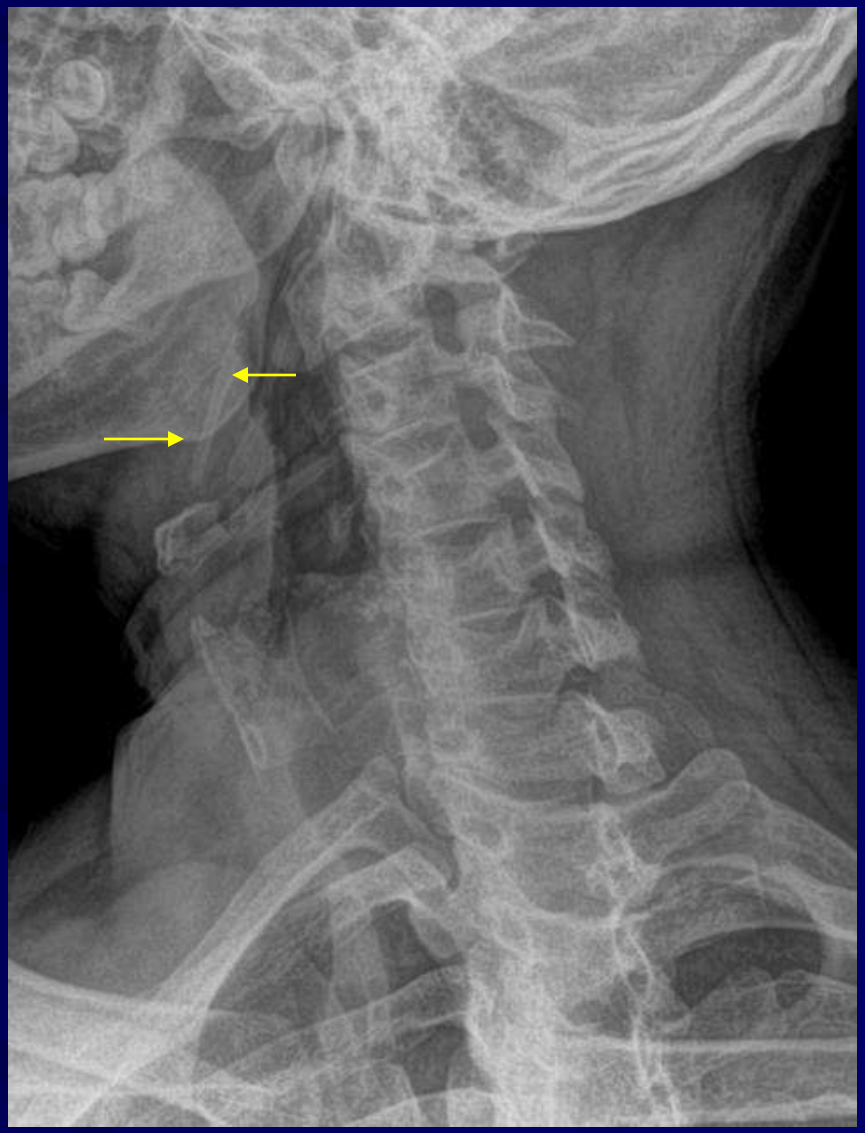
- Doppler ultrasound
- Referral to primary care physician

Case 3: Cervical Spine

- 35 year-old female with neck pain. No trauma.

Lateral cervical spine





Findings/Diagnosis

- Calcification of the stylohyoid ligament
- May be symptomatic
  - Clinically correlate for Eagle's Syndrome

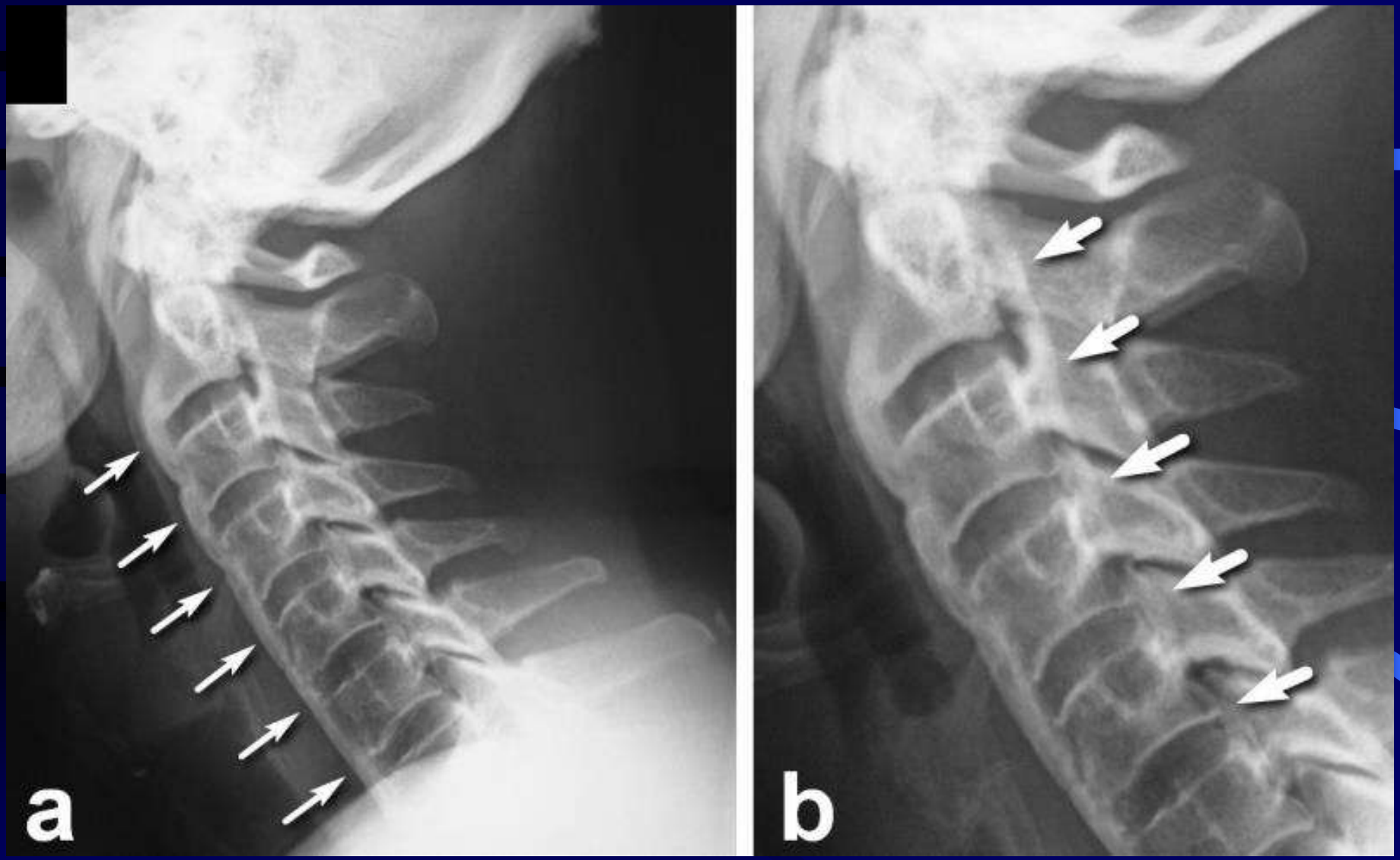
Eagle's Syndrome

- Symptoms: sharp nerve-like pain in the jaw or back of the throat, or ringing or buzzing of the ears (tinnitus) increased with moving jaw, swallowing or the cervical spine rotation.
  - May come in contact with the internal carotid artery
- Cause: idiopathic
- Treatment: If symptomatic, surgical resection.
  - Regrowth are common

Case 4: Cervical Spine

Male with neck pain.

www.auntannie.com



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Findings

- Ossification of the anterior longitudinal ligament.
- Ossification of the posterior longitudinal ligament.

Diagnosis-

- Diffuse Idiopathic Skeletal Hyperostosis (DISH)

- Complications: compress the esophagus with difficulty swallowing, and spinal cord stenosis.

Case 5: Cervical Spine

- 73 year-old male neck pain following a motor vehicle accident.

Lateral radiograph

Findings

- Retropharyngeal soft tissue widening
  - 29.0 mm
- Retrotracheal soft tissue widening
  - 53.0 mm

Widening of prevertebral soft tissues

- Retropharyngeal soft tissue: Normal= at C2 level is 7 mm
- Retrotracheal soft tissue:

  Normal= at C6 and C7 level is 22 mm

Diagnosis/Cause

- Edema or hemorrhage resulted in widening of the prevertebral soft tissues following the motor vehicle accident.

- Complication: compressing the esophagus and displacing the trachea

Follow-up imaging

- MRI (without contrast)
  - Identify soft tissue swelling/edema
  - Evaluate the remaining soft tissues such as disc, posterior soft tissues, spinal cord and neural elements.

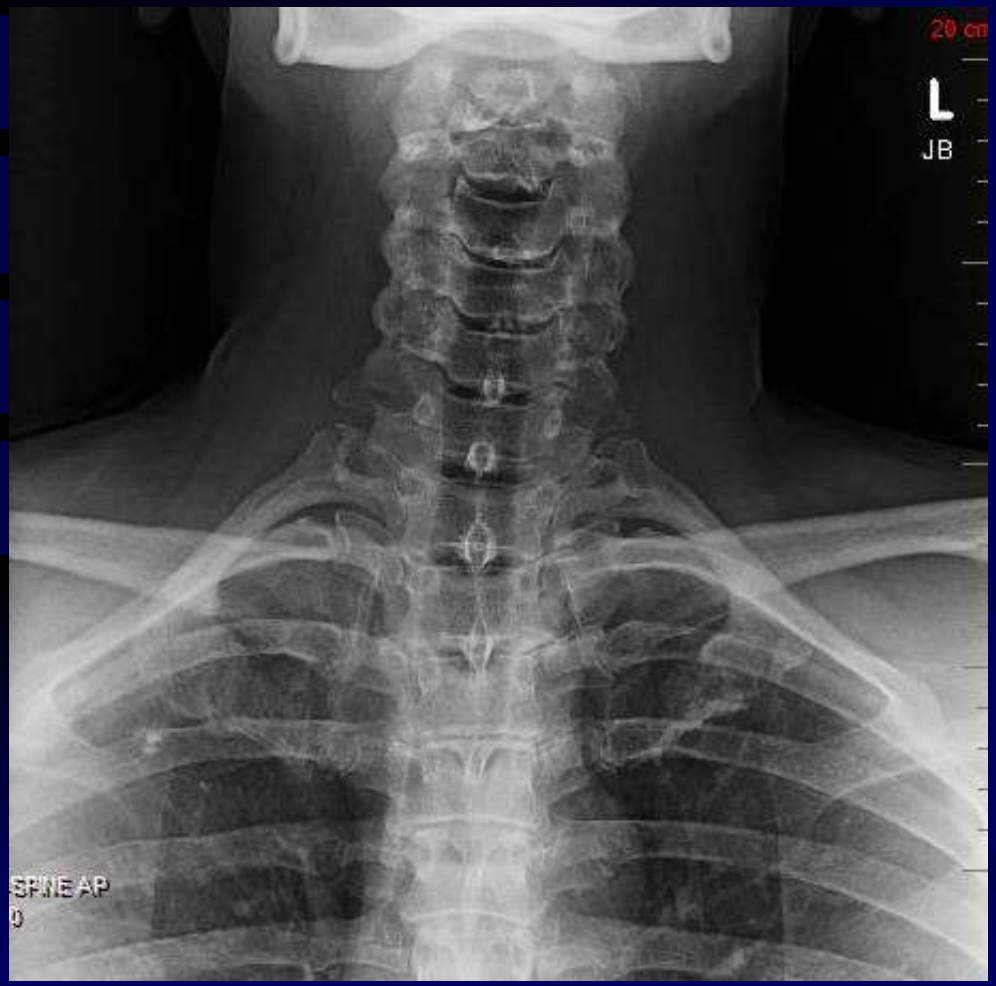
Other differentials

- Other differential diagnosis for widening of the prevertebral soft tissues (nontrauma):
  - Infection
  - Tumor of the thyroid gland

