A charitable non-profit organization registered in the United States, the United Kingdom and Canada with the goal of helping people with spinal disorders in underserved communities throughout the world.

Third Botswana Spine Care Conference

“Creating a country wide program for the prevention of spine disability”

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North American Spine Society [www.spine.org]
Association of Academic Physiatrists [www.physiatry.org]
The South African Spine Society [www.saspine.org]
The indications for and interpretation of spine imaging in a setting with limited resources

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Indications for spine imaging

• An imaging examination is needed for every patient that can get advantage from it
• The most suitable examination is needed for the suspected condition
• An accurate clinical examination is mandatory
  – Clinician must have enough time to examine the patient, suspect a pathology and ask for the most suitable examination
A self-limited, nonspecific mechanical cause is found in most primary care patients

Serious causes of low back pain are distinctly uncommon

An efficient history and physical examination is mandatory to determine

- the likely cause of the complaint
- whether diagnostic tests are needed
- which treatments are warranted
Accepted International Guidelines

- Radiographic studies and laboratory tests should not be routinely ordered for patients with acute low back pain.
- Referral for physical treatments is appropriate for patients who are not improving with initial conservative care after 2 to 4 weeks.
### Table 1

**Differential Diagnosis of Low Back Pain**

<table>
<thead>
<tr>
<th>Mechanical Low Back Pain</th>
<th>Nonmechanical Spine Disease</th>
<th>Visceral Disease</th>
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<tr>
<td>Lumbar strain or sprain</td>
<td>Neoplasia</td>
<td>Pelvic organs</td>
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<tr>
<td>Degenerative disease</td>
<td>Metastatic carcinoma</td>
<td>Prostatitis</td>
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<tr>
<td>Disks (spondylosis)</td>
<td>Multiple myeloma</td>
<td>Endometriosis</td>
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<tr>
<td>Facet joints</td>
<td>Lymphoma and leukemia</td>
<td>Chronic pelvic inflammatory disease</td>
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<tr>
<td>Diffuse idiopathic skeletal hyperostosis†</td>
<td>Spinal cord tumors</td>
<td>Renal disease</td>
</tr>
<tr>
<td>Spondylolysis†§</td>
<td>Retroperitoneal tumors</td>
<td>Nephrolithiasis</td>
</tr>
<tr>
<td>Spondylolisthesis†</td>
<td>Infection</td>
<td>Pyelonephritis</td>
</tr>
<tr>
<td>Herniated disk</td>
<td>Osteomyelitis</td>
<td>Perinephric abscess</td>
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<tr>
<td>Spinal stenosis</td>
<td>Septic discitis</td>
<td>Vascular disease</td>
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<tr>
<td>Osteoporosis with compression fracture</td>
<td>Paraspinal or epidural abscess</td>
<td>Abdominal aortic aneurysm</td>
</tr>
<tr>
<td>Fractures</td>
<td>Endocarditis</td>
<td>Aortoiliac disease</td>
</tr>
<tr>
<td>Congenital disease</td>
<td>Inflammatory arthritis</td>
<td>Gastrointestinal disease</td>
</tr>
<tr>
<td>Severe kyphosis</td>
<td>Ankylosing spondylitis</td>
<td>Pancreatitis</td>
</tr>
<tr>
<td>Severe scoliosis</td>
<td>Reiter's syndrome</td>
<td>Cholecystitis</td>
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<tr>
<td>Paget's disease</td>
<td>Psoriatic spondylitis</td>
<td>Perforated bowel</td>
</tr>
<tr>
<td></td>
<td>Inflammatory bowel disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Polymyalgia rheumatica</td>
<td></td>
</tr>
</tbody>
</table>
Lumbar spine X-rays

• Pros
  – Fast, no contraindications
  – Bony structures
  – Panoramic
  – Cheap
  – Low radiation
  – Pathologies mimicking LBP as hip and SIJ

• Cons
  – Poor soft tissues discrimination
  – Difficult to be correctly interpreted
Standard Lumbar X-Rays

AP and lateral views (12T to S1)
De Seze (lumbopelvic X-Ray)

Pelvis retroversion
Oblique views

Scottish terrier image

Nose:  tr. process
Eye:    pedicle
Ear:    sup. art. proc.
Neck:   pars.interart.
Fr.leg:  inf. art. proc.
Dynamic imaging

- standing
- flexion
- extension
Sagittal instability

Flexion

Extension

Sagittal Translation (mm) = a - (-b)
Discs shape

Segmental Angulation (degree) = β - (-α)
Lateral bending Lumbar X-Rays
Vertebral alignment

Anterior profile

Spino-laminar line

Posterior profile

Alignment of the spinous processes

Posterior spinous
Lateral view: from C0 to T1

Checkpoints:
- Correct alignment of the vertebrae
- 3 lines
CT

- Facet arthritis
- Pars defects in axial or reformation images
- Stenosis
- Degenerative disc disease
- Bone and soft tissues setting
Soft and hard stenosis
T12-S1 = 7 vertebrae = 750 chest X-ray
MRI

