Lumbar Radiology

Color

- Black=gas, fat
- Gray=muscle, water, soft tissue
- White=bone, metal

ABC’s of Radiology

- Alignment: spinal curves, scoliosis, deformity, rotation, malposition, deviation are noted.
- Bone: cortex, medulla, subchondral bone, mineralization, trabecular patterns, and density. Size and shape as well as osteophytes, sclerosis, or any lesions such as tumors.
- Cartilage: joint spaces (↑/↓), asymmetry, congruity, obliteration of the joint.
- Soft tissue: note fat pad sign, cysts, deposits, calcifications, or edema.
- This is how the report should be WRITTEN. Today we will look at how to EVALUATE a film.
6 Motive steps for evaluating a film

- 1. Identify view
- 2. What is motive for taking film?
- 3. Color motive - How does film appear, 5 color motives
- 4. First impression
- 5. Second impression.
- 6. Then check normal anatomy for age, sex and deformity

Identify view

- Oblique lumbar
- Oblique cervical
- PA ulnar deviation - scaphoid and lunate
- Cervical flexion/extension

What is motive for taking film?

- Oblique lumbar - view pars and facets
- Oblique cervical - view IVF
- PA ulnar deviation - scaphoid and lunate
- Cervical flexion/extension - for abnormal motion and/or fusion, stability or instability
  - Contraindicated in all fractures (fx) except Clay shoveler’s fx
  - Contraindicated in traumatic dislocation, infection, malignancy
  - Only time you see a dislocated facet on a flexion film is with inflammatory arthritis, usually RA
4/8/2014

**Color motive**

- **How does film appear, 5 color motives**
  - 1. Bone is white, soft tissue is gray, gas is dark or black. A normal motive film = good quality film.
  - 2. Bone is white, soft tissue is white.
    - a. Underpenetrated/underexposed
    - b. Lousy film
    - c. Taken for soft tissue.
    - d. Always check bone first on underpenetrated film then check soft tissue (abdominal aorta primarily on lumbar views).

**Axial radiograph of the calcaneus showing soft tissue swelling with amorphous calcification. Biopsy proved a malignant synovioma.**

- 3. Bone is dark, soft tissue is dark.
  - a. Overpenetrated/overexposed
    - a. Lousy film
    - b. Or a bone film taken to see one area of film
    - c. Don’t worry about what you cannot see, only what you can on an OVERPENETRATED film.
  - b. Note: overexposure and underexposure techniques are not used so much today because of advanced imaging.

- 4. Bone is gray, soft tissue is gray = osteopenia
  - a. Hyperparathyroidism, b. Lytic mets, c. Multiple myeloma (MM), d. RA, e. Ankylosing Spondylitis (AS) If you cannot find a condition to explain osteopenia then you change your diagnosis (dx) to osteoporosis.
  - To confirm osteoporosis is on a film you must see pencil thin cortices going all the way around vertebra.

- 5. Bone is white, soft tissue is dark or black. Bone film - problem is in the bone

**Color motive**

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Step 4 First impression

- Either normal or abnormal. Are you distracted by something on film?
- Yes = first impression is abnormal
- No = first impression is normal
- If your first impression is abnormal then go to second impression, which is motive step 5.

Step 5 Second impression

- Is it congenital, is it acquired, am I unsure.
- If second impression is congenital
  - Rule: once you have a congenital anomaly you no longer worry about alterations of color from Paget’s, infections, or malignancies. You no longer worry about subtle fx or subtle dislocations.
  - The only time you will pick an acquired condition once you have a congenital anomaly on the film is if the acquired condition is OBVIOUS ENOUGH to override the congenital anomaly.