Case 6: Cervical Spine

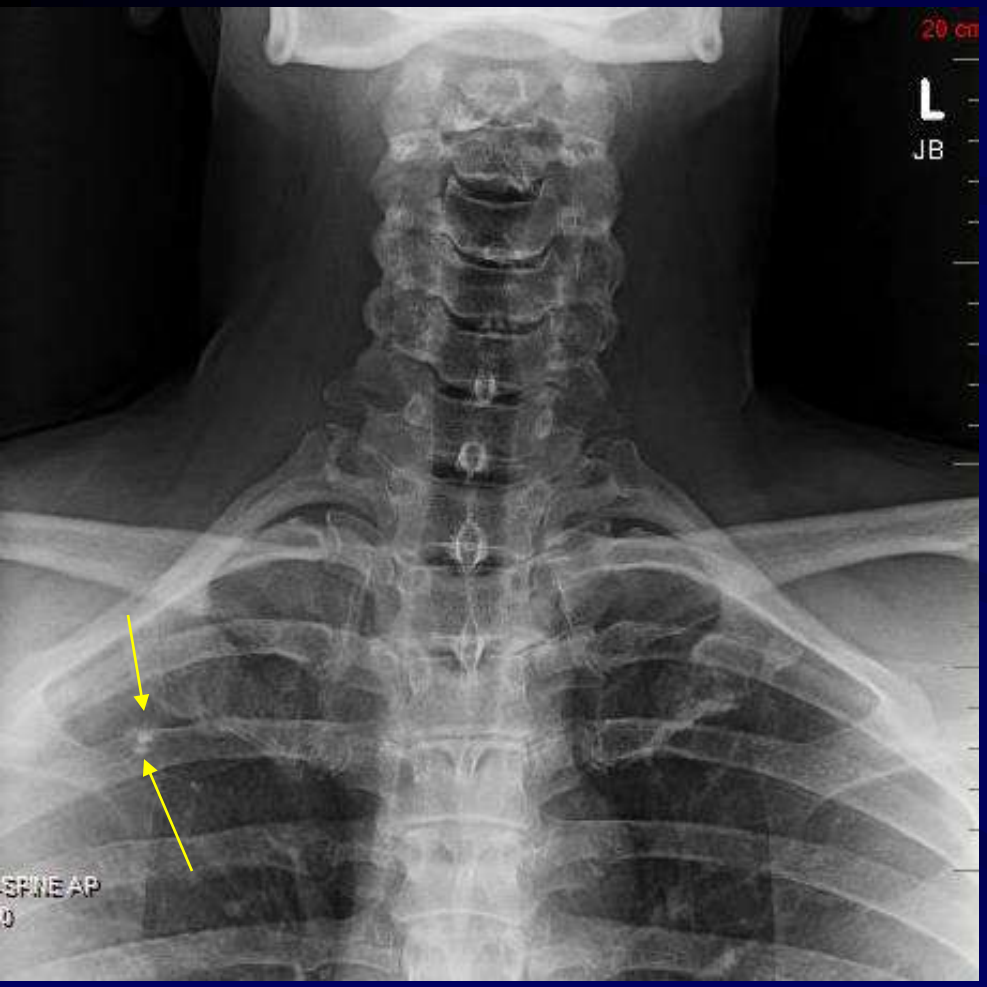
- 55 year-old female with neck pain following motor vehicle accident

AP and lateral



Bilateral anterior oblique

Radiopacity of right upper lung field



Differential Diagnosis

- Pulmonary nodule
- Versus exostosis of the posterior 4th rib
- On a side note: There is a normal nuchal bone within the posterior soft tissues.

Follow-up

- Advanced imaging: CT imaging of the chest will determine the location (lung vs. rib) of the radiopacity

- Final diagnosis= unknown

Case 7: Cervical spine

- Chronic neck pain

Lateral cervical-QUIZ COMING UP

Findings

- Continuous, thin ossification of the outer fibers of the annulus fibrosus.
- Fusion of the facet joints
- Normal nuchal bone within the posterior soft tissues.

Diagnosis

- Ankylosing Spondylitis
- Thin ossification of the annulus fibrosus
  - Inflammatory arthritis, seronegative rheumatoid factor; positive lab study of HLA-B27
  - Favors the synovial joints such as the facet and sacroiliac joints.

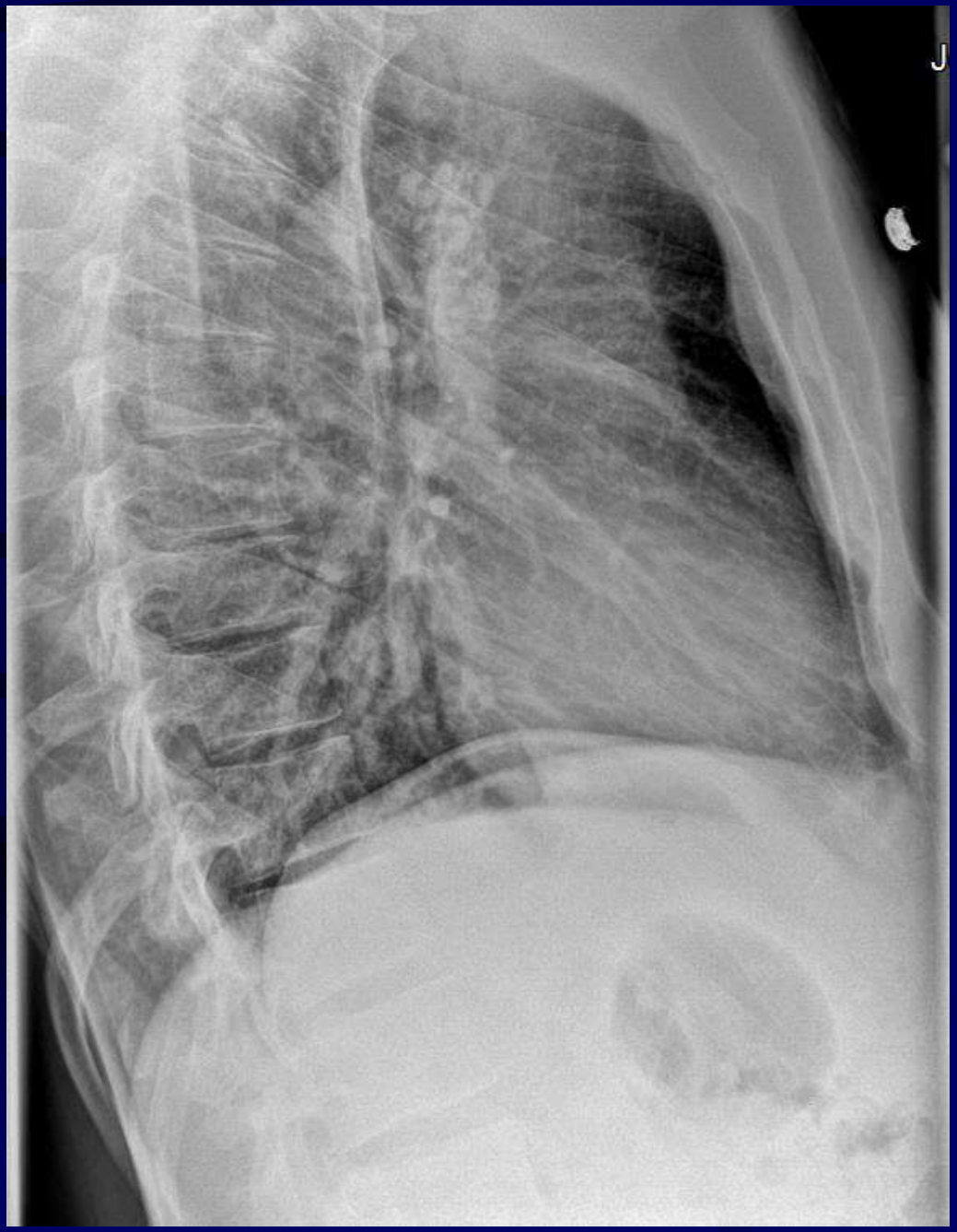
- Differs from DISH which is thick, flowing ossification of the anterior longitudinal ligament.

Search Pattern for Thoracic Spine

- Search pattern other than osseous of thoracic spine:
  - Lung fields/Chest
  - Tracheal air shadow
  - Vasculature
  - Spinal soft tissues

Case 1: Thoracic spine

- AP image not available



Findings

- Cluster of radiopacities or calcifications within the right mediastinum, at the level of the aortic knob

Differential diagnosis

- Calcified lymph nodes versus space occupying lesion (tumor)

Follow-up

- Need history and prior chest radiographs
- Chest radiographs: PA and lateral views with full inspiratory effort.
- CT imaging

Diagnosis

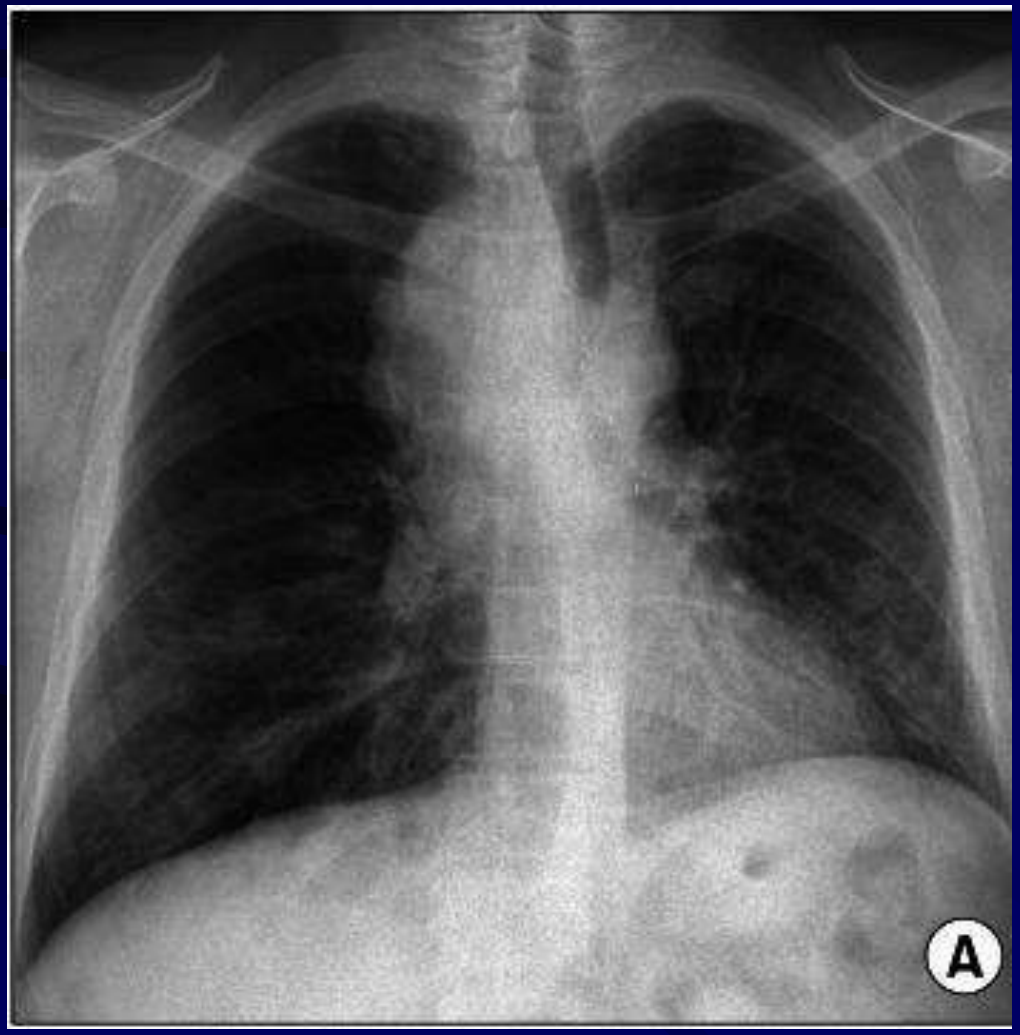
Patient was diagnosed with either calcified lymph nodes versus granuloma due to previous old infection. No tumor.

Case 2: Thoracic spine

- The search pattern on the AP thoracic spine should also include evaluating the chest anatomy such as the tracheal air shadow.

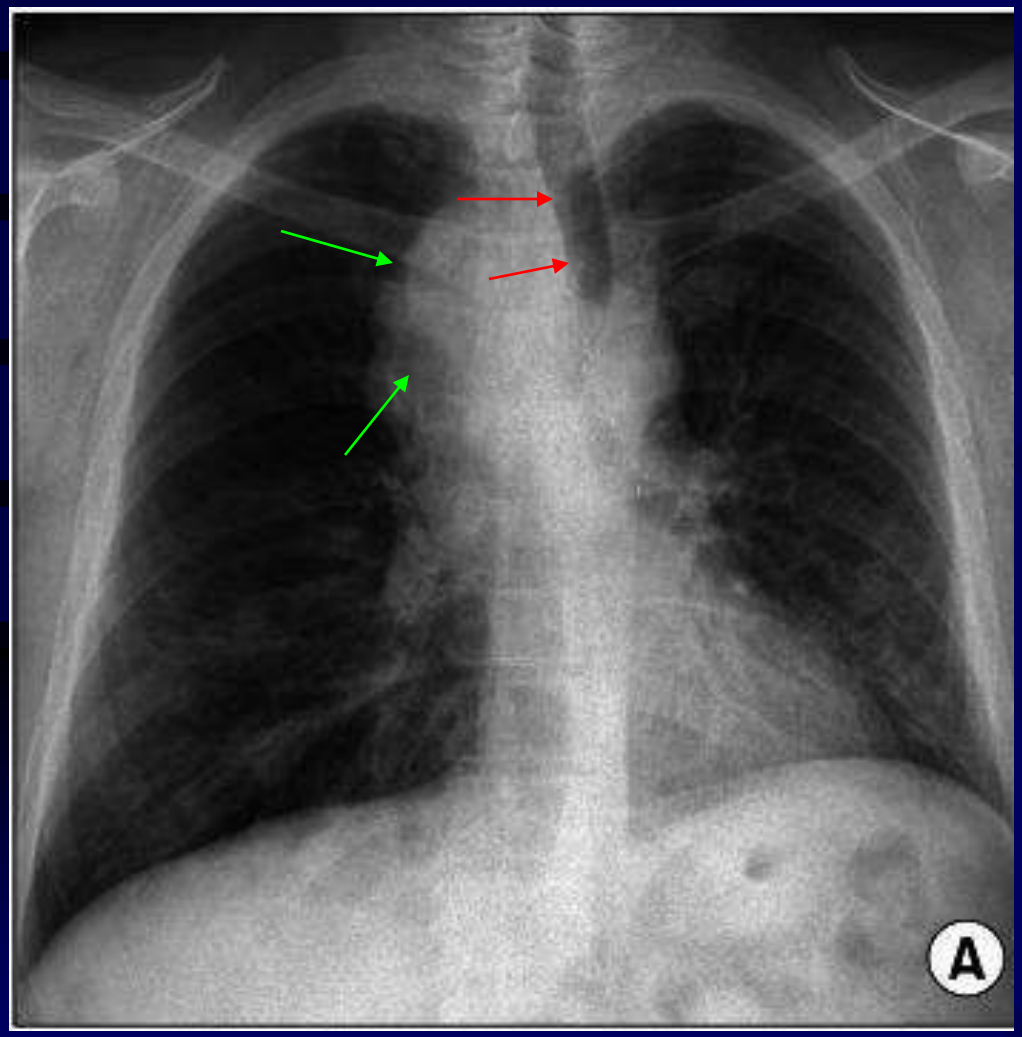
- If there is abnormality seen within the chest such as tracheal air shadow deviation, PA and lateral chest radiographs should be performed with full inspiratory effort.

