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SPINE CONSENSUS CONFERENCE
Spine Anatomy; Sources of Spine Pain

November 9, 2018

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Disclosures

- Cate Pandiscio and Martha Magnuson have no disclosures.

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Objectives

- Identify the anatomy of the spine
- Identify subsequent pathology and clinical presentation surrounding common spine problems
- Understand the treatment options for various conditions

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Epidemiology

- 50 million Americans have low back pain at any given time.
- 80%-90% lifetime chance of experiencing neck or back pain.
- Most common cause of disability under age 45.
- Peak age 35-55
- Most expensive health care costs in the 20-50 year age group.
- Estimated costs of treating back pain is 100-200 billion dollars per year.
- Risk factors: low education status, stress, anxiety, depression, job dissatisfaction, low levels of support in the workplace, and whole body vibration.
- Ref epidemiology of back pain the global burden of disease study 2010

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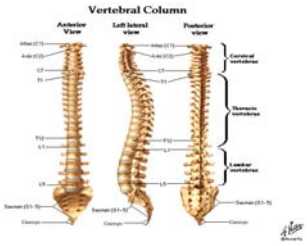
Vertebral (Spinal) Column



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Four Major Sections of the Spine

- Cervical Spine
  - C1-C7
  - Neck problems cause neck pain, headaches and/or arm pain.
  - Function for sense organs (micro mobility over stability)
- Thoracic Spine
  - T1-T12
  - These vertebrae attach to the ribs and sternum giving this area greater stability. Protection of internal organs.

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- Lumbar Spine
  - L1-L5
  - This section bears the majority of the body's weight, therefore, this area is associated with the most spine related problems. Function: mobility, stability and power.
- Sacral Region
  - The sacrum is composed of 5 bony segments fused together. Four bones extend down from the sacrum to form the coccyx.

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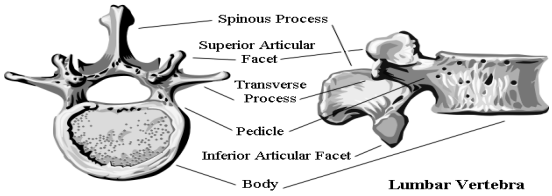
Vertebral Anatomy



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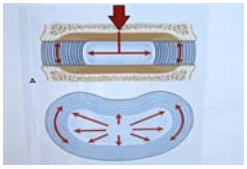
Intervertebral Discs

- Spinal discs are located in between each of the vertebral bodies
- Discs are fibrocartilaginous cushions serving as the spine's "shock absorbers". The disks allow for some vertebral motion.



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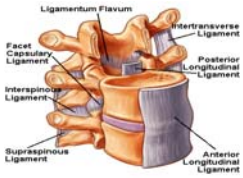
Spinal Ligaments



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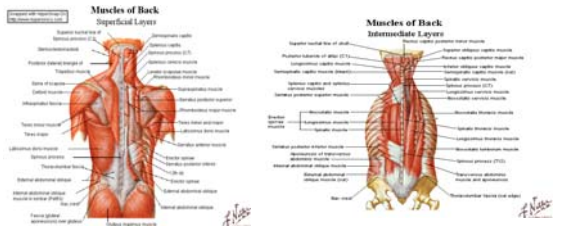
Posterior Musculature



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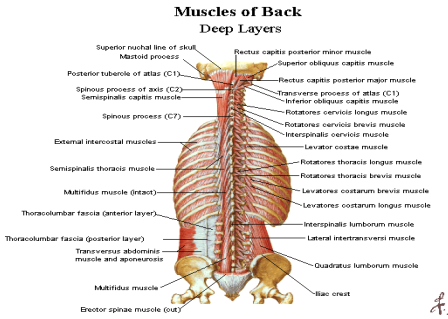

