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Plain Film Radiography

- Each case is unique
- First line of imaging in most cases
- Always make decisions based on case history, physical exam and differential diagnosis
- Clinical necessity?
- Will it change your treatment plan?



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Indications

• >50yo

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- History of malignancy- with unexplained new symptoms
- Trauma- significant, recent, repetitive
- Suspected Fractures
- Clinically significant neurological signs and symptoms
- Unexplained weight loss or gain

- Unrelenting night pain
- Suspicion or history of inflammatory arthritis with change in symptoms
- Known or suspected bone density loss – think DEXA
- Prolonged corticosteroid use

Indications cont...

- Fever of unknown origin >100
- Suspected infection- INITIAL imaging of choice
- Recent surgery or invasive procedure related to chief complaint
- Failure to improve without prior radiography
- Substance abuse
- Palpable Mass

- Surgical history at area of chief complaint
- Failed surgery
- Postural abnormalities (scoliosis, kyphosis, short leg...)
- Hypermobility
- Segmental instability
- Recent International travel

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Pregnancy
Financial gain
Patient education
Routine (habitual) radiographic screening and follow up
Research without sanctioned review-board approval
Routine discharge radiography



Computed Tomography

Good for:

- Bony detail
- Chest and Abdomen
- Fractures: Occult or Complex
 MVA
- Crystal deposition disease- more sensitive
- Head injuries (epidural and subdural hemorrhages)



Gold Standard: Chest and

Spinal Stenosis (pacemaker)

Abdominal imaging

Bone destruction

Sinuses

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CT- Contraindications

- Pregnancy
- Children- weigh the options
- Contrast- iodine allergy
 Renal impairment
 Pheochromocytoma
 Myasthenia Gravis

• Weight limit- 485lbs approx.

- Limitations
- Metallic hardware
- Dose



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Magnetic Resonance Imaging MRI

- Good For:
- CNS
- Shows physiology
- Very sensitive <1% marrow change
- Muscle injuryLigament injury

Disc herniation

Metastasis

Central canal stenosis

Marrow infiltrative process-

Multiple Myeloma or

MRI Utilization

- Cord compression-Neurological signs: myelopathy (ie: Bilateral extremity symptoms, hyperreflexia, pain, numbness...)
- Stress fractures- Bone marrow edema
- Avascular necrosis

• <u>Contrast:</u>

- Post surgical- scar tissue ALWAYS
- Tumors

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MRI-Contraindications

- Pacemaker
- Ear implants
- Electronic devices
- Cardiovascular clips
- Machine shop worker
- Claustrophobia
- Some Orthopedic implants
- 1st Trimester of Pregnancy



Musculoskeletal Diagnostic Ultrasound

- Good soft tissue resolution and can evaluate blood flow
- Allows for movement/orthopedic tests during the exam
- Limited at evaluating articular/internal joint structures
- Very limited in the spine
- Very operator dependent
- Open wounds
 - Fracture?-NOT contraindicated because done at high frequency



MISC Imaging...

• Nuclear Medicine

- Shows physiology similar to MRI
- Very sensitive 3-5% marrow change...<u>NOT</u> specific
- DEXA- Dual-energy X-ray absorptiometry
- Bone density

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Also gives body composition



- Very limited application Difficult to reliably interpret
- Many artifacts seen with movement
- High dose
- Digital Motion X-ray- DMX



Sequence	Fat	Water
T1	High - White	Low - Black
Т2	Low - Black (Grey)	High - White
STIR	Very Low - Very Black	High - White

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Denis spinal columns Stability Post-fracture stability is determined based on the classification by Denis • <u>Anterior column</u> – from ALL and anterior 2/3 of body • <u>Middle column</u> – posterior 1/3 of body and PLL • <u>Posterior column</u> – from the PLL to the supraspinous ligament

If two or more compartments are disrupted the fracture complex is <u>unstable</u> – neurological injury is high and interventional surgery is likely

Compression Fractures

- Most common fracture of the lumbar spine
- Result from combined flexion and axial
- Most common at T12-L1
- Degree of compression and comminution depends on severity of the force applied and the strength of the vertebra
- Children torus type fracture
- Incidence increases with age
- Acute symptoms of only 10-14 days duration, if no dislocation