PA radiograph of the chest



www.researchgate.net

Findings



- Large mass of the right paratracheal region with medistinal widening, and with left deviation of the tracheal air shadow.

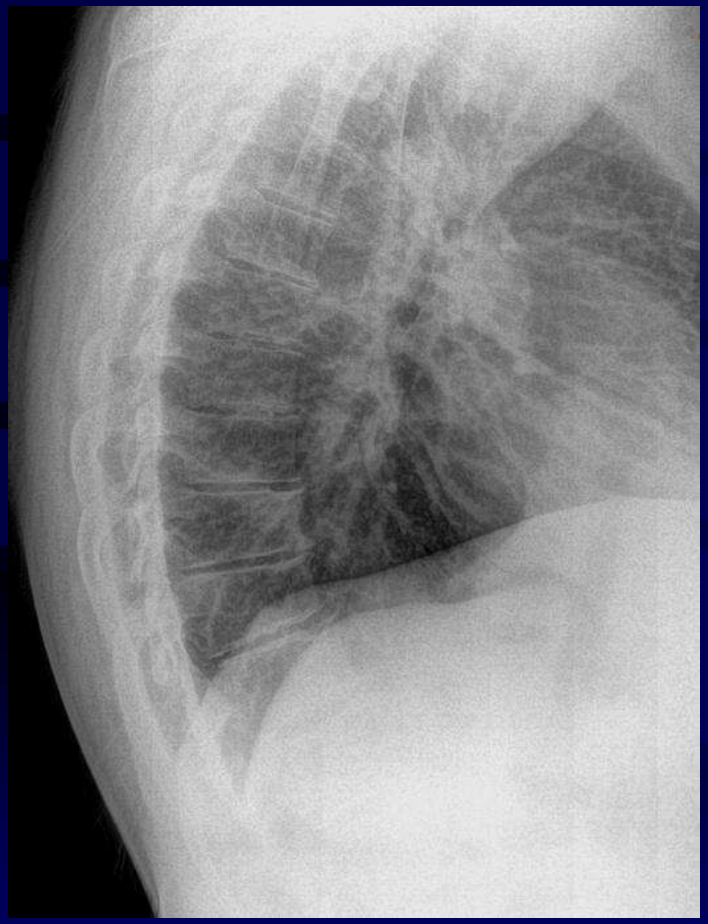
Follow-up

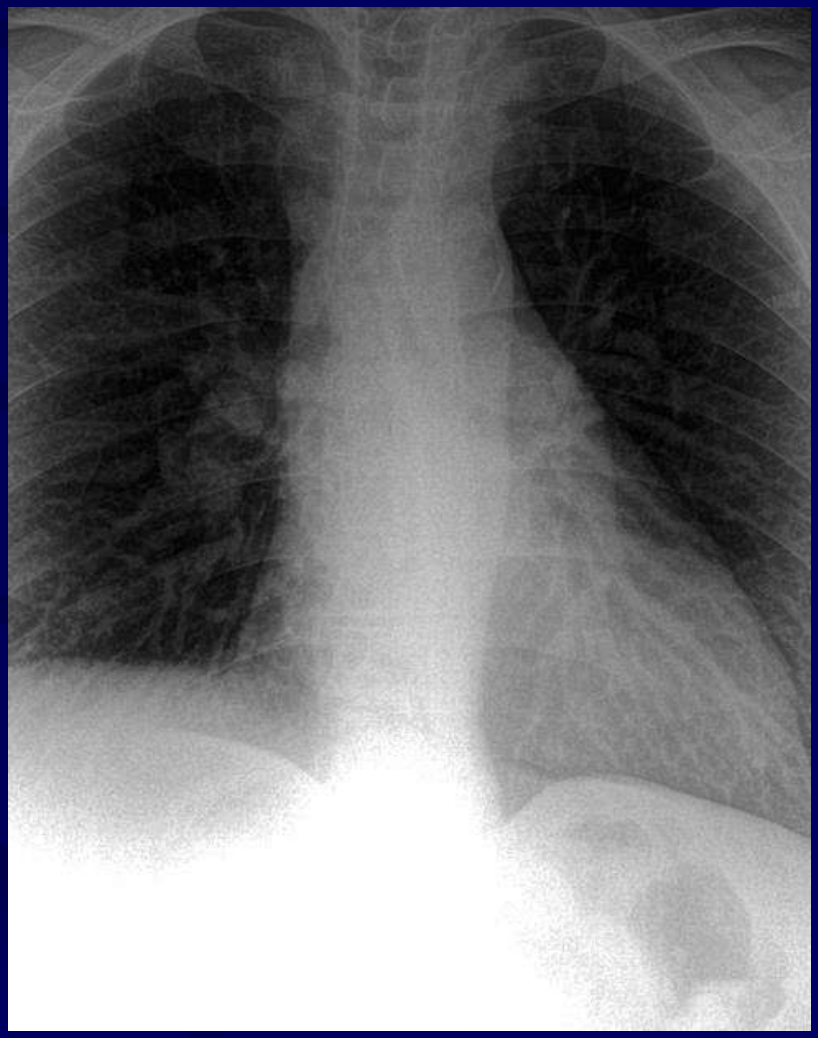
- CT imaging of chest
- Diagnosis: Tumor, adenocarcinoma of the lung.
- Referral to primary physician
  - Patient underwent chemotherapy

Case 3: Thoracic spine

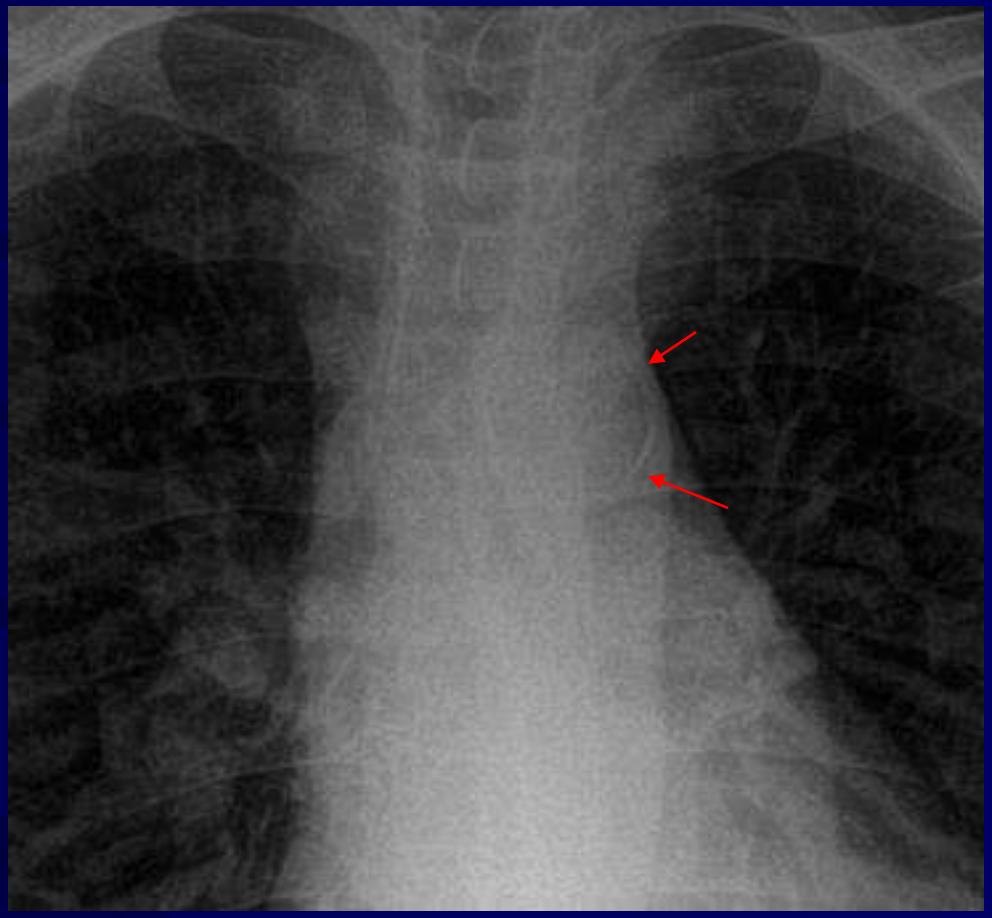
- Mild mid back pain

AP and lateral thoracic spine





- Curvilinear calcification within the aortic knob



Diagnosis

- Atherosclerosis of the aortic knob
- Degenerative disc disease of the thoracic spine

Case 4: Thoracic spine

- Chronic mid back pain

Lateral Thoracic

www.researchgate.net

Findings

- Thick flowing anterior ossification of the anterior longitudinal ligament.

Another patient-AP Thoracic

- Anterolateral ossification of the anterior longitudinal ligament, absent/less severity on the left side of the mid thoracic spine.

Diagnosis

- Diffuse Idiopathic Skeletal Hyperostosis (DISH)

- Avoids the left side of the mid thoracic spine due to the descending thoracic aorta.

Search Pattern of Lumbar Spine

- Search pattern other than osseous of lumbar spine:
  - Liver
  - Pancreas
  - Adrenal Glands
  - Kidneys
  - Spleen
  - Gallbladder

Search Pattern of Lumbar Spine

- Search pattern other than osseous of lumbar spine:
  - Bowel
  - Vasculature
  - Lower lung fields

Case 1: Lumbar spine

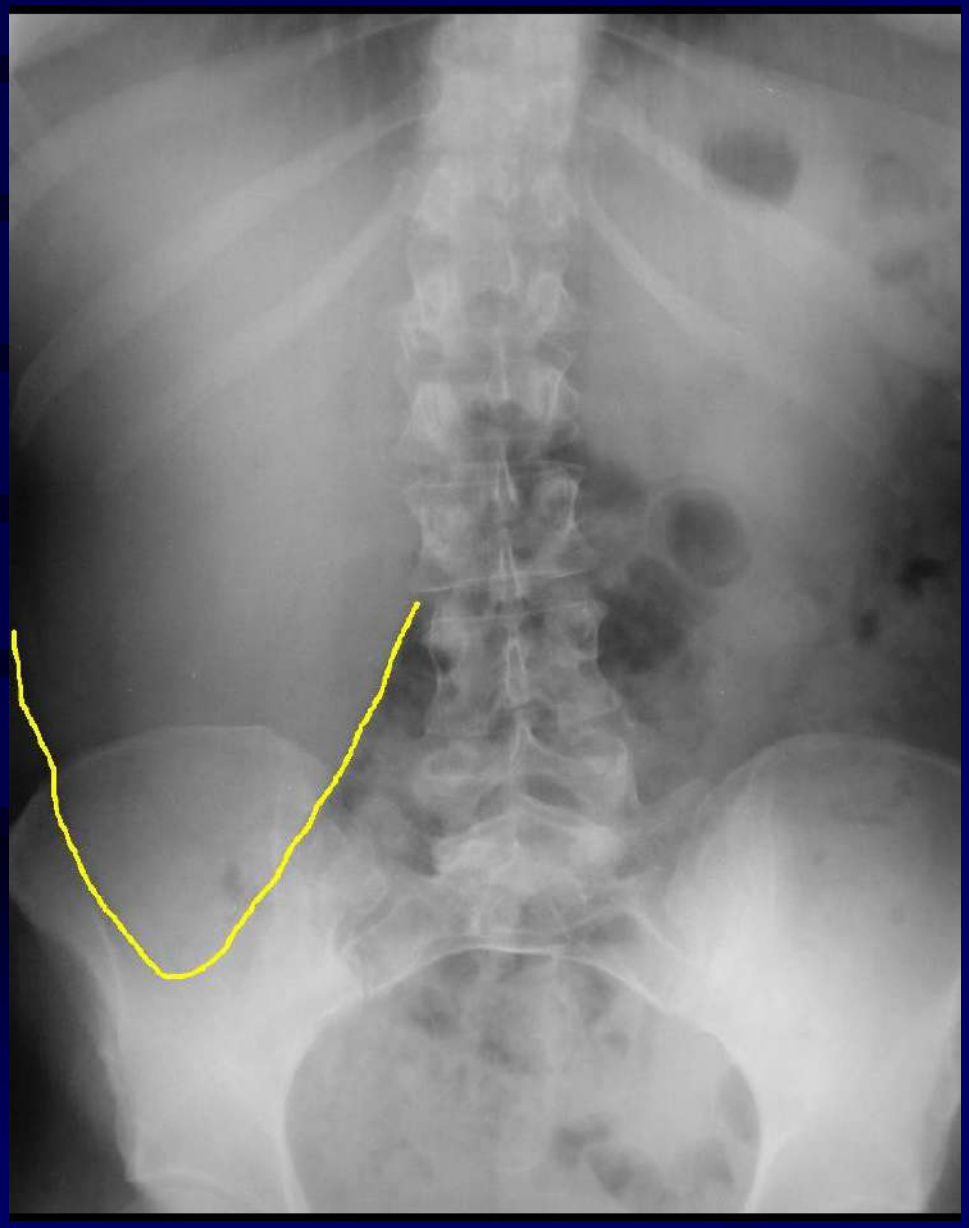
- Female with chronic low back pain; previous abdominal surgery (surgical clips)
- Patient is 60 years-old