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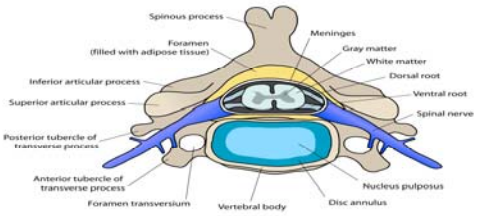
Nerves



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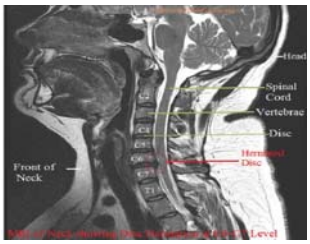
Cervical MRI Anatomy



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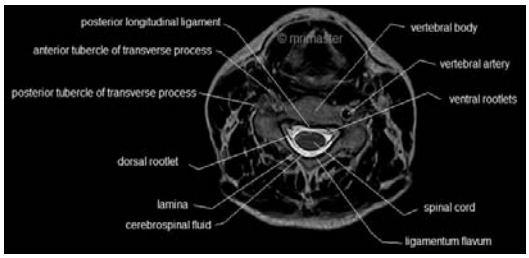

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Lumbar Anatomy/Different Studies

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Physical Exam

- Necessary part of spine assessment
- Determine normal, abnormal and variants of normal
- Correlate exam findings with history and imaging studies for a complete assessment of the patient.

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Cervical Physical Exam

- Gait: assess for ataxia, tandem gait, Romberg test
- Inspection: rashes, moles, hairy patches, atrophy, deformity
- Palpation neck, shoulder, elbow, wrist, scapular, periarticular nodes, cervical nodes, thyroid
- ROM; painful, limited, mechanical, reproducing arm pain or paresthesia,
- Motor exam: C4-T1 C4=shrugs, C5=deltoid, C6= biceps/WE, C7= triceps/flexors
- C8= thumbs up T1= finger abduction
- Sensory exam C4-T1
- Reflexes: biceps= C5/6, brachioradialis=C6, Triceps=C7
- Special tests: Sperlings, cervical compression/distraction, shoulder abduction (reverse 7 sign)
- Clear Shoulder: Speeds test, Hawkins Impingement,
- Clear elbow: epicondylar tests, ulnar nerve test
- Clear wrist: Tinels, Phalens
- Vascular exam: radial pulse

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Lumbar Physical Exam

- Gait: ataxia, antalgia, tandem gait, heal toe walking, Romberg
- Inspection: rashes, moles, hair patches, deformity, shifted
- Palpation: spinous process, interspinous ligaments, paravertebral muscles, SIJ, sciatic notch, trochanter, percussion over spine, cva area
- Rom spine, hips, knees
- Motor exam: L2-S1 L2= hip flexor, L3=Quad L3,4, TA=L4,5 EHL=L5, gastroc=S1
- Sensory L2-S1
- Reflexes: patellar= L3-L4, Achilles=S1
- Clear hip: rom, faber(ant pain), scour, bursitis test
- SIJ: distraction, thigh thrust, faber (post pain)
- Special tests: SLR, femoral nerve tests, stork test(spondylolysis)
- Vascular: pedal pulses

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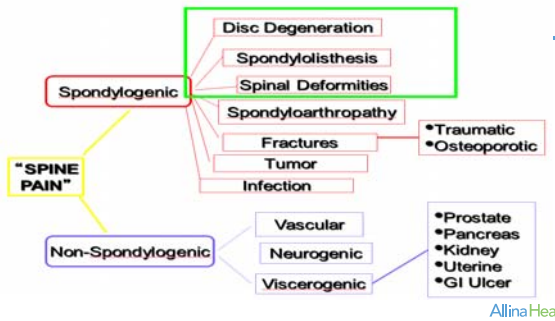
Sources of Spine Pain



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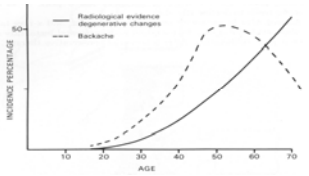
Disc Degeneration