Treatment is based on the nature of the collapse and whether or not there is associated neurological symptomology



Osteoporosis and Compression Fractures

- Precipitates spontaneous compression fractures during everyday activities
- Classified as insufficiency fractures ("grandma fracture")
- Most commonly occur in women
- Up to 35% in female pts. Over the age of 45 years may be the result of early menopause and 30% to secondary osteopenia (corticosteroids 15%, hyperthyroidism 8%, malignancy >2%)

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Lateral radiographs best demonstrate fracture features

Include:

- Step defect
- Buckling and sliding forward of the anterior cortex, usually near the superior vertebral endplate
- Wedge deformity

<u>Anterior</u> loss of height

- Linear zone of condensation
- Sclerotic line represents early site of bone impaction

Displaced endplate

Paraspinal hematoma

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Old vs New Compression Fracture

- Acute < 2 Months Old
- Step defect
- White band of condensation
- Soft tissue hemorrhage
- Bone marrow edema on MRI
- Hot on Bone scan (Remains hot for up to 24 months!

• Old

- Healing of compression fracture can take up to 3 months in the adult spine
- Contiguous disc degeneration Altered biomechanics











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Simple vs Pathologic Compression Fracture

cortex

• Anterior wedge Posterior height is maintained

Preservation of posterior

- Anterior and Posterior Collapse >20% loss posterior
- Pathologic bone
- Mechanism of action
- MRI is indicated and beneficial to evaluate bone integrity





Radiographic Features

- Compression of anterior vertebral body –
 wedge
- Widening of the interpediculate distance
- May see vertical fracture line
- Buckling of posterior vertebral body
 Fragment?





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Chance Fracture

- Seatbelt or Fulcrum Fracture
- Most common upper lumbar spine
 Midlumbar in children
- All 3 columns involved
- Wedge deformity
- Extends through posterior elements
- Flexion Distraction (Seatbelt)
- High Association with intraabdominal injuries
 Pancreas and duodenum





Widening of intepediculate distance (Burst)



Kummel's Disease

- Delayed post-traumatic vertebral collapse
- Caused by complicating avascular necrosis resulting in progressive compression deformity
- Approx 2 weeks following trauma
- Intravertebral vacuum phenomenon may be evident on radiographs

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INCIDENCE OF SPONDYLOLYSIS AND/OR SPONDYLOLISTHESIS • CAUCASIAN: 5-7%

CAUCASIAIN: 5-/70

- AFRICAN AMERICANS: 2%
- ALASKAN ESKIMOS: 40%
- HIGHLY MOTIVATED ATHLETES PERFORMING HYPEREXTENSION: 15%
 GYMNASTS, DIVERS, POLE VAULTERS
- POWER WEIGHT LIFTERS: 40-50%







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Libson E, Bloom RA: Anteroposterior angulated view A new radiographic technique for the evaluation of spondylolysis, Radiology 149:315, 1983.



Tilt up view

- 15-25 ° cephalic tube tilt
- CR half way between umbilicus & pubic ramus (1.5" below ASIS)

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•Tilt up view L/S Jt.





Case Study

A 15-year old son of an orthopedic surgeon presents to a chiropractor with a three month history of low back pain. He has failed his father's treatment of rest, NSAIDs and physiotherapy.



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T2 Weighted Sagittal MRI
 Normal



Parasagittal T2weighted MRI Scan

> - Bone Marrow Edema in the Left Pars

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Parasagittal T2weighted MRI Scan

- Bone Marrow Edema in the Right Pars



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No more SPECT bone scans MRI with STIR (short tau inversion recovery)

Fat suppression technique or Fluid sensitive imaging



Boston Overlap Brace

The Boston Overlap Brace(B.O.B.) is a versatile, lowe priced, easy-to-apply, medium duty, method for treating most indications where back pain is evident. It is highly recommended as an alternative where other bracing methods have been ineffective.

The B.O.B. features a unique anterior opening with a 3"-4" overlap. This is normally made with 1/8" thick low-density polyethylene unlined but can be made with different types of plastic and liner. This permits a wide range of adaptability to a variety of body configurations. The B.O.B. kit includes a premade Velco docume with a formable spring steel inserts for adjustment of abdominal pressure.