Step 6 Check normal anatomy for age, sex and deformity

- Age
  - Biggest differential in radiology,
  - Sex - important in pelvis only
  - Deformity - defined as the bending or twisting of bones with the cortex still relative intact. Deformity in spine – Paget’s or congenital anomaly. Deformity in the extremities – Paget’s or fibrous dysplasia.
- Ilia and sacrum are considered part of the extremities for radiological/bone pathology.
LATERAL LUMBAR SPINE

- Motive=Routine Scout.
- 8 steps

Step 1

- Go down front of vertebral bodies looking for
  - 1- lipping and spurring of DJD or infection
  - 2- hyperostosis aka candle wax drippings of Diffuse Idiopathic Skeletal Hypertrophy (DISH) aka anterior spinal bridging
  - 3- marginal syndesmophytes of Ankylosing Spondylitis (AS)
  - 4- avulsion or compression fx.

DISH  AS  Compression fracture
Step 2
- Check vertebral bodies for alteration of shape or color.
  - Alteration of shape
  - Alteration of color
    - Whiter = blastic mets or Paget's,
    - Blacker = lytic mets or MM.

Step 3
- Check disc spaces for alteration of size and color.
  - DDD
  - Infection
- Differential in history is that DDD is relieved by lying down & infection is not.
- Also, DDD is usually at more than one level while infection tends to be limited.

Step 4
- Back of vertebral bodies
  - 1-overall curve
  - 2-decreased posterior body, and posterior body destruction to indicate malignancy.
  - Malignancy is only your diagnosis if no signs of infection or trauma, slippage of dislocation or spondylosis
Step 5

- Check pedicles.
- With pedicle fx you see a vertical lucency through pedicle.
- Pedicle fx is very unstable.
- Will have displacement.

Step 6

- Check pars for pars fx.
- Pars fx without anterior slippage = spondylosis.
  Locate pars, base of pedicle meets facets, 45 degrees.
Step 7

• Check Spinous Process. On lateral lumbar film they are usually over penetrated.
• Absent
  — 1-surgical removal
  — 2-eaten away due to malignancy
  — 3- congenitally absent.
• If you see missing SP and there are myelographic remnants most likely surgical removal.

Step 8

• Soft tissue in front of spine. Primarily looking at the abdominal aorta.
• Usually L2-4.
• Abdominal aorta should be no more than 3.8 cm. Greater than 3.8 cm = aneurysm. Greater than 5cm is a surgical referral.
• Normal width of abdominal aorta is 1/2 to 3/4 the width of lumbar vertebral body. If wider = aneurysm.
• 2 signs for abdominal aorta are half-moon shape and curvy linear calcification

Visible Posteriority: look for an interruption of George's line (posterior vertebral body). May be seen in acute or chronic conditions.

Intervertebral Foramina Encroachment (thoracics and lumbars). May be seen in acute or chronic conditions.

Stacking: a change in the normal curve. With stacking, a straight line may be drawn up the posterior aspect of three or more consecutive vertebral bodies. May be seen in acute or chronic conditions.

Hour glassing is a term used to describe the ellipse effect seen on the lateral film when a segment has tipped laterally, such as in scoliosis. May be seen in acute or chronic conditions.
Increased disc angle (severe wedging) anteriorly, may be seen in acute or chronic conditions.

Thin discs is when one disc is thinner than discs above and below. Indicates a chronic condition.

Spurring (exostosis/osteophytic change) & indicates a chronic condition.

Eburnation: conversion of bone into an ivory-like mass (OA) It will indicate a chronic condition.

Stair stepping is when more than one vertebral body exhibits posteriority and usually indicates a chronic condition.

Schmorl’s nodes are associated with fractures of the end plate. Indicates a chronic condition.

Facets - Checking for facet imbrication (AKA facet syndrome), using MacNab’s line which is drawn along inferior aspect of the vertebral body, the superior articular facet of the vertebral body below should not cross McNabb’s line.

If it does cross (positive McNabb’s line) = facet imbrication.