- Low Back Pain is Common
  - 90% lifetime prevalence
- Peak incidence: 35-55 yr
- Self-limiting symptom (not a disease)
  - Most cases of acute back pain resolve spontaneously within a few weeks.
  - **These episodes may be cyclical**

- No Correlation of Pain Severity with the amount of Disc Degeneration



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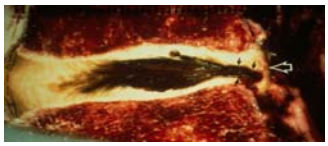
Pathology of Disc Degeneration

- "Dehydration"
- Nucleus Pulpolsus – desiccated, looses is shock absorbing abilities
- Annulus Fibrosis - fissures or tears in the wall of the disc, looses its elasticity
- Sponge analogy



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Stages of Degeneration

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Aggravating Factors –Symptomatic Disc Degeneration

- Repetitive bending, lifting, twisting
- Vibration
- Smoking
- Genetic
- Obesity, sedentary lifestyle
- Occupational factors
- Anxiety/stress/depression

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Outline of Disorders

- Acute back sprain/strain
- Spondylosis
- Spondylolysis
- spondylolisthesis
- Spinal stenosis
- Cervical myelopathy
- Herniated disc
- Ankylosing spondylitis
- Red flag disorders
  - Cancer
  - Discitis
  - Cauda Equina syndrome
  - Fractures
  - Scoliosis

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Acute Low Back Sprain/Strain

- A back strain usually occurs when the muscles surrounding the spine are asked to stretch too far, lift to much weight, or move in such a way that they sustain very small tears. Because if the tearing of the muscles, small microscopic bleeding occurs which in turn results in pain and muscle spasm.

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Acute Back Strain/Sprain

- Strain or sprain to muscles or ligaments that support spine
- symptoms: pain stiffness, local tenderness, sometime shifted torso if disc involvement.
- pain worse with bending, sitting, twisting, coughing, lifting.
- resolves in 2-6 weeks
- self limiting problem

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Strain/Sprain

- Rx: ice, modified activity, NSAIDS, resume activity as tolerated.
- narcotics have limited short term benefit, avoid benzos
- PT, chiropractic
- *X-ray: A/P lateral spine standing (debatable)
- Advanced imaging is not necessary unless red flags
- 90% improve within 4 weeks, but re injury is common.
- Once healing occurs, high level strength, conditioning and body mechanics training for lifting.

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Spondylosis

"Gray Hair of the Spine"

- Generalized term used for spine pathology
- Natural degenerative process "arthritis" "bone spurs"
- affects joints/disc
- inflammation/narrowing
- mechanical back pain
- Can have elements of leg pain/radicular pain

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Spondylolysis

- Defect that occurs in the posterior aspect of the spine called the pars interarticularis. This disorder is essentially a stress fracture.
- Common cause of low back pain in adolescences age 10-16.
- 5% of the general population has this condition with the vast majority being asymptomatic.
- Acute stress fractures occur most common sports such as football, gymnastics and hockey, and more recently weight lifting in the off season.
- Increase prevalence with high level sports and training demands.
- *Kids do not complain of back pain, its a fracture until proven otherwise.
- Stress fracture of the par's interarticularis one or both sides.

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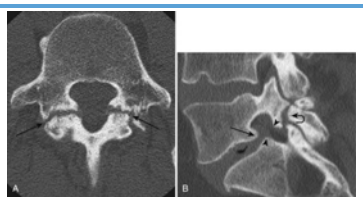
Spondylolysis



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Spondylolysis Exam

- Symptoms: localized back pain, pain with extension, pain to hip or hamstring.
- Findings: hamstring tightness, paraspinal spasm and guarding, pain with palpation, + standing extension test(stork test)
- Work up X-ray A/P, lateral/ Oblique
- If x-ray negative and still strong indication a stress fracture then MRI

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MRI Spondylolysis

- If suspicious get MRI

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Spondylolysis

- Refer to ortho spine
- Initial treatment is forced activity rest and +/- bracing with hopes of the fracture healing. 6wk-3months.
- Progress into exercise with emphasis in trunk and abdominal strengthening after 6weeks of bracing.
- Return to normal activity once healed.

