Part I
Introduction

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Population Screening Definition

“The presumptive identification of unrecognized disease or defect by the application of tests, exams or other procedures which can be applied rapidly to sort out apparently well persons who probably have a disease from those who probably do not” (Commission on Chronic Illness, 1957)*

General Examples

- PSA (Prostate-Specific Antigen (PSA) is given to >50 years of age (↑sensitivity)
  Biopsy is used as confirmatory test (↑specificity)
- ELISA (ELISA test is mainly used to screen for HIV infection in blood donors and for general surveillance (↑sensitivity) Western Blot and PCR are used as confirmatory tests (↑specificity)

Clinical Screening-Definition

- Clinical screening involves the use of special tests or standardized examinations in order to identify individuals needing special intervention (e.g. referral out, structural identification, ruling out disorders (Yun, 2005).
Clinical Examples

• Canadian C-Spine Rules are used to determine who doesn’t need an x-ray (↑sensitivity-99%) X-ray is used to diagnose fracture (↑specificity)
• Ottawa Ankle Rules are used to determine who doesn’t need an x-ray (↑sensitivity) X-ray is used to diagnose fracture (↑specificity)

Criteria for Screening

• Significant burden of disease in population either in prevalence or morbidity/mortality.
• Pathology screened has high prevalence (↑5%)
• Pathology has a pre-clinical phase (onset of disease to the first appearance of symptoms)
• Screening tests are inexpensive to administer.

Criteria for Screening

• Screening tests should be relatively accurate and should not routinely identify pseudo-diseases (sensitivity vs. specificity)
• Screening causes little morbidity
• Screening tests should have high sensitivity
  – For clinical structural tests (typically >90).
  – For pathological processes in medicine (typically >95-99)
  – For mundane slow acting diseases with low morbidity (>65)


Special Test has been Tested

• Study is free from bias (QUADAS)
• Study was performed in pre-clinical phase
• Test is repeatable and has clinical utility
• The test makes clinical sense


QUADAS

• (Quality Assessment of Diagnostic Accuracy Studies)
• 14 items
  – 1. Appropriate selection of patient spectrum
  – 2. Appropriate reference standard
  – 3. Absence of review bias (both test and diagnostic)
  – 4. Clinical review bias
  – 5. Reporting of ininterpretable/ indeterminate/ intermediate results

Whiting et al. BMC Medical Research Methodology. 2003, 3:25

Consider Prevalence

• Prevalence is the proportion of people in the entire population who are found to be with disease at a certain point in time
• Point, interval, and location prevalence can be very useful for non-fatal conditions.
  – (Point) The chance of correctly and routinely identifying ALS is low because the prevalence is low (proportion at a given time)
Prevalence

• (Interval) Up to 3% of individuals over the age of 60, with neck pain, have cord compressive myelopathy
• (Location) Prevalence of obesity (BMI>30%) is 22% in Australia, 34% in USA, 3% in Japan, 5% in China
• (Location) Prevalence of an ACL injury at a weekend sports screening versus a Geriatric Health Care Fair

Consider Incidence

• Incidence is a rate, showing how many new cases of a disease occurred in a population during a specified interval of time (usually expressed as number of new cases per unit time per fixed number of people; e.g., number of new cases of cancer per 10,000 persons in one year).

Incidence may relate to populations and prevalence

• # of new cases…….
• HIV is more common in young homosexual men than older heterosexual Women
• Cervical myelopathy is more common in Asians than African Americans.
• Rotator cuff tears are more common in patients 60 and older than 20 and younger

Consider Disease Natural History

• Some disease processes lack signs and symptoms to allow testing (tests lack accuracy) (Osteochondral lesion)
• Some conditions do not have definable symptoms that are homogenous and discreet from other (SIJ dysfunction)

Consider Disease Natural History

• Some conditions do not exhibit symptoms in early stages thus are not caught on a clinical examination (degenerative meniscus of the knee)
• Some conditions have such low prevalence, that good tests will never identify their presence (Maroteux-Lamy Syndrome)

Natural History Screening for Signs and Symptoms
Onset of Disease
Critical Point For Detection
Clinical Signs And Symptoms Too Late

Pre-Clinical Phase
 Detectable Pre-Clinical Phase
Clinical Phase

How many Clinical Special Tests have the capacity to detect the presence of a disease in the absence of clinical signs and symptoms?