**LUMBAR OBLIQUE**

- Motive= To view pars and facets.
- In lumbar anterior oblique film you see opposite pars and facets.
- With lumbar posterior oblique you see same side pars and facets
- Note: this is the opposite with cervical spine oblique films so don’t get confused. Also, C-spine oblique is for IVF; Lumbar is for the pars
- Pars fx is primary concern on oblique film. Can only diagnose as spondylosis (spondylolisthesis is done on the lateral view).
When looking at the AP lumbar, the Square Blockhead System is useful. There are 4 steps.
- Step 1. Square blockhead = body.
- If you see vertical striations in a single vertebra is most likely hemangioma.
- Can have hemivertebra = butterfly vertebra.
- Can have: Whiter - blastic mets or Paget’s, Darker - lytic mets or MM.
- Crushed blockhead - think malignancy. Malignancy is only a diagnosis if no other signs of infection or trauma. Vertebral body should NEVER be the same height as pedicles.

Step 2. Check 2 eyes. If pedicle is missing it could be
- 1-Lytic mets,
- 2-Agenesis of pedicle. Referred to as owl winking sign.
- To differentiate between lytic mets and agenesis, once you see missing pedicle assume it’s due to lytic mets.
- To change diagnosis to agenesis you must go to opposite pedicle. Is opposite pedicle more sclerotic than the one above AND the one below. If yes = agenesis. If no = lytic mets.

MM leads to a decrease of body height with SPARED PEDICLES = MM pedicle sign.

MM is referred to as a plasma cell leukemia, which is found in bone marrow.

Most bone marrow found in medulla of vertebral bone. Appears cold on bone scan.

Labs for MM - IGG-M spike on electrophoresis, reversed AG ratio, Bence-Jones proteinuria seen on urinalysis, normocytic normochromic anemia, rouleaux formation = stack of coin appearance = stacking of blood cells.
Square Blockhead System (cont.)

• Step 3. Check nose.
  • Is it present or absent.
    – 1- surgical removal
    – 2- eaten away due to malignancy
    – 3- congenitally absent.
• Missing spinous and remnants of myelogram on film, most likely surgical.
• If SP is present check for vertebral lucency of spina bifida.

Square Blockhead System (cont.)

• Step 4: Check TP.
  • Primarily looking for fx.
  • To differential fx from nonunion, with fx usually lucency is jagged with no cortical margin and with displacement.
  • Nonunion lucency is usually smooth with cortical margins around fragments with no displacement. The only time to diagnosis TP fx without displacement is if you see a bony callus. Callus appears as bony cloudy density around bone.

Orientation to AP lumbar view.
Patient’s right is always on your left.
AP lumbar view

• Motive = Routine Scout.
• Step 1.
  – Start at lower 1/3 of SI joint. 3 conditions come to mind – AS (ankylosing spondylitis, benign sclerosis of bilat SIJ), DJD, OCI (Osteitis condensans illii).
  – AS starts in SI joints and causes bilateral symmetrical fusion of SI joints.
  – Ask yourself if you can see SI joints (from lower 1/3). Yes = rule out AS. No = is it technical reason or pathological?

DJD vs. OCI. Symmetrical refers to same area but not equal. Use whitening of iliac side of SI joint to differentiate. Blastic mets is not symmetrical.

To differentiate DJD from OCI compare color of ilium to the lower portion of sacrum of SI joint. If ilium is OBVIOUSLY whiter the diagnosis is OCI.

If color of ilium is SIMILAR to lower portion of sacrum of SI joint then diagnosis is DJD.

OCI = osteitis triangularis = hyperostosis triangularis. Seen in multiparous women 20-40 years old. Bilateral stress hypertrophy of ilium. Is a benign condition, which is self limiting and self resolving. Responds well to manipulation and utilize trochanteric belt for stability.

No positive labs. Radiographic sign is triangular sclerosis but these are only seen in advanced stages.

AP Lumbar view (cont.)