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Spondylolysis can progress to Spondylolisthesis

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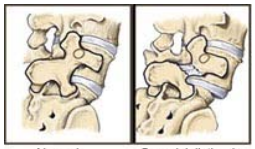
Spondylolisthesis

- This occurs when one vertebrae slips forward on another. This will produce a gradual deformity of the spine but also a narrowing of the vertebral canal and foramen.
- Can be congenital or degenerative or as a result of the lolysis progressing.



Normal Spondylolisthesis

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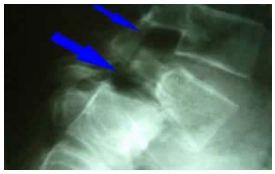

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Spondylolisthesis

- Symptoms: back and leg pain(radicular)
- Hip pain, often mistaken for bursitis
- Mechanical pain transitional activity
- Pain with standing and walking
- Pain worse with end range of motions
- Treatment: NSAIDs, PT, modified activity injections, surgery

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- Radiculopathy is a common problem that results when a nerve root is compressed or irritated. Its often paired with spinal stenosis, disc herniations, and spondylolisthesis
  - Patient complains of pain, numbness, tingling or weakness.
  - Follows a dermatome

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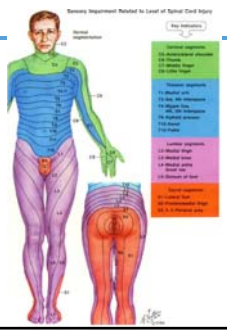
Dermatomes



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Spinal Stenosis

- Spinal stenosis comes from the Greek and means “choking”. In lumbar stenosis, the spinal caudal roots or spinal nerve roots are compressed, and this can produce symptoms of pain, tingling and weakness that radiates into the buttocks and down the legs This can one or both legs.
- Classically, patients state the symptoms are made worse with standing and walking and are relieved when they sit and rest.
- The shopping cart sign-this is the “tell-tail” sign.

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Is it Neurogenic or Vascular?

Table 2. Differentiation of vascular and neurogenic claudication

Signs and symptoms	Vascular	Neurogenic
walking distance	• fixed	• variable
type of pain	• cramps, tightness	• dull ache, numbness
relief at cessation of activity	• immediate	• delayed
back pain	• rarely	• occasionally
pain relief	• standing	• flexion and sitting
posture provocation	• uncommon	• common
walking up hill	• pain	• no pain
bicycle riding	• pain	• no pain
pulses	• absent	• normal
trophic changes	• likely	• absent
muscle atrophy	• rarely	• occasionally

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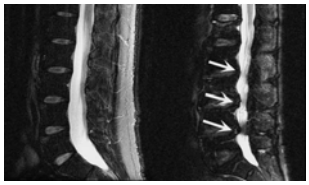

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Spinal Stenosis

- Non-surgical treatment
  - Activity modification. Avoid activities or motion that put the spine in extension or backward bent positions
  - NSAIDS or other oral analgesics.
  - Epidural steroid injections. Typically recommend no more than 3/calendar year.
  - Physical therapy should consist of exercises that emphasize "flexion" type exercises and pelvic tilts.
  - Look at other structures such as hips and knees to improve mobility and function.
  - possible traction type exercises or activity
  - Surgical treatment is a decompression operation to take pressure off the nerves

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Cervical Myelopathy

- Injury to the spinal cord that can be secondary to degenerative changes that cause stenosis, acute disc herniation, trauma or congenital stenosis
- Symptoms: loss of balance, changes to fine motor skills of the hands, weakness, diffuse numbness and tingling in the hands or feet, loss of bowel/bladder function
- Signs: Ataxia, hyperreflexia, clonus, weakness in exam, Babinski test and Hoffman's positive.