Beneficial for PT's?
- Reduces risk of contraindicated treatment
- Improves ability to identify risks as entry point provider
- Identifies “Red Flags” prior to dedicated care
- Allows structural differentiation and targeting of appropriate segment/region

Ask Yourself-Am I Using the Most Effective Screening Tool?
- Is the test accurate?
- Is the test reliable?
- How likely is the finding prevalent?
- Who is more likely to have the problem that we are screening for?
- How likely are we to identify symptoms at a given time?
- Is there a better process I should follow?

Diagnostic Accuracy of the Clinical Exam:
What Factors are Important in Screening Tests?

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Diagnostic Utility of Clinical Tests
- Judge evidence for diagnostic tests, select the most appropriate test for an individual patient, and interpret the results.
- The need to become familiar with skills of physical therapy diagnosis is to become a more evidence-based process.

Diagnostic Accuracy
- Each time a clinical test is performed we must understand how the results of the test compare with the truth.
- This is determined by comparing the test results with a measure of the truth.
- So- how do we do this?
Relevant clinical population

Compare the Results

“The optimal design for assessing the accuracy of a diagnostic test is a prospective blind comparison of the test with a reference standard in a consecutive series of patients from a relevant clinical population”

(Lijmer et al, 1999)

Diagnostic Test Characteristics

Definition: Prevalence

- Prevalence
  - The percentage of patients who truly have the condition in the sample studied

- Value: provides an estimate of the probability that an individual will have a particular condition

Contingency Table

<table>
<thead>
<tr>
<th></th>
<th>Reference Standard Positive</th>
<th>Reference Standard Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic Test</td>
<td>True Positive Result</td>
<td>False Positive Result</td>
</tr>
<tr>
<td>Positive</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>False Negative</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>Diagnostic Test</td>
<td>False Positive Result</td>
<td>True Negative Result</td>
</tr>
<tr>
<td>Negative</td>
<td>A + C</td>
<td>B + D</td>
</tr>
</tbody>
</table>

Example

Hoffman’s Test Positive

- Myelopathy Present: A=13 (True Positive)
- Myelopathy Absent: B=3 (False Positive)

Hoffman’s Test Negative

- Myelopathy Present: C=37 (False Negative)
- Myelopathy Absent: D=47 (True Negative)
**Definition: Sensitivity**

- **Sensitivity**
  - Test's ability to obtain a positive test when the target condition is really present
  - True Positive Results
  - Calculated as: $\frac{A}{A + C}$

**Definition: Specificity**

- **Specificity**
  - Test's ability to obtain a negative test when the target condition is really absent
  - True Negative Results
  - Calculated as: $\frac{D}{B + D}$

**SnNouts and SpPins**

- Mnemonics to remember the most useful aspects of tests with moderate to high sensitivity and specificity
  - **SnNout**: A test with a high sensitivity value (Sn) that, when negative (N), helps to rule out a disease (out)
  - **SpPin**: A test with a high specificity value (Sp) that, when positive (P) helps to rule in a disease (in)

**100% Sensitivity**

![Image of 100% Sensitivity]
100% Specificity

Myelopathy Example

- Sensitivity: = 26%
- Specificity: = 94%

<table>
<thead>
<tr>
<th></th>
<th>A=13 (True Positive)</th>
<th>B=3 (False Positive)</th>
<th>C=37 (False Negative)</th>
<th>D=47 (True Negative)</th>
</tr>
</thead>
</table>

So is this a good test for screening for myelopathy?

Is it important for a Screening Test to have High Sensitivity or Specificity?

| SnOUT: If Sensitivity is high, a negative test will rule the disorder OUT. |

Does This Patient Belong in My Clinic???

