Orthopedic Examination of the Spine, Pelvis, and Extremities, DX 611
Clinical Assessment Protocol

James J. Lehman, DC, MBA, DABCO
University of Bridgeport College of Chiropractic
This lecture and laboratory course introduces students to the procedures necessary to examine the neuromusculoskeletal system. Normal and abnormal findings are presented and discussed. An emphasis is placed on a student's understanding of clinical anatomy and interpretation of positive tests and signs.

2 lecture hours, 4 laboratory hours, 4 semester hours
Life-Long Learners
Orthopedics
Clinical assessment protocol

- Patient history
- Inspection and observation
- Palpation
- Range of motion

- Orthopaedic and neurologic testing
- Diagnostic imaging
- Functional testing
Orthopedics
Clinical assessment protocol

- **Subjective**: Patient history
- **Objective**: Objective findings
- **Assessment**: Diagnoses
- **Plan**: Further testing or treatment
Closed-Ended History
Patient completes an intake form with direct and pointed questions.

Open-Ended History
An open dialogue to discuss the patient’s condition.
Closed-Ended History
Completion of an intake form by patient
Open-Ended History
Doctor records medical history
Orthopedics
OPQRST Mnemonic

- Onset of complaint
- Provoking or palliative concerns
- Quality of pain
- Radiating to a particular area or referred
- Site and severity of complaint
- Time frame of complaint
Orthopedics
Observation

- General appearance
- Functional status
- Body type
- Postural deviations
General Appearance

Obese, middle-aged, Caucasian female
Functional Status
Athletically active adults
Body Type and General Appearance
Young, healthy appearing, mesomorphic, male Caucasian
Body Type
Mesomorph
Body Type
Endomorph
Body Type

Ectomorph
Postural Deviations

Young, healthy appearing, mesomorphic, black female with scoliosis
Postural deviations
- Gait
- Muscle guarding
- Compensatory or substitutive movements
- Assistive devices for functional status
Posture Deviations

Antalgic posture with limping gait
Orthopedics
Inspection

- Skin
- Subcutaneous soft tissue
- Bony structure
Orthopedics
Skin Inspection

- Contusions or cicatricial formations
- Evidence of trauma or surgical intervention
- Changes in color or texture
- Open wounds
Skin Inspection
Post-surgical thoracic spine cicatriz formations
Skin Inspection
Contusions from “Kinetic Impact Munitions”
Orthopedics
Subcutaneous Inspection

- Inflammation and swelling or atrophy
  - Compare for bilateral symmetry
  - Circumferential mensuration of extremities
Orthopedics
Subcutaneous Inspection

- Increase in size
  - Edema
  - Articular effusion
  - Muscle hypertrophy or other
  - Note nodules, lymph nodes, or cysts
Subcutaneous Inspection

Pitting Edema
Subcutaneous Inspection

Articular effusion
Orthopedics
Bony Structure Inspection

Evaluate

- Functional abnormality
  - Gait deviation
  - Altered range of motion
Orthopedics

Bony Structure Inspection

Evaluate

1. Spine
   - Scoliosis
   - Pelvic tilt or obliquity
   - Shoulder height
Bony Structure Inspection
Scoliosis examination
Orthopedics
Bony Structure Inspection

- Note and possibly measure extremity malformations
  - Traumatic
    - Healed Colles’ fracture with residual angulation
  - Congenital
    - Genu varus or Genu valgus
Colles Fracture
Bony Structure Inspection

Colles Fracture
Wrist Fractures

Flexion fracture of the radius (Smith's fracture)

Extension fracture of the radius (Colles' fracture)
Orthopedics
Bony Structure Inspection

- All bony structures should be visually assessed for abnormalities and documented
Orthopedics

Skin palpation

Palpation with light touch

1. Temperature
   1. Elevated with inflammation
   2. Lowered with vascular deficiency

2. Mobility
   1. Post-traumatic or post-surgical adhesions
Orthopedics
Subcutaneous soft tissue palpation

Palpation with increased pressure

1. Consists of fat, fascia, tendons, muscles, ligaments, joint capsules, nerves, and blood vessels
2. Note tenderness
3. Determine tenderness and grade it
Orthopedics
Tenderness Grading Scale

- Grade I
- Grade II
- Grade III
- Grade IV

- Pain
- Pain and winces
- Winces and withdraws
- Does not allow palpation
Orthopedics