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Myelomalacia

- increase cord signal or signal changes on MRI at the level of compression
- Surgical intervention to decompress the cord and prevent progression.

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Disc Herniation

- Most herniations occur in the age group 30-40 years.
- Patient typically describes "sharp, shooting" pain usually down a leg
- Most common location is in the lumbar spine; L4-5 or L5-S1

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Disc Herniation

- If pain is severe and not responding to conservative Rx and time and or neurologic deficit is found, advanced imaging/diagnostics is warranted:
  - MRI

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Disc Herniation

- Treatment modalities:
  - 85-90% of first time disc herniations will resolve within the first 6 weeks to 3 months of onset of symptoms with conservative treatment
  - Initially treated with 1-2 days rest with gradual return to normal activities. Anti-inflammatories, ice, heat
  - Other conservative modalities include: physical therapy, chiropractic, acupuncture, exercise, yoga, injections, etc
  - Surgical treatment is warranted when all conservative measures fail or neurologic deficit is present.
  - IF motor loss on presentation refer to spine specialist.

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Ankylosing Spondylitis

- Seronegative spondyloarthropathy (ie -RF,-ANA)
- +HLA B-27
- Males>females mid 20s.
- Symptoms: pain and **stiffness**, relieved with movement/activity, they can get to sleep but are awaken with night pain
- Inflammatory sacroilitis,enthesis, autofusion from SI to cervical

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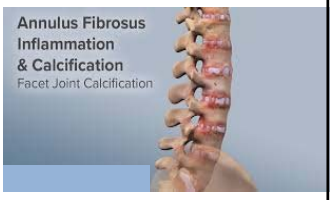
Ankylosing Spondylitis

- The fusion takes place as a reaction to inflammation of ligaments or tendons at the site of attachment to bone. The inflammation causes bone to erode at the site of the attachment, and then as the inflammation subsides, the body's natural healing process causes new bone growths in its place.



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Bamboo Spine

SIJ Autofusion

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AS Treatment

- Early diagnosis is key
- Rheumatology referral
- NSAIDs
- Tumor necrosis factor (TNF) blocker or an interleukin 17 (IL-17) inhibitor
- Mobility exercises, yoga, posture
- Important: ***A patient with known AS falls, and has pain, it is a fracture until proven otherwise.
- CT scan +/- MRI

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Red Flags

- Severe unremitting pain
- Unremitting night pain
- Night sweats
- General malaise
- Trauma
- Unexplained weight loss >10% 3-6 mos
- Bony tenderness
- Multiple myotomal loss
- Immuno-suppressed
- Saddle anesthesia
- Bowel or bladder retention or incontinence
- gait disturbance
- Bandlike pain
- Can't lie supine
- Pins/needles both hands and feet

- PMH of:
- Cancer
- TB or other infections
- IV drug use
- Long-term steroid use
- HIV
- osteoporosis

Also consider:

- Age - < 20 or > 55
- Any previous surgery

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Red Flags by Age Group

- Children don't complain of back pain
- Rare compared to adults
- Must be evaluated
- Painful scoliosis is a red flag (Scoliosis is typically not painful)

- Adolescent
- Tumor
- Infection
- Spondylolysis/fracture (athlete)
- Scheuerman's Disease
- Scoliosis

- Elderly
- Osteoporotic or senility fracture
- Tumor
- Infection

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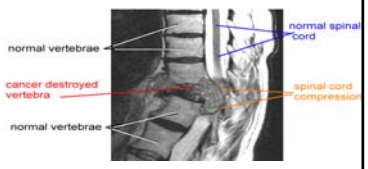
Cancer

- Cancers most commonly seeding metastases to the spine are:
- BREAST, PROSTATE, LUNG
- Mechanism of metastatic disease is via tumor emboli entering the blood stream.
- Multiple Myeloma is the most common primary malignant spinal cancer
- Those with past history of cancer and new spine pain need diagnostic work up



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Infection/Discitis/Osteomyelitis