Red Flags

<table>
<thead>
<tr>
<th>Cervical Myelopathy</th>
<th>Neoplastic Conditions</th>
<th>Upper Cervical Ligamentous Instability</th>
<th>Venous Artery Insufficiency</th>
<th>Inflammatory or Systemic Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory disturbance of the hands</td>
<td>Age over 65 years</td>
<td>Occipital headache and numbness</td>
<td>Drop attacks</td>
<td>Temperature &gt; 38°C</td>
</tr>
<tr>
<td>Muscle wasting of hand intrinsic muscles</td>
<td>Previous history of cancer</td>
<td>Breathlessness during neck AROM in all directions</td>
<td>Dizziness (light-headedness related to neck movement)</td>
<td>SBP &gt; 150/95</td>
</tr>
<tr>
<td>Unsteadiness gait</td>
<td>Unexplained weight loss</td>
<td>Signs of cervical myelopathy</td>
<td>Dysarthria</td>
<td>Muscle cramping</td>
</tr>
<tr>
<td>Hoffmann’s reflex</td>
<td>Constant pain, no relief with bed rest</td>
<td>Signs</td>
<td>Dysphagia</td>
<td>Progressive</td>
</tr>
<tr>
<td>Hyporeflexia</td>
<td>Right arm paresthesia</td>
<td>Sensation</td>
<td>Positive cranial nerve sign</td>
<td>Severe constipation</td>
</tr>
<tr>
<td>Muscle and bladder disturbances</td>
<td>Severe limitation during neck movement</td>
<td>Fine motor weakness</td>
<td>Positive sensory, motor signs</td>
<td>Multisegmental weakness and/or sensory changes</td>
</tr>
<tr>
<td>Multifocal weakness and/or sensory changes</td>
<td>Signs of basilar bony erosion</td>
<td>Signs of cervical myelopathy</td>
<td>Positive sensory, motor signs</td>
<td>Signs of cervical myelopathy</td>
</tr>
</tbody>
</table>

- Occipital headache and numbness
- Breathlessness during neck AROM in all directions
- Signs of cervical myelopathy
- Drop attacks
- Dizziness (light-headedness related to neck movement)
- Dysarthria
- Dysphagia
- Positive cranial nerve signs
- Temperature > 38°C
- SBP > 150/95
- Muscle cramping
- Positive sensory, motor signs
- Signs of cervical myelopathy
- Signs of basilar bony erosion
- Signs of cervical myelopathy
Screening for Ankle Fractures: Example

Your patient is a 26 year-old male who turned his ankle playing basketball last night. He has been able to walk on it with a pronounced limp. There is substantial swelling and discoloration. He complains of pain about the lateral malleolus.

EXAMPLE: Ankle radiographs

Do you need to get an x-ray?

Decision to Order X-Rays

100

Degree of Certainty

0

Action – No X-Ray (how certain would you need to be?)

Ottawa Ankle Rules

Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: systematic review

Conclusion Evidence supports the Ottawa ankle rules as an accurate instrument for excluding fractures of the ankle and mid-foot. The instrument has a sensitivity of almost 100% and a modest specificity, and its use should reduce the number of unnecessary radiographs by 30-40%.
Do you need to order x-rays?

You presume he has a 25% chance of having a fracture.

– The patient is positive on the OAR
  • Revised probability of fracture: 35.3%
– The patient is negative on the OAR
  • Revised probability of fracture: 0.99%

SnNout

Identification of a Fibular Fracture in an Intercollegiate Football Player in a Physical Therapy Setting

Dorothy Lee Que, MPT, OCS, ATC
Jared H. Authors, PE, PhD, OCS, ATC
Daniel T. Thomas, MD
Thomas M. DeRusso, MD

• 20 year-old male
• Left ankle injury sustained during a football game
• Moderate edema
• Limited ROM
• Unable to WB
• Tenderness over posterior fibula

Screening for Knee Fractures: Another Example

March 13, 2004: A 9-year-old girl had injured her left knee in a gymnastics event the evening before. She was performing a front flip and heard a pop in her knee as she landed. She reported immediate pain in the left knee and was unable to walk. She had not been seen by another medical professional.

Clinical question: Is radiologic examination necessary for a 9-year-old girl with a knee injury?

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Joshua A. Cleveland, PT, DPT, OCS, is Assistant Professor, Physical Therapy Program, Franklin Pierce College; Physical Therapist, Rehabilitation Services of Concord Hospital, Concord, NH; and Fellow, Manual Therapy Program, Regis University, Denver, Colo.

Clinical Question?

Ligament?
Meniscus?
Fracture?

Is diagnostic imaging necessary on a 9-year-old female presenting with anterior knee pain in a direct access setting?
The Ottawa Knee Rule

A knee x-ray series is only required for knee injury patients with any of these findings:

1. Age 55 years or older
2. Isolated tenderness of patella *
3. Tenderness at the head of fibula
4. Inability to flex to 90°
5. Inability to bear weight both immediately and in emergency department (4 steps)**

* No bone tenderness of knee other than patella
** Unable to transfer weight twice onto each lower limb regardless of limping.