- Most sensitive and most specific to show:
  - disc herniation
  - soft tissues or neurological lesions
  - tumours or infection
  - the biological age of the spine

- Not specific to clinical presentation
  - abnormal MRI scans were found in 30-40% of asymptomatic individuals
    (Boden 1990 - Jensen 1994)
- biological age of the spine
- the physical conditions of the patient
- history of job and trauma of the patient
MRI findings of degenerative disease

- endplate changes
- decreased disc height
- disc signal changes
- disc herniation
- flava and longitudinal ligaments hypertrophy
- central or lateral stenosis
- facet joints arthritis
- Nerve crowding
- Serpiginous aspect of the nerve roots
- Grade 3 muscles fatty atrophy
Infections and tumours

• **X-rays** shows poor performances: Detection: at least 1 cm diameter and 50% bone mineral loss

• **Second level**: (MRI +/- Gad and CT +/- Contrast)

• **Third level**: PET-SCAN
Imaging metastatic cascade

- Sensitivity
  - MRI
  - Bone Scan
  - CT Scan
  - Standard radiogram
Where’s the lesion? 
L3?  L4?  L5?  S1?

- **X-Ray:** Low sensitivity
  - Detection: at least 1 cm diameter and 50% bone mineral loss
  - Up to 40% of false-negative
Xrays
semiotics

- Winking Owl lesion
- Cortex erosion
- Trabecular defects
  - Hypodensity
  - Hyperdensity
X-Ray semiotic

- Lytic
- Osteoblastic
- Mixt

- Cortical bone
- Pedicles
- Trabecular bone
Xrays

Osteoblastic mets from prostate carcinoma
Infections
Plain radiographs are one of the first imaging modality when infection is suspected; however, negative radiographic findings do not exclude infection.

No changes in the first 3 weeks, even as clinical and laboratory markers are emerging.
Radiological semiotic

fourth - sixth week

• disc space narrowing
• endplate changes: erosions - sclerosis
• paravertebral soft tissue shadows due to paravertebral abscess.
• loosening around the implants
Lateral plain radiograph of a patient with recurrent back and leg pain 3 weeks after a percutaneous diskectomy at L3–L4.
Same patient 3 weeks later

- disc space narrowing
- endplate changes
  - erosions
  - sclerosis
Multiple localizations: MRI + Gad
MRI signal patterns

Bony lesions
- Low T1
- High T2 and FS

Abscesses
- Medium/low T1
- High T2 and FS

Sensitivity 96%
Specificity of 92%
Accuracy of 94%

(Kishore et al 2002)
MRI signal patterns

Gd-DPTA

- Intraosseous abscess
- Paraspinous abscess (ring enhancement)
- Involvement of
  - Dura
  - Ligaments
  - Subligamentous spread
  - Identification of more active lesions for biopsy.
Epidural abscess
Subligamntous spread
Diagnostic imaging in individuals with LBP should only be used if the results of the image lead to a clinical decision that results in improved patient outcomes.

This statement appears both logical and obvious; however, data suggest that in the current US healthcare system this is not the guiding principle.

Journal of the American College of Radiology:

- 26% of medical images ordered were inappropriate
- 53% inappropriate referral rate for CT
- 35% inappropriate referral rate for MRI
We are treating MRIs, not pathology adapting MRI to clinical findings.

(A) Trends in lumbar MRIs
(B) Lumbar fusions in the Medicare population.

Used with permission from Deyo et al.
The potential harm associated with overimaging of lumbar spine in patients with LBP includes:

- radiation exposure (lumbar radiographs and CT)
- exposure to iodinated contrast (CT)
- increased risk of surgery (MRI)

In 2007, 2.2 million lumbar CT scans were performed in the US.

- Based on the radiation exposure patients received, these CT scans were projected to cause **1200 additional future cancers**
Low Back – Neck Pain

• Affects more frequently elder people
• Degenerative spine condition is the rule not the exception
• Most LBP and imaging signs resolve spontaneously
• Imaging always shows
  – biological age of the spine
  – the physical conditions
  – history of job and trauma of the patient
Conclusions

- Start the imaging process...with an accurate clinical examination
- X-ray imaging is the first step
- MR imaging is the second step for discs, cord, etc., assessment
- CT is the third step
  - *Prescribing a CT you give radiation to the patients, be sure that it is necessary*
Conclusions

• When used appropriately diagnostic imaging is an important component of patient care in individuals with low back complaints.
• The inappropriate use of spine imaging
  • increases the risk of patient harm
  • contributes to the large increases in healthcare costs both directly and creating illness
• Appropriateness must lead the clinical approach