AP Lumbar

Findings

- The liver extends further medially and inferiorly than usual overlying the right iliac crest
- Spleen and kidneys are of normal size.
- Multiple surgical clips and sutures of the bowel (she still has an IUD---oops, probably forgot).

Another patient: 48 year-old female with low back pain



Findings/Diagnosis

- Enlarged liver= Hepatomegaly

Hepatomegaly vs. Reidel's Lobe of the Liver

Hepatomegaly

- Crosses the spine; rounded fullness of the inferior border extending below the kidney

Reidel's Lobe

- Normal variant of the right lobe of the liver
- Tongue-like projection that can extend to the iliac crest
- Most commonly seen in females

Differential Diagnosis of Hepatomegaly (many more causes):

- Congestive heart failure
- Diabetes Mellitus
- Alcoholism
- Cirrhosis
- Tumor mets
- Hepatitis
- Medications

Follow-up

- CT imaging
- Laboratory studies

Case 2: Lumbar spine

- 55 year-old male; alcoholic; low back pain

AP Lumbar

Findings & QUIZ

- Speckled calcifications of the midabdomen, from the left upper abdominal quadrant crossing the spine.

- The calcifications reside within the head, body and tail, pancreas

Diagnosis

Pancreatic Calculi

- Secondary to chronic pancreatitis- mc alcohol abuse.

- Other causes:
  - Gallstones- obstructing the entrance of the pancreatic duct into the CBD.
  - Hyperparathyroidism
  - Cystic fibrosis

Follow-up

- Diagnostic US
- CT of the Abdomen
- Endocrinologist

Brant W and Helm C. Fundamentals of Diagnostic Radiology, 3rd ed. 2007; 784-785.

Halpert R. Gastrointestinal Imaging, 3rd ed. The Requistes. 2006; 172.

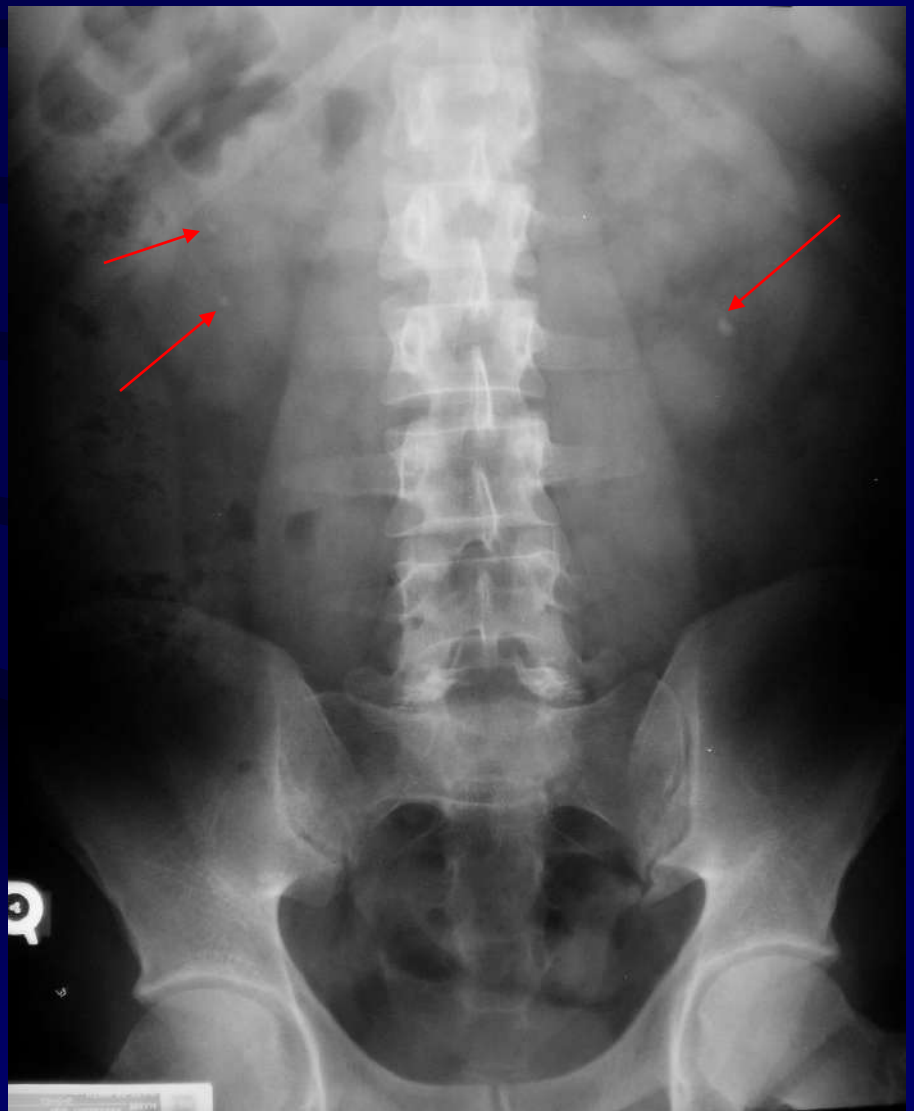
Case 3: Lumbar spine

- 45 year-old male with severe low back pain.

AP Lumbar Spine

National University of Health Sciences

Findings



Findings

- Bilaterally small round radiopacities in the right and left kidneys

- Always check in the path of the ureters and the bladder for more stones.
  - Ureters are anterior to the transverse processes.

Diagnosis

Nephrolithiasis

Symptoms:

- Cramping pain of the low back, flank, groin or abdomen
- Pain waxes and wanes; colicky
- Nausea, vomiting
- Fever
- Hematuria

Follow-up

Follow-up
- Ultrasound then if necessary,
- CT of the abdomen with and without contrast

Treatment
- Medication for pain
- If obstruction, lithotripsy or surgical (nephrologist)

Different patient

Findings/Diagnosis

- Extensive calcification within the right kidney
- Diagnosis: Staghorn Calculus

Staghorn Calculus- QUIZ QUESTION

- Cause: recurrent infections; or renal tract anomalies.
- Symptoms: fever, hematuria, flank pain, and potential septicemia and abscess formation.
- Referral: Nephrologist

Case 4: Lumbar spine

- 48 year-old female with chronic low back pain for 9 months.

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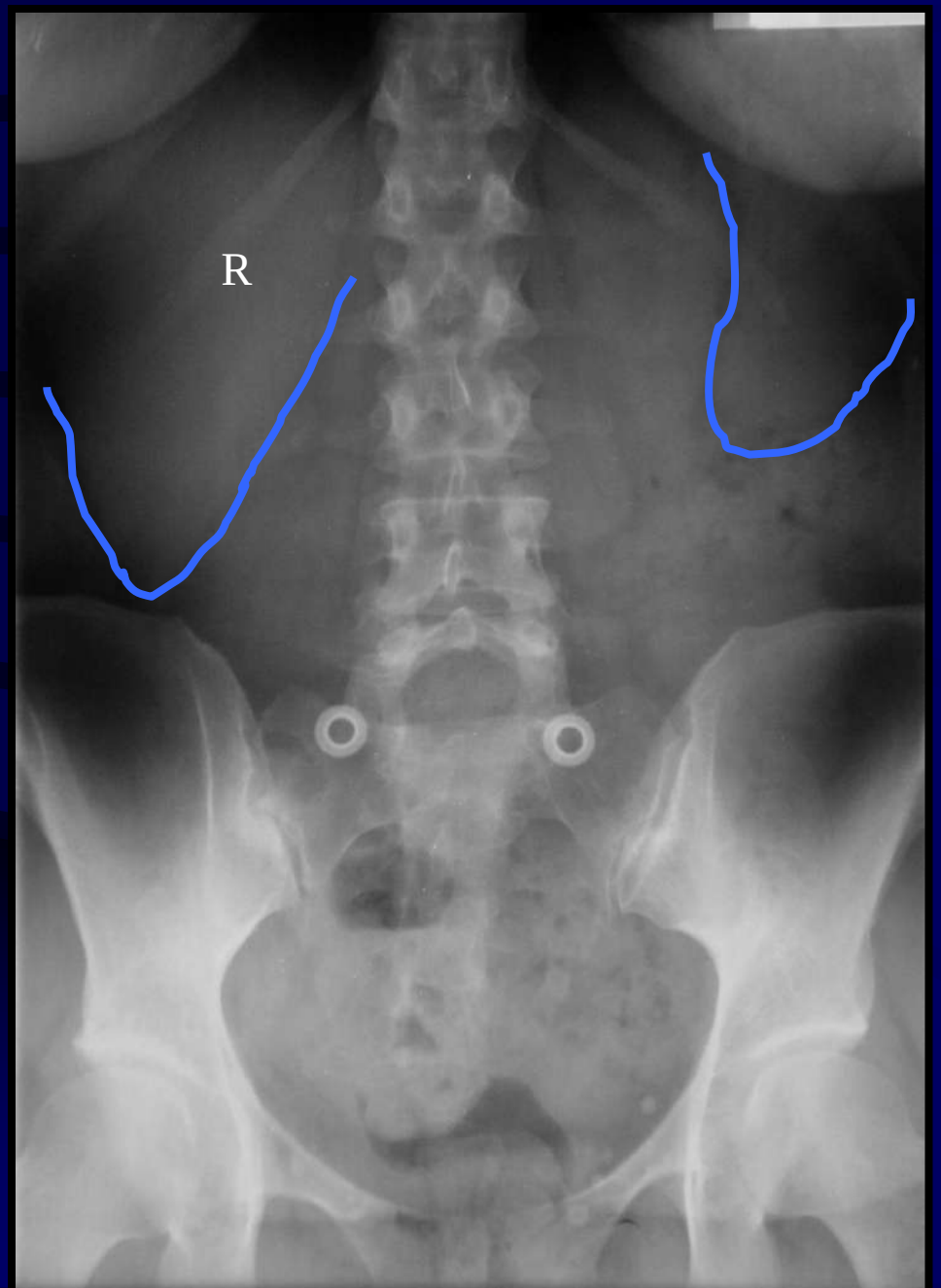


Note: metallic clothing artifact overlying the sacral ala, due to eyelets of sweatpants.

National University of Health Sciences

Diagnosis

- Normal liver: Reidel's lobe
- Enlargement of the spleen= Splenomegaly

Follow-up for Splenomegaly

- CT of the abdomen with and without contrast
- Referral/Consultation: Internist/Oncology

Diagnosis

- Lymphoma
  - Resulting in enlargement of the spleen

Differential Diagnosis of Splenomegaly

- Malignancy- lymphoma; leukemia
- Bacterial Infection- TB; lyme disease
- Fungal Infection- Toxoplasmosis; histioplasmosis
- Viral- Epstein barr virus (mononucleosis)
- Sickle cell anemia

Reidel's Lobe of the Liver

- Normal variant of the right lobe of liver
- Most common in females
- Narrow tongue-like projection, extending inferiorly and can extend to the iliac crest
- Never crosses the spine

Case 5: Lumbar spine

- 42 year-old female with thoracolumbar spine pain.

AP and lateral views

Radiopacity of right upper abdominal quadrant

Diagnosis

- Since the radiopacity is anterior to the spine, the radiopacity is not within the kidney (and not retroperitoneal in location)
  - Anatomically, the kidneys are retroperitoneal in location.