Can we apply the OKR to our patient?

- Originally derived by Steil et al (*Ann Emerg Med*)
- Numerous validation studies have demonstrated the accuracy of the OKR
- The probability of a fracture after a negative OKR was 0.37%
- Of the 4249 patients, 5 had a false negative

OKR in Children

- Bulloch et al (*Ann Emerg Med*)
- 750 children age 2-16 (Mean 11.8) who had sustained a traumatic knee injury within 7 days
- 70 fractures, all which were detected using the OKR: 100% sensitivity

...back to our patient.

- Patient was tender to palpation at the distal 1/4 of the patella.
- Patient was unable to walk secondary to reports of pain.

X-ray revealed a transverse fracture across the inferior aspect of her patella.

SnNout

So What is all the Talk about Likelihood Ratios?
Likelihood Ratios

- Reflects a combination of the information contained in sensitivity and specificity values into a ratio that can be used to quantify shifts in probability once the diagnostic tests results are known.
- Positive likelihood ratio (LR+)
- Negative likelihood ratio (LR–)

Where do likelihood ratios come from?

- In some happy (though rare) instances, investigators or test developers provide them.
- Much more commonly, we have to calculate them for ourselves.
- Luckily, these are very simple calculations when you understand 2X2 tables.

Definition: LR of a positive test result (LR+)

- LR Positive Test Result (LR+)
  - The ratio of the true positive rate to the false positive rate
  - Calculated as: \( \frac{\text{sensitivity}}{1 - \text{specificity}} \)
  - Value: Indicates the increase in odds favoring the condition given a positive result

Definition: LR of a negative test result (LR–)

- LR Negative Test Result (LR–)
  - The ratio of the false negative rate to the true negative rate
  - Calculated as: \( \frac{1 - \text{sensitivity}}{\text{specificity}} \)
  - Value: Indicates the change in odds favoring the condition given a negative test result

<table>
<thead>
<tr>
<th>+LR</th>
<th>-LR</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 10</td>
<td>&lt; .1</td>
<td>Large and conclusive shifts in probability</td>
</tr>
<tr>
<td>5-10</td>
<td>.1-.2</td>
<td>Moderate shifts in probability</td>
</tr>
<tr>
<td>2-5</td>
<td>.2-.5</td>
<td>Small shifts in probability</td>
</tr>
<tr>
<td>1-2</td>
<td>.5-1</td>
<td>Rarely alters probability to an important degree</td>
</tr>
</tbody>
</table>

Negative Likelihood Ratio

- So let’s say we have a test with a Sensitivity of .85 and a Specificity of .20
- Then the –LR = (1-.85)/.20= .75
- Rarely alters probability to an important degree
Treatment Threshold

- The point at which the examination and evaluation process stops and treatment begins.
- How do we determine this?

SnNout

What is a Red Flag?

- Signs and Symptoms found in the patient history and clinical examination that may tie a disorder to a serious pathology.
- < 5% of Primary Care Physicians Routinely Examine for Red Flags during an Initial Screen

Part III
Screening for Red Flags

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Categorizing Red Flags

**Category I:** Factors which Require Immediate Medical Attention
- Blood in Sputum
- Elevated Sedimentation Rate
- Loss of Consciousness or Altered mental state
- Bowel and Bladder Dysfunction
- Severe Non-mechanical pain
- Progressive Neurological Deficit
- Heart-Related Symptoms

**Category II:** Factors which Require Subjective Questioning and Precautionary Examination and Treatment Procedures
- Age > 50
- Clonus
- Fever
- Gait Deficits
- History of a disorder with predilection for infection or hemorrhage
- History of a metabolic bone disorder
- History of cancer
- Impairment precipitated by recent trauma
- Long-term corticosteroid use
- Long-term worker’s compensation
- Non-healing sores or wounds
- Recent history of unexplained weight loss
- Writhing pain

**Category III:** Factors which Require Further Physical Testing and Differentiation Analysis
- Myelopathic Symptoms
- Abnormal Reflexes
- Bilateral or Unilateral Radiculopathy or Paresthesia
- Unexplained Referred Pain
- Unexplained Significant Upper or Lower Limb Weakness

Cervical-Specific Red Flags

**Category I Findings**
- Head Injury (concussion or altered mental status)
- Cervical spine fractures (Canadian C-Spine Rules)
- Upper Cervical Spine Instability