- Inflammation of disc space, often associated with infection and can co-exist with vertebral osteomyelitis and epidural abscess.
- Most common presentation in lumbar spine, cervical then thoracic.
- Usually haematogenous spread of infection (spine). Urinary tract, lungs and soft tissue are primary sites.
- Staphylococcus aureus is the most common pathogen
- Most common in males >50 y/o 2:1 male to female
- Risk factors: previous spine surgery,immunosuppression, DM, IV drug use, endocarditis, corticosteroid therapy

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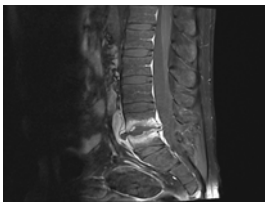
Infection/Discitis MRI



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Infection/Discitis

- Presentation: insidious, severe pain with any movement, fever.
- Labs: ESR,CRP,WBC, blood, sputum, urine culture
- MRI most sensitive
- Biopsy for organism
- Treatment: antibiotics oral/IV, analgesia, often bracing for pain control and surgery of neurological deficits or you can't control the infection.

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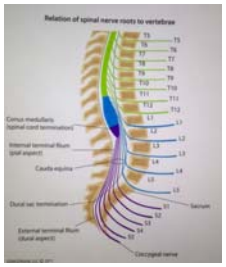
Cauda Equina Syndrome



- Occurs when there is severe compression on the cauda equina (horses tail).
- Medical emergency requiring surgical decompression.

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Cauda Equina Syndrome

- Causes: large central disc herniation spinal lesion or malignant tumor, spinal infection, hemorrhage or fracture
- Varying data but relatively rare .12% , however, need quick diagnosis and intervention when present.
- Symptoms may include: low back pain, pain radiating into both legs, numbness or paralysis in the legs, saddle anesthesia, and bowel and bladder incontinence or retention.
- Exam findings: possible localized tenderness in the low back, diminished deep tendon reflexes in the lower extremities, decreased sensation to light touch in the perineal area and loss of rectal tone, leg weakness and gait disturbances.

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Vertebral Compression Fracture

- Fracture of the vertebrae. Causes may include osteoporosis, trauma, infection and tumors.
- Compression fractures affect 25% of postmenopausal women.
- Be mindful of those fractures at the thoracolumbar junction as left poorly managed can lead to deformity.
- Only 33% of fractures in elderly women are diagnosed. Often misdiagnosed as "arthritis"
- Typical presentation is an elderly female with acute onset of mid to low back pain. This may be traumatic or non traumatic. Fall, lifting, getting out of bed. Acute sharp pain with movement.
- Diagnosis is typically made by plain x-ray studies. Other imaging studies may include: MRI, CT

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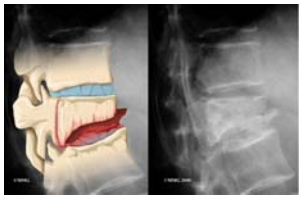
Compression Fractures

- Treatment: majority of moderate to severe compression fractures are treated with immobilization in a brace or corset for a period of six to twelve weeks.
- bracing depends on the type and location of the fracture
- Vertebroplasty: cement to stabilize in some cases
- Surgery:
  - Surgical stabilization for unstable fractures or neurological deterioration.



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Scoliosis

- Scoliosis is defined simply as a curvature of the spine.
- Scoliosis affects 2-3% of the population, or an estimated 6 million Americans.
- Scoliosis affects infants, adolescents and adults.
- Primary age on onset is between 10-15 years.
- 85% of the cases are classified as idiopathic.

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Scoliosis

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Scoliosis

- Diagnosis is made by History and Physical exam and plain x-rays. If underlying neurologic cause is suspected, advance imaging, MRI scan is warranted.
- In the primary care setting, **full spine standing PA/and Lateral X-ray serial follow up essential**
- General guidelines for treatment include:
  - Curves less than 20 degrees = observation
  - Curves between 20-40 degrees= refer to spine surgeon possible bracing
  - Curves greater than 40 degrees= surgical correction.