- Diagnosis: Gallstone (cholelithiasis)

Follow-up

- Ultrasound

- Consult with abdominal surgeon
  - Laproscopic, cholecystectomy (removal of gallbladder).

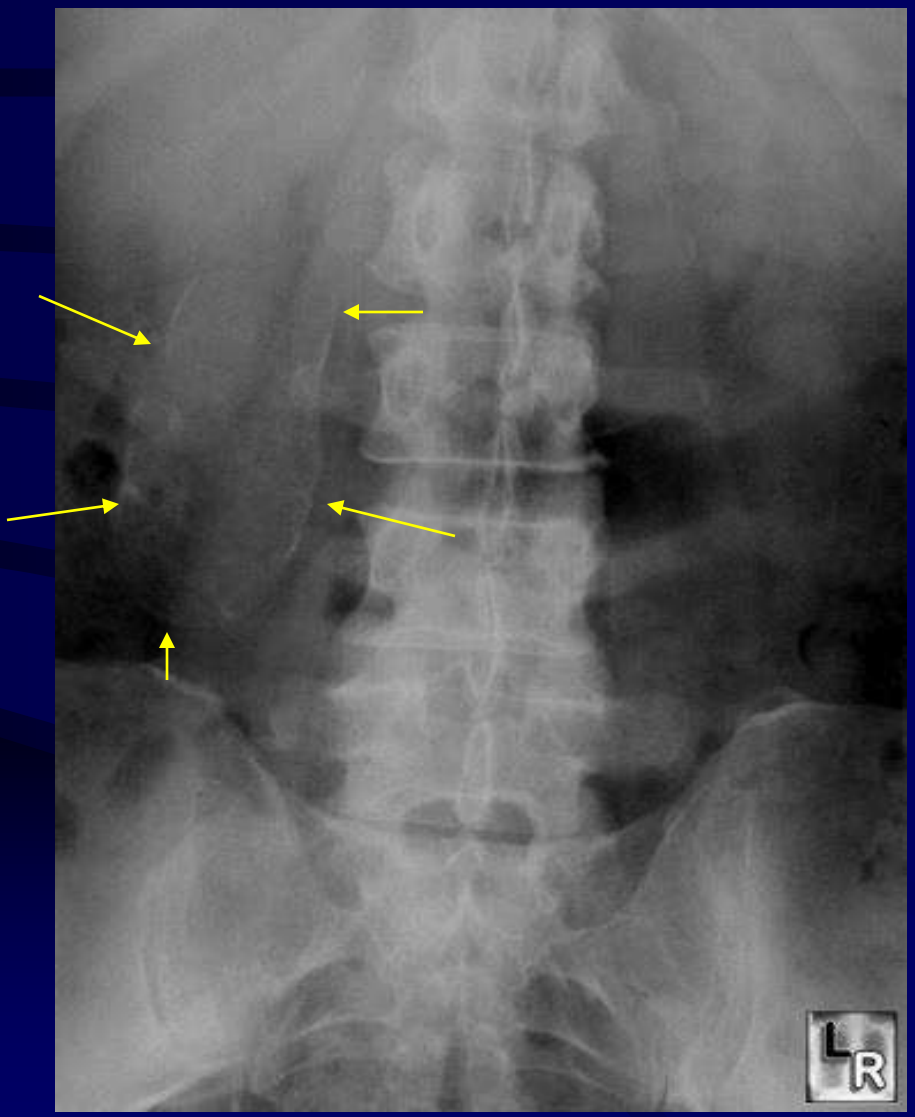
Cholelithiasis

- Most common 40 year-old female
  - younger patient with gallstone due to sickle cell anemia
- Symptoms:
  - Right upper quadrant pain, especially after a fatty meal
  - Pain radiates between the shoulders or under the right shoulder
  - Indigestion, bloating, nausea, and/or vomiting
- 10-15% radiopaque on xray; mostly made of cholesterol

Different patient

- Patient has chronic gallbladder disease (next slide)

Calcification of the gallbladder wall with multiple gallstones



www.mypacs.net

“Porcelain Gallbladder”

- Adenocarcinoma of the gallbladder, due to the calcified wall.

Follow-up

- Abdominal surgeon>> cholecystectomy
- Oncology

Case 6: Lumbar spine

- 52 year-old male with low back pain and abdominal pain.

AP Lumbar

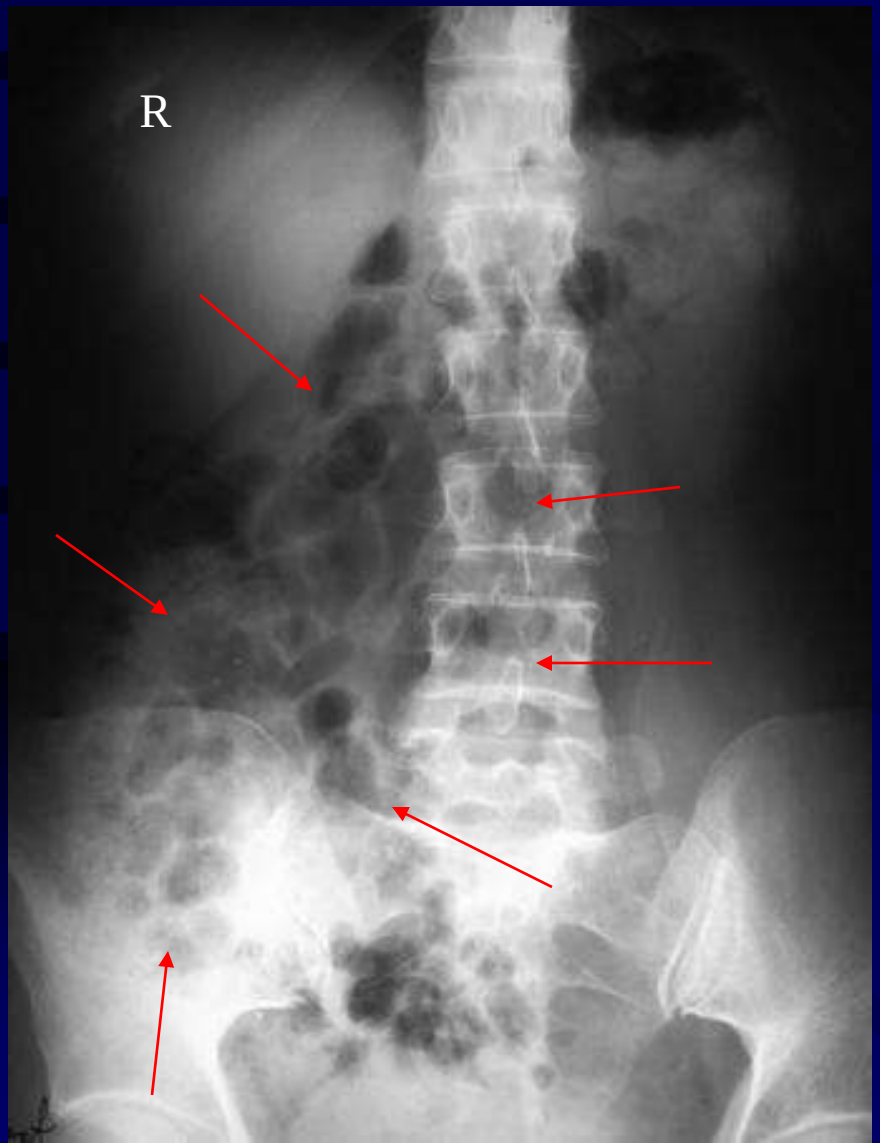
www.mypacs.net

Normal Bowel gas

- Small bowel gas should be centered over the spine on the AP lumbar radiograph.

- Large bowel gas will be located in the outer perimeter of the abdomen with ascending, transverse and descending colon.

Findings



- Small bowel gas is being displaced to the right.

Follow-up

- CT imaging (not available for this patient)
- Barium study was performed

Barium study of the small bowel

The barium study outlines the small bowel nicely but likely a mass of the abdomen is pushing the bowel to the right.

www.mypacs.net

CT confirmed mass

- Referral: Abdominal surgeon; oncologist

- End diagnosis: Retroperitoneal liposarcoma
  - A mass was compressing and displacing the small bowel to the right side of the abdomen.

Case 7: Lumbar spine

- 68 year-old male with low back pain. The pain began 4 weeks ago.

AP and Lateral Views

Lateral Spot view of the Lumbar Spine

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Findings

- Compression fracture at L1 (patient forgot that they had trauma a few weeks ago).

- Atherosclerosis of the abdominal aorta
  - Widening the abdominal aorta of 3.5 cm
    - **Normal diameter is 2.0 cm**
  - Seen best on the lateral spot radiograph for this particular patient.

Diagnosis

- Aneurysm of the abdominal aorta at the level of L3
- Suspected aneurysm at the level of L2

Follow-up

- Ultrasound

- MRI was performed as well to evaluate the fracture of L1.
  - The abdominal aorta was measured as well on MRI axial images to be 4.6 cm

  - Normal abdominal aorta= 2.0 cm in diameter.

T2 Weighted Images of the Lumbar Spine

Case 8: Lumbar spine

- Chronic low back pain

Findings/Diagnosis

- Thick, flowing ossification of the anterior longitudinal ligament.
- Diagnosis: DISH

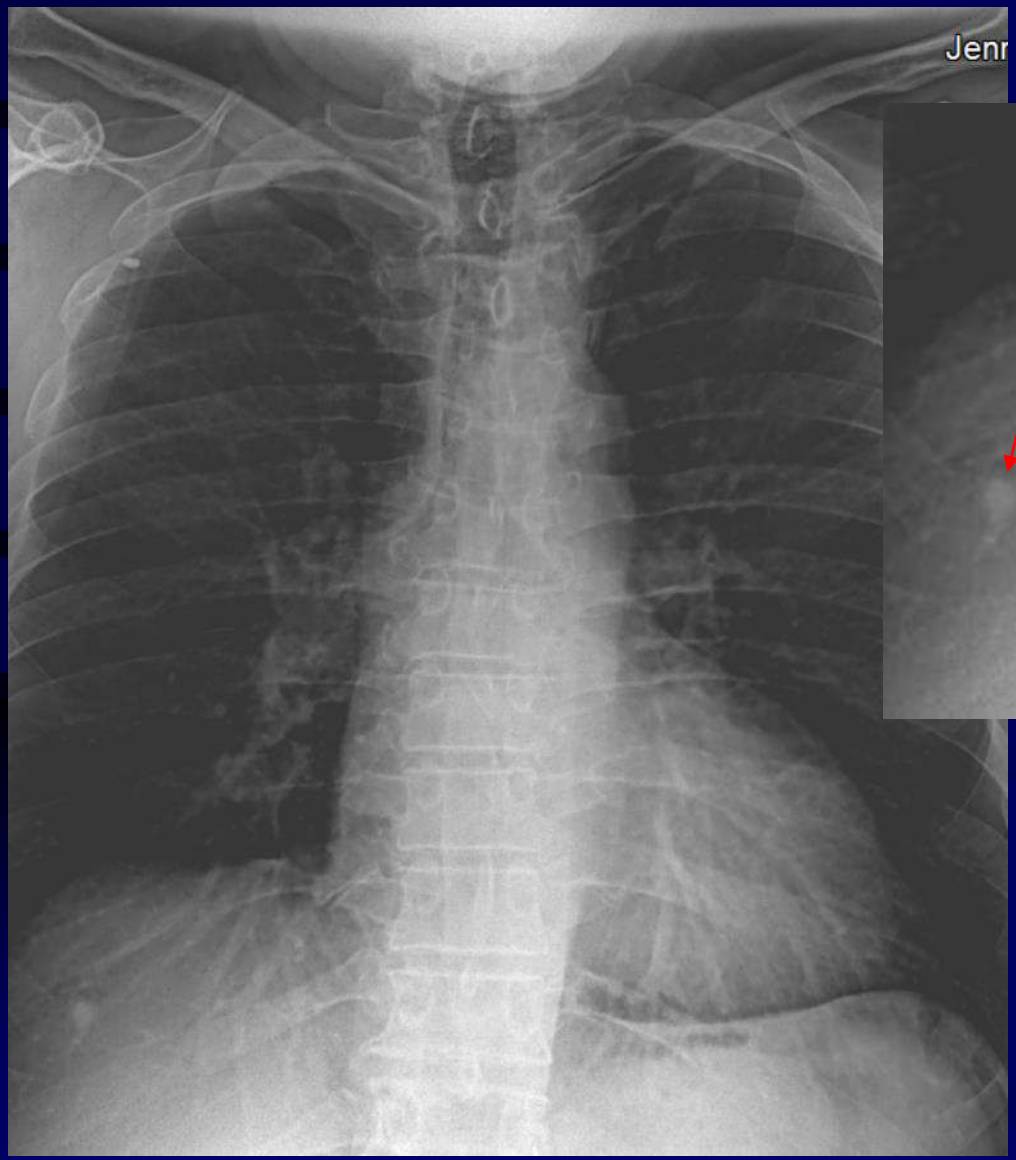
Case 9: Lumbar spine

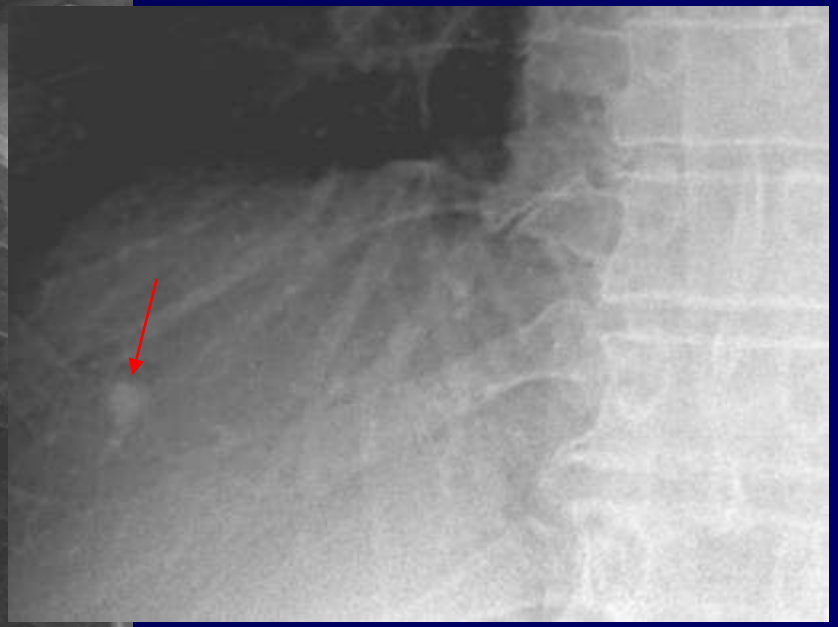
- This came across my desk the other day….