Diagnostic Recommendations for Post-Concussion Disorder—DSM-IV

- A. A history of head trauma that has caused significant cerebral concussion.
- B. Evidence from neuropsychological testing or quantified cognitive assessment of difficulty in attention
- C. Three (or more) of the following occur shortly after the trauma and last at least 3 months:
  - 1. Becoming fatigued easily.
  - 2. Disordered sleep.
  - 3. Headache.
  - 4. Vertigo or dizziness.
  - 5. Irritability or aggression on little or no provocation.
  - 6. Anxiety, depression, or affective lability.
  - 7. Changes in personality (e.g., social or sexual inappropriateness).
  - 8. Apathy or lack of spontaneity.
Diagnostic Recommendations for Post-Concussion Disorder—DSM-IV

- D. The symptoms in Criteria B and C have their onset following head trauma or else represent a substantial worsening of preexisting symptoms.
- E. The disturbance causes significant impairment in social or occupational functioning and represents a significant decline from a previous level of functioning.
- F. The symptoms do not meet criteria for Dementia Due to Head Trauma and are not better accounted for by another mental disorder.

ICD-10 Criteria

- Require a history of TBI and the presence of three or more of the following eight symptoms:
  - 1) headache,
  - 2) dizziness,
  - 3) fatigue,
  - 4) irritability,
  - 5) insomnia,
  - 6) concentration
  - 7) memory difficulty,
  - 8) intolerance of stress, emotion, or alcohol.

“or” Sensitive but not Specific

- Often misdiagnosed as
  - Head injury
  - Posttraumatic stress
  - Depression
  - Whiplash
- Swedish Post-Concussion Symptoms questionnaire
- Rivermead Post-Concussion Questionnaire

Canadian C-Spine Rules

Sensitivity = 99

Modified Sharp Purser Test

<table>
<thead>
<tr>
<th>Study</th>
<th>Sensitivity</th>
<th>Operator Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unkut &amp; Lobebaum</td>
<td>69</td>
<td>8</td>
</tr>
</tbody>
</table>


Alar Ligament Stability Test

Shear Testing


Cervical-Specific Red Flags

• Category II Findings
  – VBI
  – Congenital and Hereditary Conditions (Maroteux-Lamy Syndrome, Morquio Syndrome, RA, Down Syndrome, Marfan’s Syndrome, Klippel-Feil syndrome
  – Gait Dysfunction/Balance (myelopathy)


Assessment for the presence of symptoms and signs associated with VBI occurs at four stages in the management of a patient with an upper quadrant disorder:
1. History (subjective examination)
2. Physical (objective) examination
3. During treatment of the cervical spine, and

Although many VBI tests have shown mixed results in relation to changes in vertebrobasilar arterial blood flow in experimental, it appears that end-range rotation is the most sensitive cervical position. Recent research has also identified blood flow changes in the simulated manipulation position.


Cervical-Specific Red Flags

• Category III Findings
  – Myelopathy or Visceral Pain


Hoffmann’s Test


Others-Myelopathy

Thoracic-Specific Red Flags

• Category I Findings
  – Viscerosomatic Pain
  – Tumors and Fractures

Thoracic-Specific Red Flags

• Category II Findings
  – Metabolic Disorders (Osteoporosis)
  – Long term corticosteroid use
  – Age greater than 50
  – Spondylodiscitis

Thoracic Kyphosis
(Compression Fracture)

• Cook et al. 2002
• O’Brien et al. 1999
• 48-49 degrees of kyphosis = compression fracture

Others-Myelopathy

Heel Drop Test/Percussion
(Spondylodiscitis)

Discitis, Spondylodiscitis, Spondylitis, Vertebral Pyogenic Osteomyelitis, or Epidural Abscess.
Bacterial infection of the disc and surrounding body and tissues
Tenderness during spine palpation is most sensitive measure (Deyo & Weinstein 2001)


http://www.ki.se/odont/cariologi_endodonti/exarb/Marie_Nilsson.html
http://www.eorthopod.com/images/ContentImages/spine/spine_thoracic/herniation/thoracic_herniation_symptom01.jpg
http://academic.usf.edu/~doctor/courseweb/06lab35lab35babsrc.htm
Lumbosacral Specific Red Flags