Differentiate types of edema

1. Blood

2. Synovial fluid

1. Immediate post-traumatic warm and hard

2. 8-24 hours post-traumatic, boggy or spongy
Orthopedics
Differentiate types of edema

3. Callus
4. Chronic swelling
5. Acute
6. Bone
7. Pitting edema

3. Tough and dry swelling
4. Thickened or leathery
5. Soft and fluctuating edema
6. Hard
7. Thick and slow moving edema
Orthopedics

Pulse palpation

- Thoracic outlet syndrome
- Arterial insufficiency
Orthopedics

Palpation of bony structures

- Alignment problems
  - Dislocations
  - Luxations
  - Subluxations
  - Fractures
Orthopedics

Palpation of bony structures

- Tenderness is a major finding
  - Identify tendons and ligaments
  - Sprain, strain, or fracture
Orthopedics

Palpation of bony structures

- Bony enlargements
  - Healing of fractures
  - Degenerative joint disease
Orthopedics
Range of Motion

1. Passive
2. Active
3. Resisted
Orthopedics
Passive Range of Motion

Examiner moves the body part
1. Note normal, increased, or decreased ROM and in which planes
2. Note pain
   - Ipsilateral pain = capsular or ligamentous lesion
   - Contralateral pain = Muscular lesion
Passive Range of Motion
Orthopedics

Active Range of Motion

Patient moves body part
- Tests muscle integrity and nerve supply
- Compare ROM
- Correlate pain with movement
- Note crepitus (crackling)
Active Range of Motion
Orthopedics
Active Range of Motion

- Crepitus is crackling sound
- Indicates
  - Roughening of joint
  - Increased friction between tendon and sheath caused by edema or roughening
Orthopedics
Active Range of Motion

- You will be required to utilize goniometer but not an inclinometer.
- Medical conditions involving impairment ratings or disability determinations require specific mensuration.
Orthopedics
Resisted Range of Motion

- Examiner resists patient movement
- Assesses musculotendinous and neurologic structures
- Primarily used to test neurologic function
Resisted Range of Motion
Orthopedics
Resisted Range of Motion

- Musculotendinuous injuries are more painful than weak
- Neurologic lesions are more weak than painful
Orthopedics
Six Ranges of Motion and Pain Variations

1. Normal mobility with no pain
2. Normal mobility with pain elicited
3. Hypomobility with no pain
4. Hypomobility with pain elicited
5. Hypermobility with no pain
6. Hypermobility with pain elicited
Orthopedics
Hard End Feel Evaluation

Normal Physiological

- Abrupt hard to stop movement when bone contacts bone
- Passive elbow extension
- Olecranon process contracts the olecranon fossa
**Orthopedics**

**Hard End Feel Evaluation**

**Abnormal Pathologic**

- Abrupt stopping movement before normal expected passive movements
- Cervical flexion hard end feel due to severe DJD
Orthopedics
Soft End Feel Evaluation

**Normal**
- When 2 body surfaces come together, a soft compression of tissue is felt
- Passive elbow flexion
- Anterior aspect of the forearm approximates the biceps muscle
Orthopedics

Soft End Feel Evaluation

Abnormal

- A soft boggy sensation resulting from synovitis or soft tissue edema
- Ligamentous sprain
Orthopedics
Firm End Feel Evaluation

Normal

- A firm or spongy sensation that has some give when a muscle, ligament, or tendon is stretched
- Passive wrist flexion, passive external shoulder rotation
Orthopedics
Firm End Feel Evaluation

Abnormal

- A firm springy sensation to movement with a slight amount of give in capsular joints
- Frozen shoulder or adhesive capsulitis
Orthopedics
Springy, Block End Feel Evaluation

Abnormal Pathologic End Feels

- Rebound effect with limited motion; usually in joints with a meniscus.
- Torn meniscus
Orthopedics
Empty End Feel Evaluation

Abnormal Pathologic End Feel

- An empty feel in a joint with severe pain when passively moved. The movement cannot be performed because of the pain.
- Fracture, subacromial bursitis, neoplasm, joint inflammation.
Orthopedics

Special physical, orthopaedic, and neurologic testing

- Provocative maneuvers
- Place functional stress on isolated tissue structures
- Reveal pathologies and biomechanical lesions
- Multiple tests are necessary to confirm a diagnosis
Orthopedics