- On the AP and lateral radiographs of the lumbar spine, the search pattern should also include the lower lung fields to check for any space occupying lesion(s).

Nodule in the Right lower lung

Nodule in the Right lower lung





Follow-up

- CT of chest

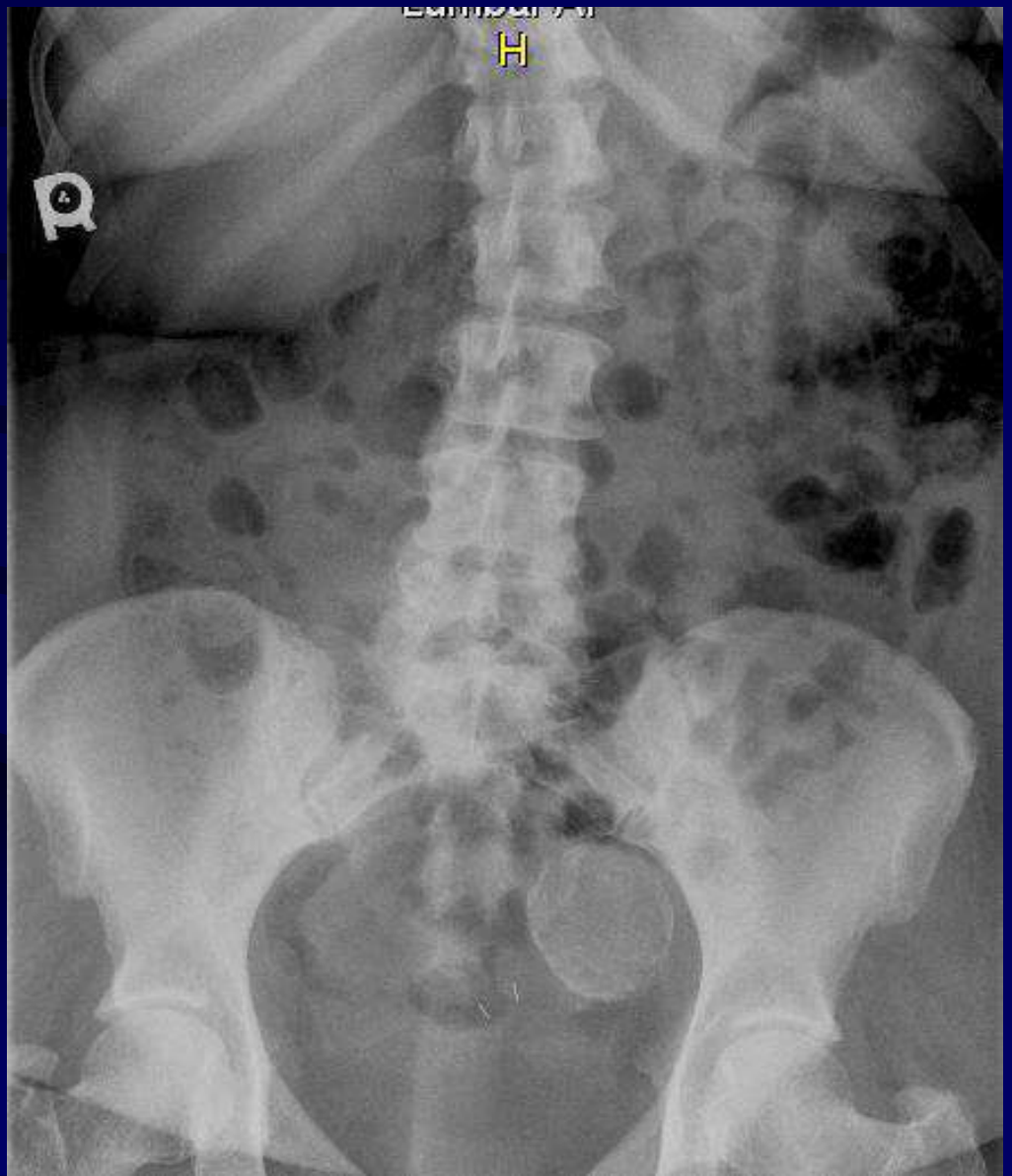
Search Pattern for Pelvis

- Search pattern other than osseous of pelvis:
  - Bladder/Prostate/Uterus
  - Vasculature
  - Vas deferens
  - Musculature/lateral soft tissues

Case 1: Pelvis

- 43 year-old female with low back and pelvic pain.
- History of cervical cancer; surgical resection and chemotherapy one year ago.

AP Lumbar



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Findings

- Large calcific mass within the pelvic basin on the left with well-defined margins.

- Two surgical clips within the pelvic basin, correlates with prior history.

Diagnosis & Follow-up

- Uterine fibroid

- If you are still unsure of the mass, referral to gynecologist and ultrasound of the pelvis are recommended.

Uterine Fibroid aka Uterine Leiomyoma

- Benign tumor within the muscular tissue of the uterus

- Symptoms
  - None; or pain back of the legs
  - Heavy, prolonged periods
  - Pelvic pain
  - Constipation &/or bloating>>pressure on bowel
  - Infertility; Miscarriage

Uterine Fibroids

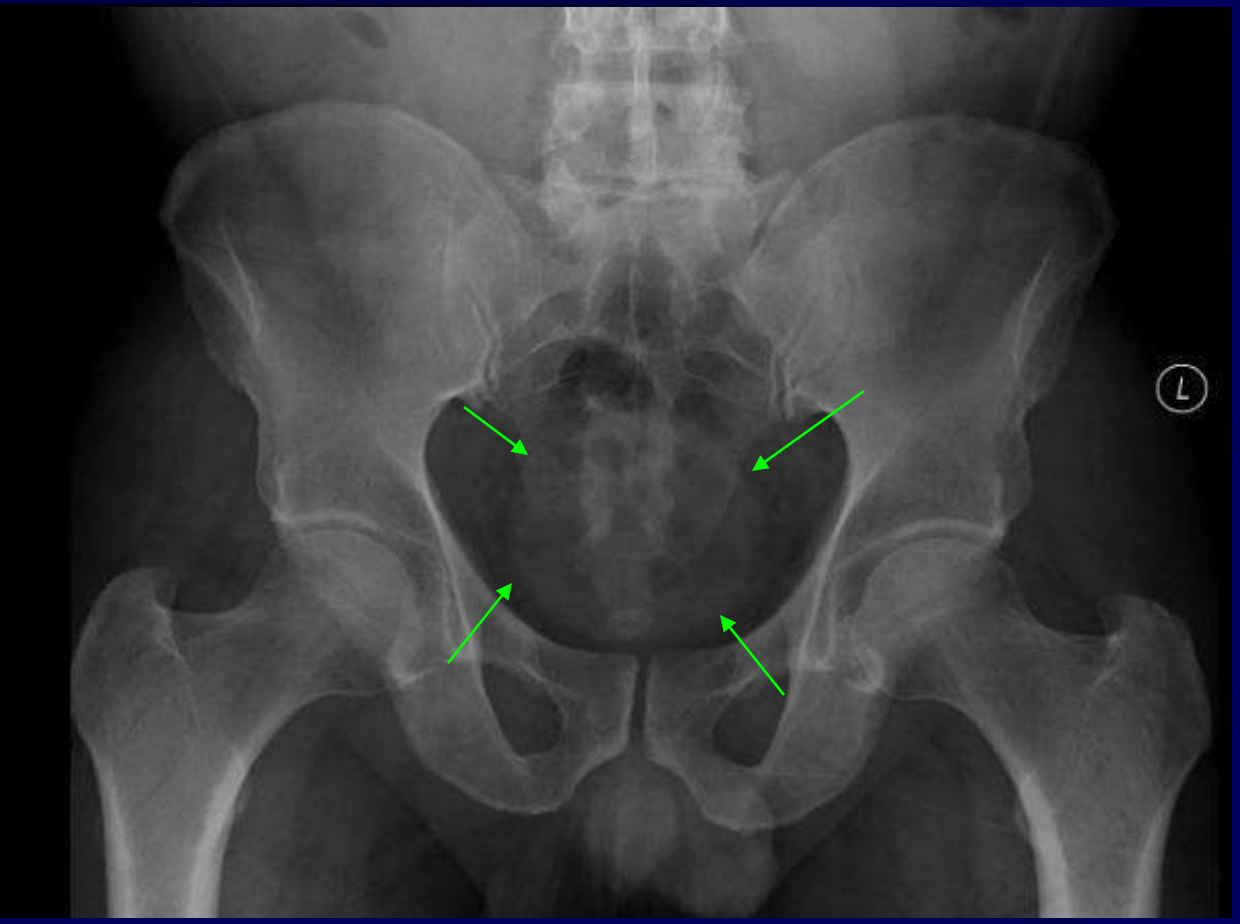
- Fibroids may shrink during menopause due to decrease in estrogen levels
  - Increase in size during pregnancy

Case 2: Pelvis

- Male with back pain and difficulty urinating

AP Pelvis

Findings



- Distended bladder

Differential diagnosis

- DDX for distended bladder:
  - They had to pee and you did not let them pee before taking the xray ☺
  - Prostate pathology/enlargement

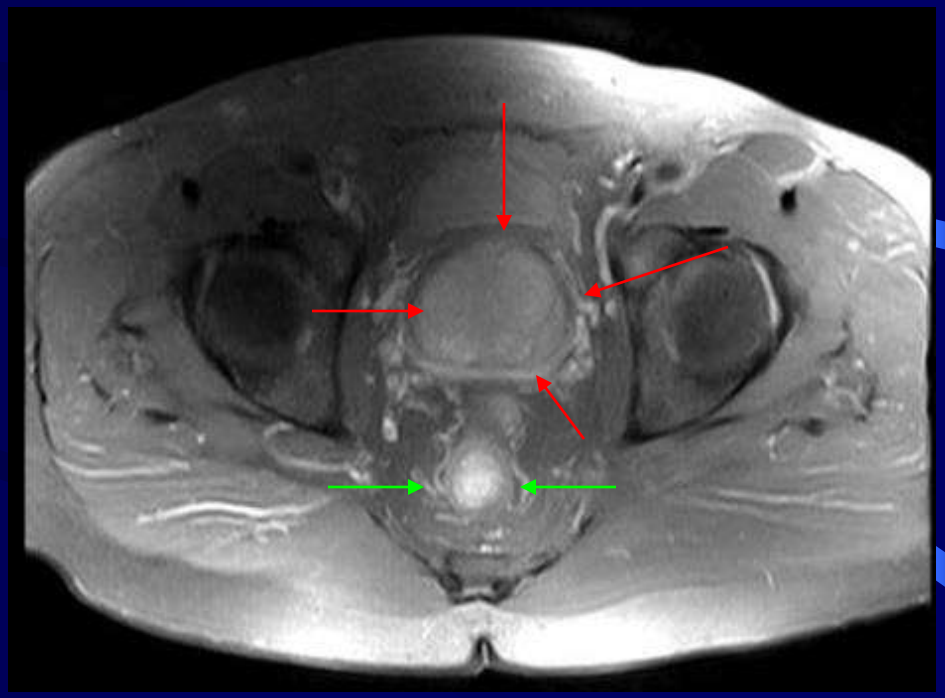
Follow-up

- Referral to Urologist
- Digital rectal examination
- Laboratory studies

- Transrectal ultrasound with biopsy
- MRI maybe performed: Differentiate between benign prostatic hyperplasia and adenocarcinoma