- Category I Findings
  - AAA
  - Cauda Equina Dysfunction
  - Upper lumbar disc herniation in younger patients
  - Non-mechanical pain distribution
  - Progressive neurological deficit
  - Sacral Fractures

Abdominal Pulsating Mass (AAA)

- Commonly latent
- Abdominal pulsating mass c/o
  - Atherosclerotic vascular disease
  - Pain at rest or nocturnal pain
  - Age greater than 60 years

Cauda Equina

Rapid symptoms within 24 hours 89% sensitivity  
History of back pain 94% sensitivity  
Urinary retention 90% sensitivity  
Loss of sphincter tone 80% sensitivity  
Sacral sensation loss 85% sensitivity  
Lower extremity weakness or gait loss 84% sensitivity  
Combined bilateral sciatica, motor loss, sacral sensory loss, and sphincter disturbance (19% sensitivity)

“Sign of the Buttock”


Ruling Out Pelvic Fractures (Negative findings of)

- Trauma +
  - Posterior Inflammation (sacral ala fracture)
  - Pain with Hip ROM
  - Pain during rectal examination
  - Pain during compression

Upper Lumbar Disc Herniation

- Commonly found with Femoral Nerve tension test
- True upper lumbar disc herniations are rare (Tokuhashi et al. 2001)
- In younger subjects, should be considered a red flag


Lumbosacral Specific Red Flags

- Category II Findings
  - Compression fractures
  - Pyogenic infections (rapid onset, leading to fever, malaise, severe low back pain), Osteomyelitis, Spondylodiscitis
  - Neurogenic vs. vascular
  - Non-traumatic, bilateral low back and SIJ pain


Lumbar Compression fracture

- History
  - age >50
  - age >70
  - trauma
  - corticosteroid use

- in elderly trauma can be minor


Spine Cancer

- History
  - Age > 50
  - previous history of cancer
  - failure to improve in 1 mo. of therapy
  - no relief -bed rest
  - duration > 1 mo
  - age >50 or cancer hx or unexplained wt loss or failure of conservative tx.
  - insidious onset
  - constitutional symptoms


Ankylosing Spondylitis

- History
  - age at onset <40
  - pain not relieved by supine
  - morning back stiffness
  - pain duration >3 months
  - 4 of 5 questions above positive also: improved by exercise +LR = 1.27


Lumbosacral Specific Red Flags

- Category III Findings
  - Myelopathy
  - Radiculopathy
  - Visceral or Somatic Referred Pain (SIJ vs. Lumbar origin)


Others-Myelopathy

Lumbar Category III Findings

- Bilateral lower extremity weakness or numbness
- Referred Pain

Visceral Referred Pain

Visceral and somatic referred pain can refer pain to the legs

Several structures of the lumbar spine and pelvis can refer pain to the legs

Hip Specific Red Flags

- Category I Red Flags
  - Hip Fracture
  - AVN
    - Trauma (not always)
    - Typically involves groin pain
    - X-ray in early stages are normal

- Category II Findings
  - Infection
  - Total Hip Replacement Failure
    - Typical failure occurs at zones 1 and 7 and involve rocking or pistoning (cement vs. cementless-no difference)

Predicting Hip Fracture

- Bone DEXA <-2.14 T
- And
- Age > 74 years
- And
- Age < 74 years
- And
- 1 functional difficulty
- And
- Walking speed, 0.96m/s

Sensitivity = 70.4%
Specificity = 78.7%


Ruling Out Hip Fractures (Negative findings of)

- + Pubic Percussion Test (LR+ = 9 to 313)
- ER of one limb versus the other

Hips Specific Red Flags

Risk Factor for Infection in THR

- Skin ulcerations / necrosis
- Rheumatoid Arthritis
- Previous hip/knee operation
- Recurrent UTI
- Oral corticosteroids
- Chronic renal insufficiency
- Diabetes
- Neoplasm requiring chemo
- Tooth extraction

Windsor et al, JBJS; 1990

Clinical Findings for Infection in THR

<table>
<thead>
<tr>
<th>Type</th>
<th>Acute</th>
<th>Subacute</th>
<th>Later Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>100%</td>
<td>100%</td>
<td>96%</td>
</tr>
<tr>
<td>Swelling</td>
<td>100%</td>
<td>?</td>
<td>77%</td>
</tr>
<tr>
<td>High WBC</td>
<td>?</td>
<td>100%</td>
<td>27%</td>
</tr>
<tr>
<td>Drainage</td>
<td>100%</td>
<td>?</td>
<td>27%</td>
</tr>
<tr>
<td>Fever</td>
<td>100%</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Windsor et al, JBJS; 1990