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Case Vignettes #1

- A 47 y/o construction worker lifts a 70 bag of cement. He reports pain radiating from his back down the back of his left leg to the outside of his left foot. He denies bowel or bladder issues.
- exam: +SLR, weakness during toe raising, loss of sensation on the outside of his foot. His left achilles reflex is sluggish.
- based on the past case vignette what is the most likely diagnosis:
- A: acute spine fracture
- B: disc herniation
- C: simple acute back strain
- D: spondylolisthesis

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Case #2

- A 22 y/o college athlete is doing dead lifts and injures his back. He has localized low lumbar area pain, that is aggravated by activity in particular any kind of extension. His pain is worse 6 weeks later and he is still symptomatic in spite of NSAIDs and modified activity. He wants to get back to his sports. His initial X-ray was unremarkable. His pain now radiates to the buttock and post thigh. Your next step is:
- A. Start vicodin and flexeril for his terrible spasms.
- B: Release him to any activity except contact sports, he's just deconditioned
- C: Order an MRI
- D: Start a PT program with Ultrasound, Estim and exercises

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Case #2 continued

- The MRI shows this
- What is the Diagnosis:
  - A: ankylosing spondylitis
  - B: spondylolysis
  - C: spondylolisthesis
  - D: spondylosis

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Case #2 continued

- Now that I know the patient has an acute/subacute par's fracture/spondylolysis
- my next step is:
- A: refer to an ortho spine specialist
- B: refer to rheumatology
- C: get a back brace for weight lifting
- D: suggest chiropractic adjustments

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Case #3

- 78 y/o Mrs. Johnson with HTN, CAD, CHF has been losing her balance repeatedly over the last 6 months. She falls and bumps her head on the sink. She has a small laceration on the back of her head, no LOC. A head CT is done and reveals no acute intracranial bleed and neck X-rays reveal no obvious fracture. She has moderate spondylosis on X-ray . She is kept overnight for observation and follows up with you in 1 week. During your visit with her, she reports new onset neck pain and worsening unsteadiness and decreased grip strength. Her balance is markedly ataxic, she has local neck tenderness, global 4/5 upper extremity weakness.

- Your next step is:
  - A: get carotid US she might have carotid artery stenosis
  - B: Get a balance assessment to prevent falls
  - C: NSAIDS PT or chiropractic and a neck brace
  - D: Order a cervical MRI and refer to Spine Specialist

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Her Diagnosis Is:

- Whiplash Injury
- Spondylotic Myelopathy
- Osteomyelitis
- Scoliosis

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Case #4

- 68 y/o male with DM, HTN, CAD walks his dog daily for one mile. For the last 3 months his ability to walk has decreased gradually, to now he walks 2 blocks and needs to stop. He describes mild back pain and significant cramping in his legs, burning in his calves that is worse with standing and walking but relieved by resting. Many times the symptoms go away with just standing in place. Your exam shows decrease hair growth and nail changes, decreased pulses, normal motor function, but tight hip girdle. You get a spine X-ray which looks like this

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Next Step

- A: EMG: neuropathy
- B: MRI : spinal stenosis
- C: ABI: PVD
- D: CRP, ESR, HLA-b27
- E: Ortho for hip evaluation

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Case #5

- 55 y/o female with 5 year history of breast cancer is training for the 3 day breast cancer walk. One day while running on the treadmill she has acute low back pain, within a week she has left leg pain and seeks chiropractic care. After her chiropractic adjustment she has excruciating increase in back pain with any kind of movement. Your next step is:
  - A: ice, rest, pain meds, steroids
  - B: lumbar x-ray
  - C: Back brace
  - D: Physical therapy

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X-ray Findings Your Next Step

- A: brace
- B: Refer for vertebroplasty
- C: Start Forteo
- D: MRI

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MRI Findings:

- Pathological fracture L1
- Needs oncology work up
- Spine consult

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Thank you

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