Special physical, orthopaedic, and neurologic testing

- “Primum non nocere”
- First do no harm
- Prior to performing provocative maneuvers it is essential that you rule out contraindications to such procedures.
"Declare the past, diagnose the present, foretell the future; practice these acts. As to diseases, make a habit of two things — to help, or at least to do no harm."
Hippocrates
Father of Chiropractic Medicine
Orthopedics
Special physical, orthopaedic, and neurologic testing

- Rust’s sign
- Post-traumatic holding of head with both hands in order to support the weight of the head on the cervical spine.
- Supine patient will grasp back of head while attempting to rise into a seated position
Rust’s Sign

Do not perform orthopedic tests or spinal manipulation
Orthopedics

Special physical, orthopaedic, and neurologic testing

- Rust’s sign indicates a probable upper cervical spine instability
- Severe upper cervical spine injury to muscle, ligament, disc, and osseous structures
- Rule out fracture, dislocation, severe strain or sprain
Orthopedics

Special physical, orthopaedic, and neurologic testing

- Rust’s sign
- Patient is attempting to stabilize the head with slight traction and reduce pain
- Patient presents guarded movements
- Imaging studies must proceed any provocative testing
Orthopedics
Special physical, orthopaedic, and neurologic testing

- Sensitivity/Reliability Scale
- Based upon the biomechanics of the movement to isolate the affected structures
Orthopedics
Special physical, orthopaedic, and neurologic testing

- Sensitivity is the proportion of true positives that are correctly identified by the test.
- Specificity is the proportion of true negatives that are correctly identified by the test.
### Sensitivity and Specificity

Instability (Rust’s sign)

<table>
<thead>
<tr>
<th></th>
<th>Abnormal</th>
<th>Normal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>VFS (+)</td>
<td>90</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>Abnormal (+)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (-)</td>
<td>20</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>90</td>
<td>200</td>
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</table>
Sensitivity and Specificity

The proportions of these two groups that were correctly diagnosed by the sign were

\[
\frac{90}{110} = 0.82 \text{ (sensitivity)} \quad \text{and} \quad \frac{80}{90} = 0.89 \text{ (specificity)}
\]
Predictive Values

"Given a positive (or negative) test result, what is the new probability of instability?"
Predictive Values

Positive predictive value = probability of instability among patients with a positive test
Predictive Values

Negative predictive value = probability of no instability among patients with a negative test
## Predictive Values

http://www.poems.msu.edu/EBM/Diagnosis/PredictiveValues.htm

<table>
<thead>
<tr>
<th></th>
<th>With instability</th>
<th>Without stability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test is Positive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a(90)</td>
<td>b(10)</td>
</tr>
<tr>
<td><strong>Test is Negative</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c(20)</td>
<td>d(90)</td>
</tr>
</tbody>
</table>
Predictive Values

We can now define positive and negative predictive value

- Positive predictive value = $a / (a+b)$
- Negative predictive value = $d / (c+d)$
- Post-test probability of instability given a positive test = $a / (a+b)$
- Post-test probability of instability given a negative test = $c / (c+d)$
Predictive Values

We can now define positive and negative predictive value

- Positive predictive value = \( \frac{90}{(90+10)} = 90\% \)
- Negative predictive value = \( \frac{90}{(20+90)} = 82\% \)
- Post-test probability of instability given a positive test = \( \frac{90}{(90+10)} = 90\% \)
- Post-test probability of instability given a negative test = \( \frac{20}{(20+90)} = 18\% \)
Bone is best-seen tissue on plain film radiography
Standard Plain Film Radiograph
Computed Tomography

- CT is best used for bone detail and demonstration of calcifications.
- Intervertebral disc defects may also be visualized on CT, but not as well as MRI.
CT Scan
Magnetic Resonance Imaging

- MRI is invaluable in contrasting soft tissue structures in many planes without the use of ionizing radiation.
- It poorly demonstrates bone density detail or calcifications; this is the advantage of CT.
Myelography

- Water-soluble contrast medium is injected into the subarachnoid space
- Standard radiographic exposure is used to evaluate any defects of the spinal canal
- Spinal stenosis, spinal cord lesions, and dural tears
Skeletal Scintigraphy or Bone Scans

- Intravenous radiopharmaceutical, technetium-99m
- Attracts osteoblastic activity, such as healing fractures
- Best suited for undetectable fractures and arthropathies (DJD, osteomyelitis, bony dysplasias, primary bone tumors, and METS)
Clinical Assessment Protocol
Final Slide