OK: So the patient belongs in your clinic- now what?
Differentiation of the Upper Quarter
Josh Cleland, PT, PhD, OCS, FAAOMPT
Assistant Professor
Franklin Pierce College

Cervical Radiculopathy


Reliability and Diagnostic Accuracy of the Clinical Examination and Patient Self-Report Measures for Cervical Radiculopathy


Lauder et al, Predicting electrodiagnostic outcome in patients with upper limb symptoms: Are the history and physical exam helpful?. Arch Phys Med Rehabil. 2000. (QUADAS = 9)
Predicting Electrodiagnostic Outcome in Patients With Upper Limb Symptoms: Are the History and Physical Examination Helpful?

- Electrodiagnostic testing used as reference standard
- Raters blinded to patient’s diagnosis and suspected condition

Reliability and Diagnostic Accuracy of the Clinical Examination and Patient Self-Report Measures for Cervical Radiculopathy

- Patient reports?

Table 3: Sensitivity in Relationship to a Cervical Radiculopathy

<table>
<thead>
<tr>
<th>Impairment</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness</td>
<td>0.65</td>
<td>0.94</td>
<td>0.62</td>
<td>1.17</td>
<td>0.84-2.13</td>
</tr>
<tr>
<td>Numbness</td>
<td>0.70</td>
<td>0.94</td>
<td>0.63</td>
<td>1.20</td>
<td>0.65-2.57</td>
</tr>
<tr>
<td>Arm pain</td>
<td>0.65</td>
<td>0.96</td>
<td>0.62</td>
<td>0.66</td>
<td>0.36-1.24</td>
</tr>
<tr>
<td>Neck pain</td>
<td>0.62</td>
<td>0.95</td>
<td>0.57</td>
<td>0.84</td>
<td>0.46-1.54</td>
</tr>
<tr>
<td>Tingling</td>
<td>0.72</td>
<td>0.94</td>
<td>0.60</td>
<td>0.87</td>
<td>0.45-1.67</td>
</tr>
<tr>
<td>Burning</td>
<td>0.33</td>
<td>0.63</td>
<td>0.38</td>
<td>0.58</td>
<td>0.47-1.38</td>
</tr>
</tbody>
</table>

Reflex Testing - Biceps

Sensitivity
Wainner et al.: .24
Lauder et al.: .10

Reflex Testing - Brachioradialis

Sensitivity
Wainner et al.: .06
Lauder et al.: .17
Reflex Testing - Triceps

Sensitivity
Wainner et al: .03
Lauder et al: .10

Motor Exam

Motor Exam

<table>
<thead>
<tr>
<th>Test</th>
<th>Sens</th>
<th>Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deltoid</td>
<td>.24</td>
<td>.89</td>
</tr>
<tr>
<td>Bicep</td>
<td>.24</td>
<td>.94</td>
</tr>
<tr>
<td>ECR</td>
<td>.12</td>
<td>.90</td>
</tr>
<tr>
<td>Triceps</td>
<td>.12</td>
<td>.94</td>
</tr>
<tr>
<td>FCR</td>
<td>.06</td>
<td>.89</td>
</tr>
<tr>
<td>APB</td>
<td>.06</td>
<td>.84</td>
</tr>
<tr>
<td>First DI</td>
<td>.03</td>
<td>.93</td>
</tr>
</tbody>
</table>

Wainner et al

Sensory Examination

<table>
<thead>
<tr>
<th>Test</th>
<th>Sens</th>
<th>Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5</td>
<td>.29</td>
<td>.86</td>
</tr>
<tr>
<td>C6</td>
<td>.24</td>
<td>.66</td>
</tr>
<tr>
<td>C7</td>
<td>.18</td>
<td>.77</td>
</tr>
<tr>
<td>C8</td>
<td>.12</td>
<td>.81</td>
</tr>
<tr>
<td>Decreased pin prick</td>
<td>.38</td>
<td>.46</td>
</tr>
</tbody>
</table>

Wainner et al, Lauder et al

Cervical Range of Motion

- Cervical flexion < 55: Sens = .89
- Cervical rotation ipsilateral < 60: Sens = .89
  – Wainner et al, Spine 2003
Spurling’s Test