• Step 2.
  – Compare color and shape of one ilium to the other.
  – Alteration of shape is Paget’s, fx or fibrous dysplasia. Alteration of color - whiter, blastic mets or Paget’s, darker is lytic mets, MM or benign bone tumor.
• Step 3.
  – Check for Risser’s sign. Helps determine age of patient. Found between iliac epiphysis and crest. Most physicians agree that by the time “Risser 3” the patient has passed the peak of the “growth spurt” (a period of rapid spinal growth during which Scoliosis curves can increase rapidly).
  – A thin black line means growth center is open and patient is under 20. A thin white line means growth center just closed, patient is 20-30. No thin line or signs of DJD, patient is 30-40. Signs of DJD, patient is over 40.
AP Lumbar view (cont.)

• Step 4.
  – Go to top of iliac crest and draw horizontal line across. This line should bisect L4-5 disc spaces.
• Step 5.
  – Count up lumbar spine until last set of ribs that point down and assume this to be T12.

AP Lumbar view (cont.)

• Step 6. Count down lumbar spine checking for lumbosacral transitional segment. If you count 6 lumbar vertebra = lumbarization of S1. If L5 TPs are fused or articulating with sacrum = sacralization of L5. If L5 TP is flattened or wider than normal = spatulating TP. (Not only condition where this is seen)
• Sclerosing at articulation of L5 TP and sacrum = subchondral sclerosis. Subchondral sclerosis is only seen in true joint and not pseudo joint (L5-S1 articulation would be a pseudo joint)
• Inferior aspect of TP with sclerosis, radiologists say this is sacralization because TP is trying to articulate with sacrum = sacralization.
• Another congenital anomaly that affects L5 is hypertrophic enlargement of TP of L5.
Lumbarization Sacralization Hypoplastic 12th rib giving the illusion of sacralization

AP Lumbar view (cont.)
• Step 7.
  • Check sacrum for alteration of shape, alteration of color and for vertical lucencies.
  • Alteration of shape: Paget’s, fx, congenital anomaly, and fibrous dysplasia.
  • Alteration of color - whiter is blastic mets or Paget’s, darker is lytic mets, MM or benign bone tumor.
  • Most common benign bone tumor of sacrum is giant cell tumor.
  • Check for vertical lucencies of spina bifida. Spina bifida of S1 is difficult to see.

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AP Lumbar view (cont.)

- Step 9.
- Perform square blockhead system all the way up spine.
- Check disc spaces all the way up spine looking for DJD, infection and marginal syndesmophytes of AS.

AP Lumbar view (cont.)

- Step 10.
- Check opposite L2 vertebral for renal artery calcification or renal artery aneurysm.
- To differentiate calcification from aneurysm, if the calcification is smaller than vertebral its calcification, if it’s larger then its a renal artery aneurysm.
- Renal artery aneurysm will only span 1 or 1-2 vertebra. Aortic aneurysm will span 3+.

AP Lumbar view (cont.)

- Step 11.
- Check soft tissue bilaterally from L2-4 for a half-moon shape, curvilinear calcification of an abdominal aortic aneurysm.
- Abdominal aorta should never be seen on AP film.
AP Lumbar view
(cont.)

• Step 12.
• Check soft tissue bilaterally from 12th rib to iliac crest looking for gallstones, kidney stones, stag horn calculi.

Kidney stones and staghorn calculi

Gall stones, 90% not seen on x-ray. Only seen on x-ray when calcified.

Gallstone is cholesterol, fat. Appearance of gallstone on x-ray is black center outlined in white. Seen only on right side of body, usually at L1-2 area.

Kidney stones, 90% do show up on x-ray. Appearance is pure white, unilateral or bilateral, seen at L1-3 area. 3 major types of kidney stones: 1-calcium oxalate, 2-calcium urate, 3-calcium phosphate. Appearance on x-ray as black center with white border.

Gallstone located in line with middle of ilium. Kidney stone located in line with lower SI joint.

Renal artery calcification located very close to spine at L2.

Stag horn calculi can be unilateral or bilateral. It is the calcification of the renal calices.

AP Lumbar view
(cont.)

• Step 13.
• Check soft tissue of pelvic inlet for uterine fibroids, calcified prostate, ureter stones and phlebolithes.
Questions?

The Venus Pool at Caesar's Palace