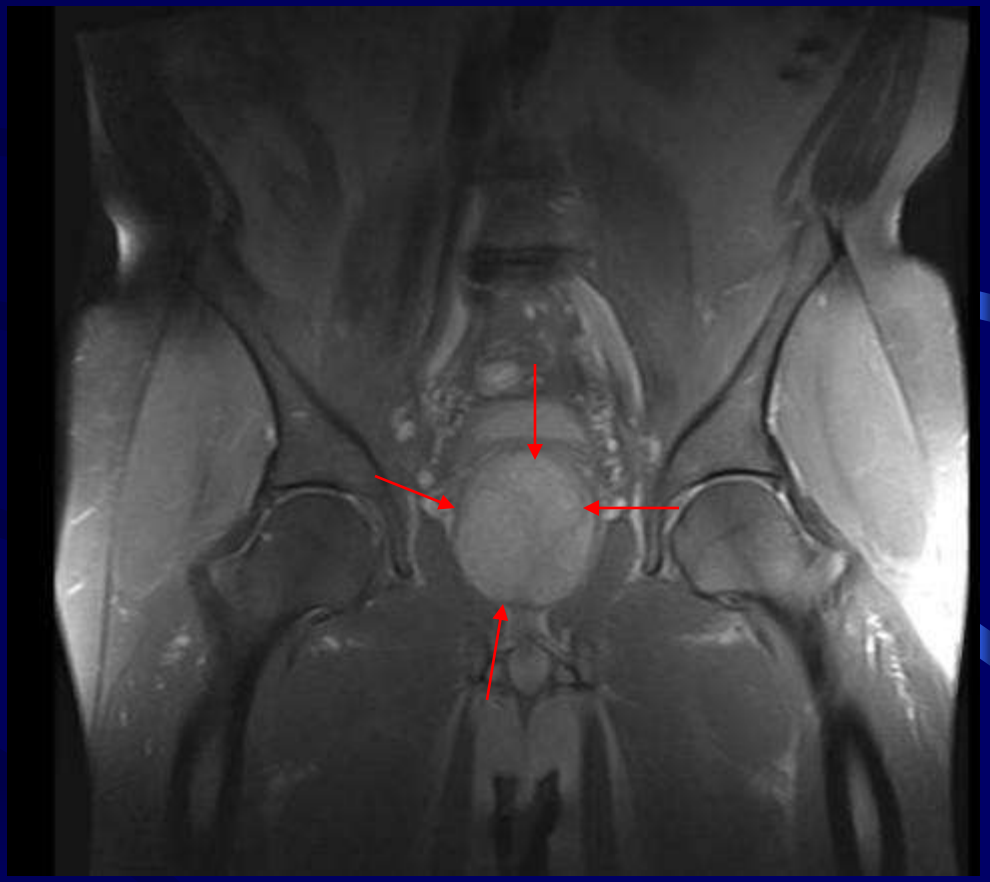
MRI: Axial Proton Density weighted fat saturated images

- **Enlarged prostate**
- **Normal size=same size as rectum**
- Note: A normal **prostate** should be approximately the **same size** as the **rectum** on the axial image.



Coronal PD Weighted Fat Sat Images

- Enlarged prostate



Diagnosis of the Prostate

- Adenocarcinoma

- Symptoms:
  - Fever, night sweats, chills & weight loss
  - Pain, burning with urination
  - Blood in urine
  - Weak flow of urine; frequency
  - Constant back, hip &/or pelvis pain

Treatment

(Prostate Cancer Institute & National Cancer Institute)

Surgical

- Radical prostatectomy

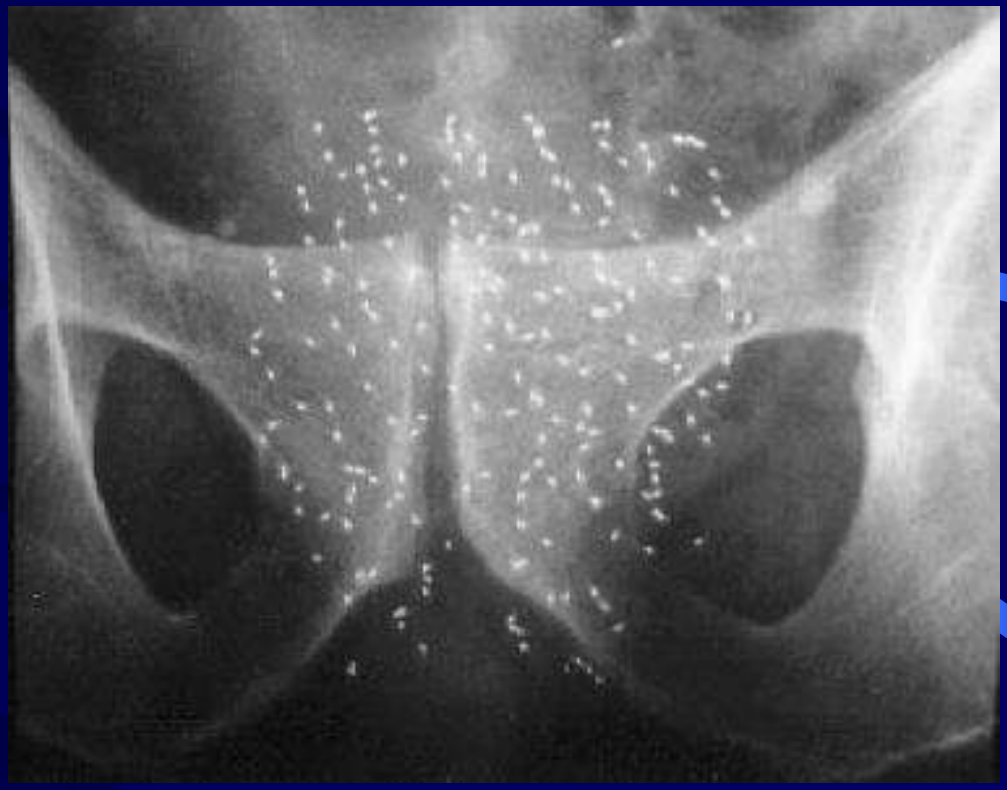
- Robotic laparoscopic prostatectomy
  - 5 small abdominal incisions
  - Ex. Da Vinci Robotic Prostatectomy (Texas)- www.video.google.com

Treatment

- Radiation-brachytherapy (radiation seeds)
- Hormone therapy- decreased testosterone by LHRH
- Chemotherapy

Radiation Seed Implantation

- Multiple metallic specks overlying the symphysis pubis are radiation seeds within the prostate.
  - Normal: prostate overlies the symphysis pubis on the AP view of the pelvis



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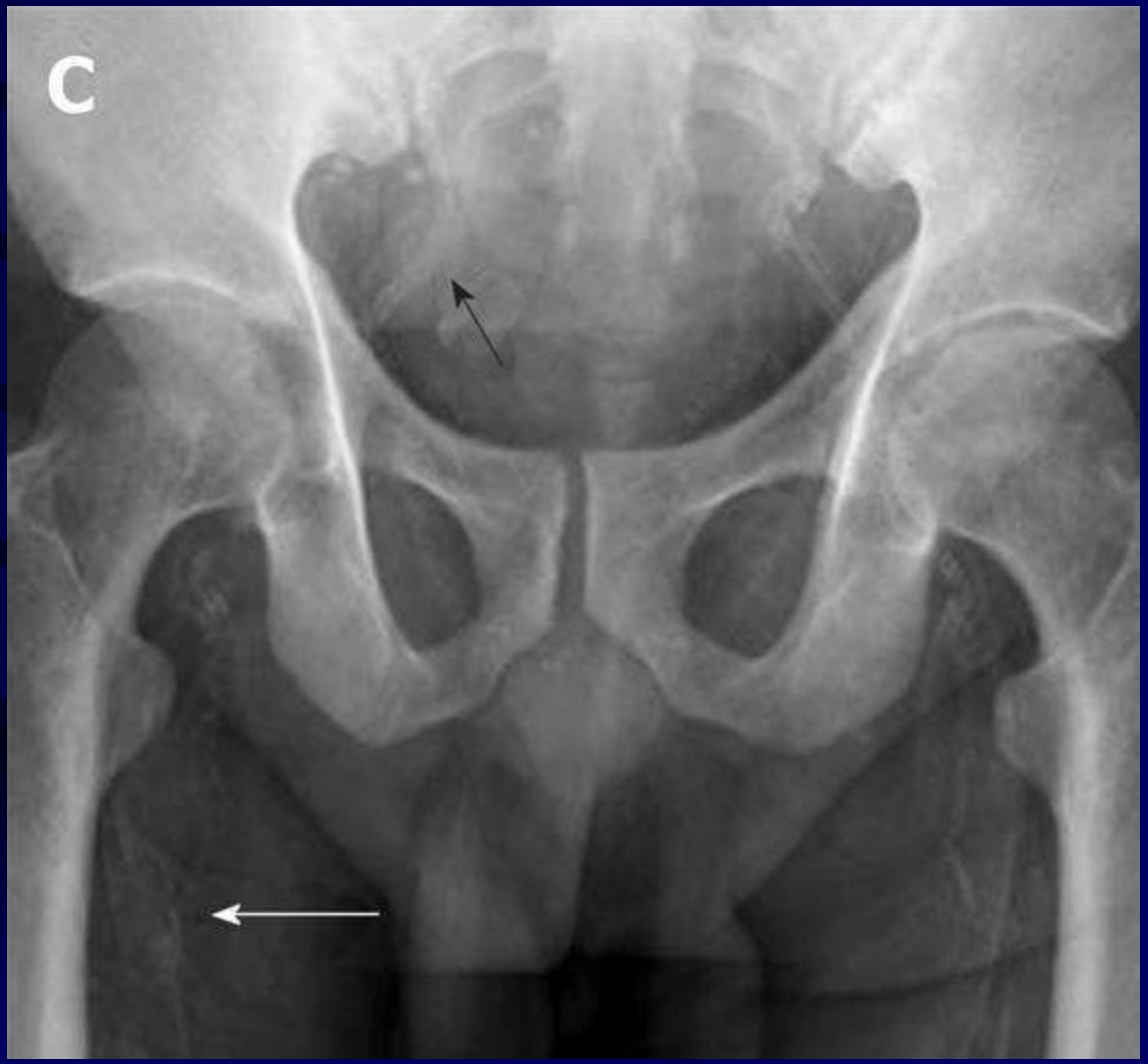
Case 3: Pelvis

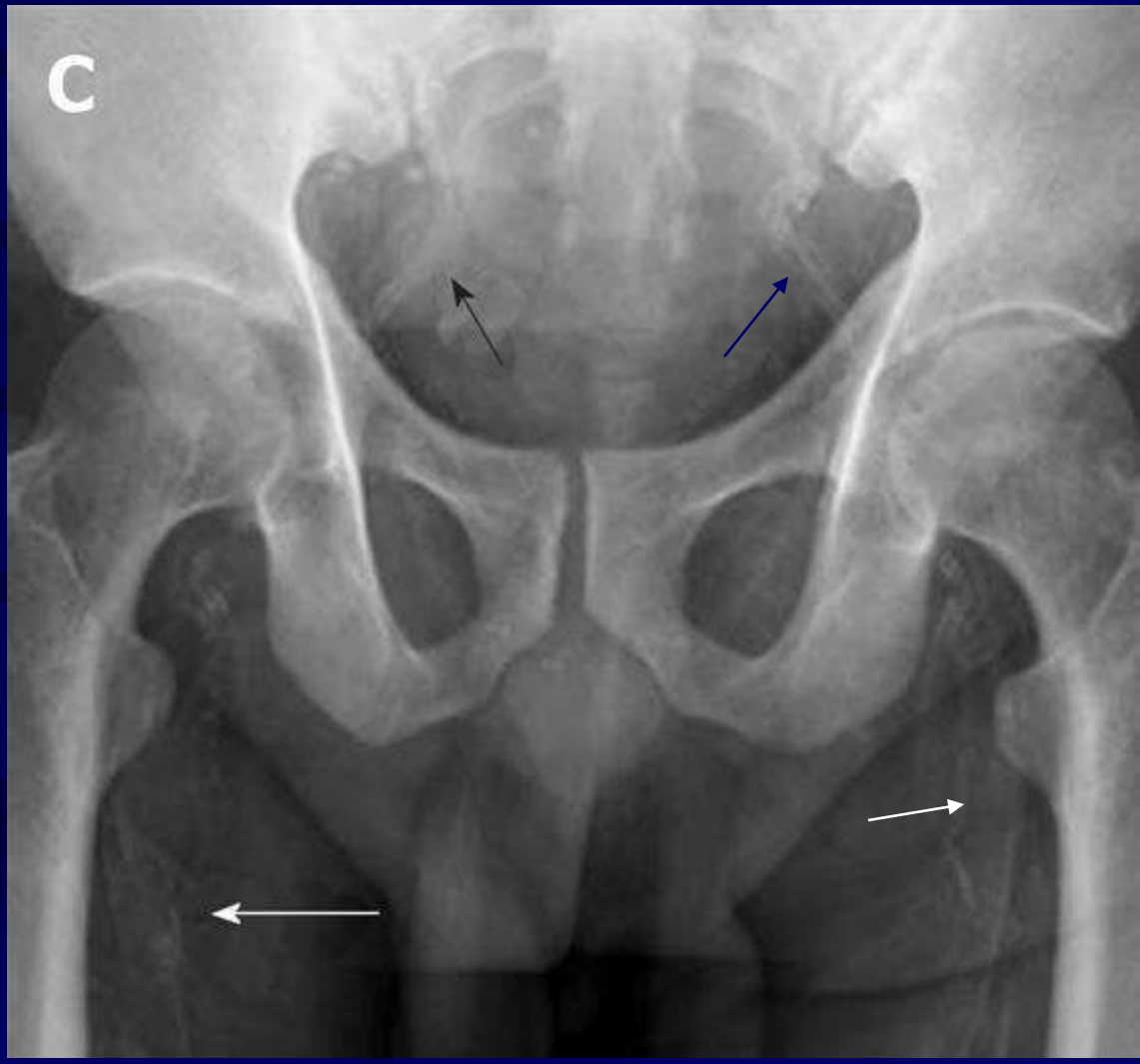
- Mild low back and bilateral hip pain.