EL RASSI, ET AL LUMBAR SPONDYLOLYSIS IN PEDIATRIC AND ADOLESCENT SOCCER PLAYERS AMERICAN JOURNAL OF SPORTS MEDICINE, 33.1688-1693, 2005

 According to Rassi and colleagues, bracing itself, does not determine successful results, whereas physical activity restriction has a higher influence on clinical outcomes. The combination of both physical activity restriction and lumbar bracing – would have a higher impact when the clinical outcome is compared to the use of either alone.

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STEINER AND MICHELI TREATMENT OF SYMPTOMATIC SPONDYLOLYSIS AND SPONDYLOLISTHESIS WITH MODIFIED BOSTON BRACE SPINE:10:937-943, 1985

 According to Steiner and Micheli, clinical outcomes of patients undergoing conservative treatment, along with spinal bracing found that <u>patients</u> wearing the thoracolumbar orthosis obtained a higher functional outcome (acoo% excellent results), compared to those not wearing the braces (68% excellent results). Caution must be taken when attributing this increase function to the use of the thoracolumbar orthoses alone. Patients needing the brace were also patients needing a longer period of physical activity restriction.

 The conclusion is that the reduction in physical activity, rest and the thoracolumbar Boston Overlap Brace will yield the most positive clinical results.









14 year old male football player, severe pain on hyperextension





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 Disc Pressures External load- body weight

Seated - Standing - Supine

 Positional Changes Flexion

Extension

DISC DEGENERATION CLASSIFICATION

- Many classifications exist
- Understanding the morphology of the patients condition is the importance
- Classification is unreliable without imaging









Stress in Lumbar Intervertebral Discs during Distraction A Cadaveric Study

Ralph E., Gay, M.D., D.C.,^{a,b} Brice Ilharreborde, M.D.,^b Kristin D. Zhao, M.S.,^b Lawrence J. Berglund, B.S.,^b Gert Bronfort, D.C., Ph.D.,^c and Kai-Nan An, Ph.D.^b

Distraction decreases disc pressures

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Classification of Disc Lesions

Recommendations of the Combined Task Forces: North American Spine Society American Society of Spine Radiology American Society of Neuroradiology

Adopted by the ACR and ACCR

Fardon DF and Millette PC. Spine 26:E93-113, 2001

2014 updated from 2001 Spine Journal

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Direction

- Anterior herniation
- Not as rare as commonly believed • Much less common than posterior
- Diagnosis often missed as "disc" due to lack of radicular symptoms











Annular Bulge

- Apparent generalized extension of disc beyond the edges of the apophyses
- Greater than <u>50%</u> of the circumference of the disc and extends a relatively short distance, usually less than 3 mm
- More or less used only as a descriptive term of morphology





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Protrusion

- Base of the lesion at the origin is broader than disc material beyond the disc space
- Most commonly seen herniation
- <u>Contained-</u> remains within the PLL/outer annular fibers • <u>Non-Contained</u>- breaks through the PLL/outer annular fibers













Extrusion

• Disc material beyond the disc space is broader than the base

- Most are symptomatic
- Jenson MC, Brant-Zawadski MN et al. MRI of the lumbar spine without backpain. N Engl J Med 1994; 331:69



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Annular tear/fissures

- Separation between fibers, avulsion from vertebral body insertions, breaks through fibers
- May be classified as:
- Circumferential-Concentric
- Radial
- Transverse- Horizontal

Annular fissuring does not imply a traumatic etiology!!!!



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High Intensity Zones (HIZ's)

- ${\scriptstyle \bullet}$ Area of high signal intensity within the disc on T2-weighted MRI's
- May reflect annular fissure
- Not to imply knowledge of etiology, concordance with symptoms, or need for treatment
- Has not been related to instability within the spine



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Annular Fissure- HIZ's

- Studies showing a high correlation between HIZ's and concordant pain with discography
- April, C, Bogduk, N. "High intensity zone": Br. J Radiol 1992; 65:361
- Shellas, K. et al. "Lumbar disc high intensity zone". Spine 1995



























