Pelvis



Findings

- Vascular calcification of the bilateral iliac arteries (black arrows)
- Vascular calcification of the bilateral femoral arteries (white arrows)



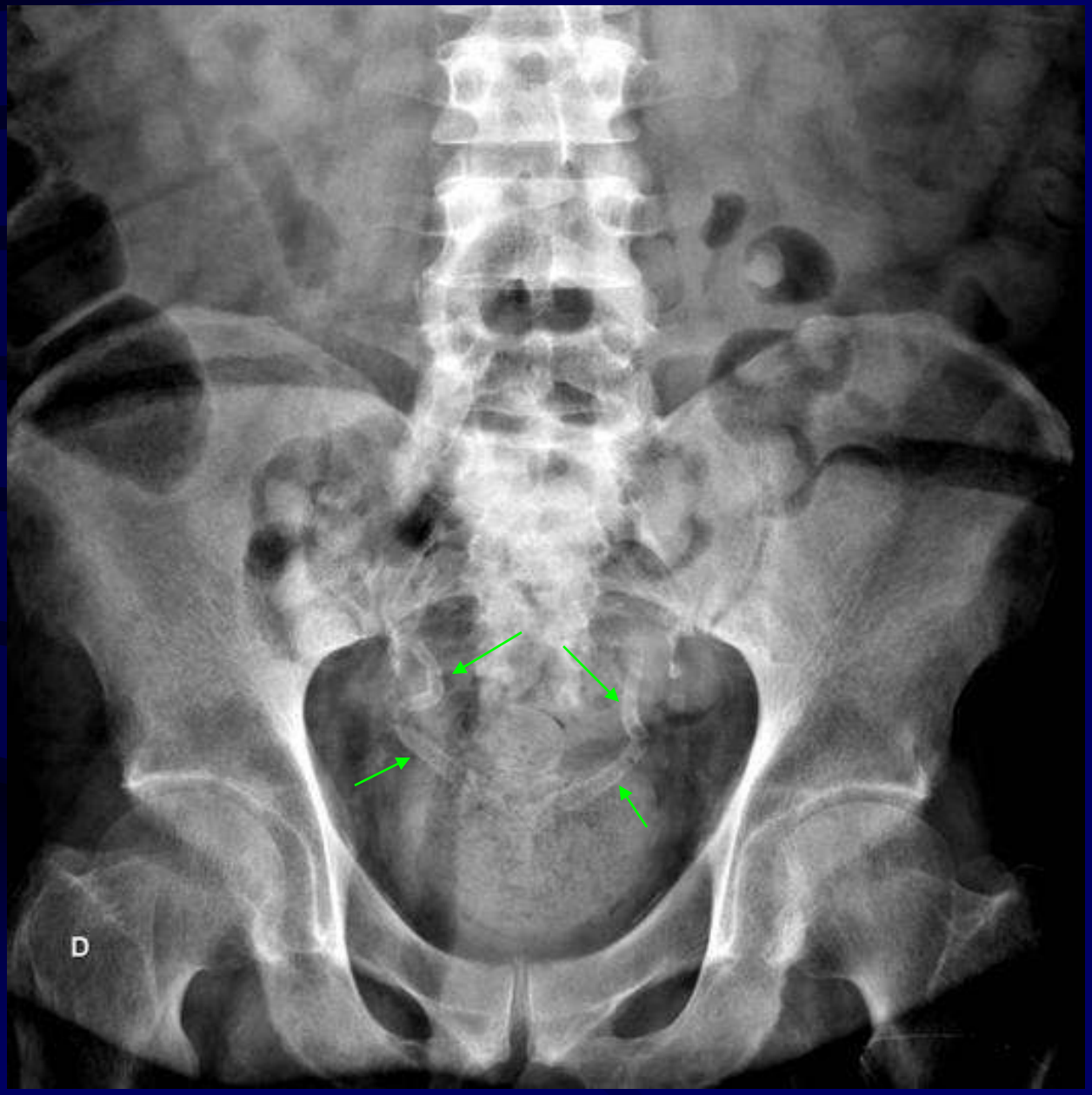
Diagnosis

- Atherosclerosis of the bilateral iliac and femoral arteries.
- Patient is likely on hypertension medication
- Referral: primary physician if patient has not discussed vascular disease with their primary doctor.

Case 4: Pelvis

- History: Mild low back pain.

AP Lumbopelvic


D

Findings

- Tubular calcification in a V-formation within the central portion of the pelvic basin

Diagnosis

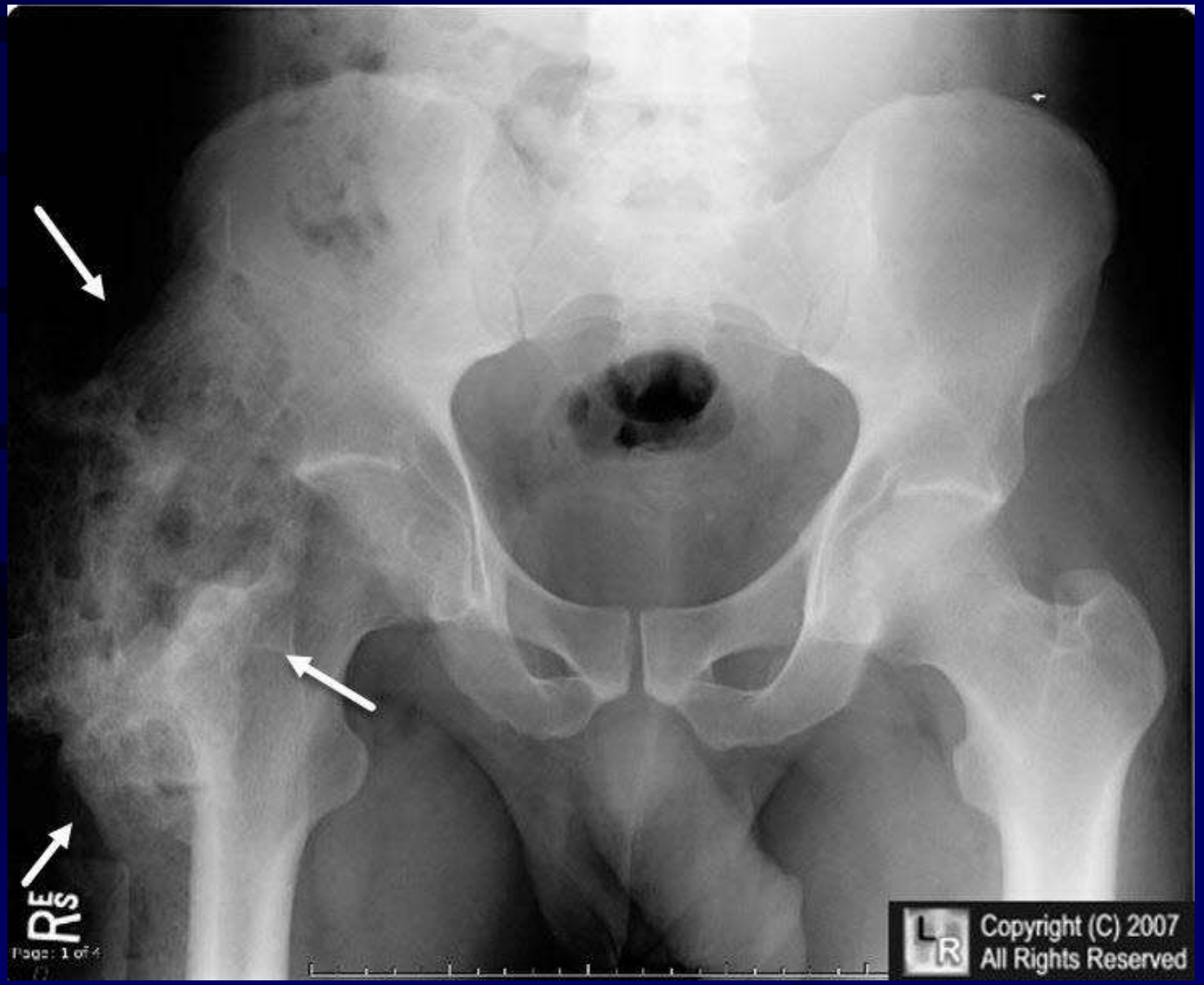
- Calcification of the vas deferens

- Clinical Significance:
  - Diabetes mellitus,
  - Normal ageing,
  - Or due to infection

Case 5: Pelvis

- Young patient with spinal cord trauma several months ago.

AP Pelvis



Findings

- Abnormal bone formation within the extra-skeletal soft tissues surrounding the right hip.

Diagnosis

- Heterotopic Ossification known as myositis ossificans.

Other Examples

Follow-up

- Standard advanced imaging is triple phase bone scan with Tc 99M MDP
  - early detection early as two weeks after injury.

- Biopsy leads to false positive diagnosis of osteosarcoma
- CT can detect calcifications within the soft tissue earlier than xrays.
- MRI is not helpful
- MSK Ultrasound Imaging can be performed.

Causes of Heterotopic Ossification

- Trauma to the spinal cord
- Blunt trauma
- Contusion or bruise to muscle
- Repetitive trauma or muscle strain
- Burn victims
- Post surgical changes of the same region

Myositis Ossificans

- Calcification may show up 2-4 weeks after trauma
- Most commonly the thigh.

Treatment

- Light therapies that does not induce bleeding; Treat the inflammation first.
- Surgical resection: It may reoccur.
- Radiation therapy with external beam, or non-steroidal inflammatories

Case 6: Pelvis

- Mild low back pain. Doctor performed AP pelvis radiograph to further evaluate the left hip, after identifying calcific mass on the left on the AP radiograph of the lumbar spine.

AP Pelvis

Findings

- Multilobulated, periarticular densely calcified mass is overlying the left hip and hemipelvis.

- There are no osseous erosions.

Diagnosis

- Tumoral Calcinosis
  - Hereditary metabolic dysfunction of phosphate regulation
  - Most commonly painless; Underlying bone is normal.
- Most common locations (in descending order of frequency):
  - hip (most common), shoulder, elbow, and foot (least common).

Other Examples

Follow-up

- Family history
- CT and MRI
- Laboratory studies

Other possible differentials

- Hyperparathyroidism
- Calcium pyrophate deposition disease (pseudogout)
- Dermatomyositis
- Myositis ossificans
- Hypervitaminosis D
- Calcinosis of chronic renal failure
- Synovial sarcoma
- Calcific tendinitis

Referral for Advanced Imaging- Don’t be Afraid☺

Advanced Imaging: Evaluating the soft tissue

- Abdomen/Pelvis: US>>>>>CT
- Spine: MR, evaluate the disc, spinal cord, nerve roots, brain
- Brain: CT for acute bleed/trauma
- Chest: Xray>>>>CT

Advanced Imaging: Evaluating the soft tissue-continued

- Extremities: MR for ligaments, labrum, menisci, cartilage, tendons and muscle

- Extremities: CT for fracture and dislocation

Criteria for Ordering MRI

- Some indicators:
  - Neurological deficit
  - Radiculopathy with no response to 4 week treatment
  - Spinal stenosis
  - Spinal fracture
  - Degenerative disc disease with no response to 4 week treatment
  - Recurrent sx's after spinal surgery
  - Clinically: infection, cancer, metastatic disease

www.healthlink.com and www.aetna.com

MRI

- Contrast for Spine
  - Intravenous: Prior surgery; Tumor/mass and Infection

Magnetic Resonance Imaging

- Sequences
  - T1- fat is bright
  - T2- CSF, fluid is bright
  - Proton Density
  - Gradient Echo
  - STIR

- Sagittal, Axial and Coronal

Spinal Structures (Sagittal)

- Cord-conus medullaris
- Central canal
- Disc – signal, height and contour
- Vertebral bodies; Facet; Spinous processes
- Nerve roots and neural foramina
- Ligaments (ALL, PLL, interspinous, ligamentum flavum)
- Abdominal Aorta

www.medifax.com

www.mypacs.net

Spinal Structures (Axial)

- Nerve roots and neural foramina
- Cord/Thecal sac
- Disc contour
- Central canal
- Ligaments (ligamentum flavum)
- Epidural space
- Facet joints

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