Cleland, Icon Learning Systems, 2005

Cervical Distraction Test

POSITIVE TEST:
Decrease in symptoms

• Sensitivity: .44

Cleland, Icon Learning Systems, 2005

Shoulder Abduction Test

Cook, Prentice Hall, 2007

Upper Limb Tension Test- Median Nerve Bias

POSITIVE TEST:
• Symptom Reproduction
• Side-to-side differences in elbow ext > 10 deg
• Contralateral Cx SB increases symptoms OR Ipsilateral SB dec sxs

• Sensitivity: .97

Cleland, Icon Learning Systems, 2005

Upper Limb Tension Test- Radial Nerve Bias

POSITIVE TEST:
• Symptom Reproduction
• Side-to-side differences in elbow ext > 10 deg
• Contralateral Cx SB increases symptoms OR Ipsilateral SB dec sxs

• Sensitivity: .72
Screening for the Presence of Cervicogenic Headaches

The diagnostic validity of the cervical flexion-rotation test in C1/2-related cervicogenic headache

Mark Ognae, Toby Hall, Kim Robinson, A.M. Birdmore
School of Physiotherapy, Flinders University of South Australia, Adelaide, South Australia, Australia.

The flexion-rotation test and active cervical mobility—A comparative measurement study in cervicogenic headache

T. Hall*, K. Robinson
Curtin University of Technology, Raymond Joel Centre, Kwinana, Western Australia.

Table 2
The sensitivity, specificity, positive and negative predictive values as well as likelihood ratios of the cervical flexion-rotation test

<table>
<thead>
<tr>
<th></th>
<th>Therapist 1</th>
<th>Therapist 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (%)</td>
<td>91.3</td>
<td>91.3</td>
</tr>
<tr>
<td>Specificity (%)</td>
<td>91.4</td>
<td>88.6</td>
</tr>
<tr>
<td>Positive predictive value (%)</td>
<td>87.5</td>
<td>84.0</td>
</tr>
<tr>
<td>Negative predictive value (%)</td>
<td>94.1</td>
<td>93.9</td>
</tr>
<tr>
<td>Positive likelihood ratio</td>
<td>10.65</td>
<td>7.99</td>
</tr>
<tr>
<td>Negative likelihood ratio</td>
<td>0.095</td>
<td>0.098</td>
</tr>
</tbody>
</table>

Note: *For the flexion-rotation test in cervicogenic headache, Ognae et al. (2010). Man Ther 8: e50-e53. doi:10.1016/j.math.2010.03.015.

Clinical tests of musculoskeletal dysfunction in the diagnosis of cervicogenic headache

G. Zhao*, G. Jaffé, I. Story

- Posture
- Pain pressure threshold
- CROM
- Manual Assessment
- Muscle extensibility
- Mechanosensitivity of neural tissue
- Craniocervical flexion test

Clinical tests of musculoskeletal dysfunction in the diagnosis of cervicogenic headache

G. Zhao*, G. Jaffé, I. Story

- Manual Examination of upper cervical spine
- Length of pectoralis major muscle

Sensitivity = .80
Cervical Rotation Lateral Flexion Test

- The patient is seated and the examiner passively rotates the head away from the affected side.
- The examiner then sidebends the head towards the chest.
- The test is positive if restrictions limit the sidebending.

Lindgren, Muscle and Nerve, 1995

---

Rib Spring Test

- Sensitivity and specificity have not been reported.


Thoracic Outlet Syndrome

www.medicalmultimediagroup.com

---

Hyper Abduction Test

- Patient is seated and examiner palpates radial pulse
- The patient is told to place the arm in 90 degrees of abduction and full external rotation
- After 60 seconds the radial pulse is palpated
- A positive test: change in radial pulse or reports of parasthesias.

Cook and Hegedus, Prentice Hall, 2007

---

Roos Test

- The patient is seated and instructed to abduct and externally rotate their arms.
- The patient is then instructed to pump their hands.
- This is repeated for 60 seconds

Cook and Hegedus, Prentice Hall, 2007
Adson’s Test
• The patient is sitting and the arms are placed in 15° of abd.
• The patient is instructed to inhale and point their chin toward the side being tested.
• The examiner records the radial pulse

Costoclavicular Test
• The patient is seated with both arms at their side.
• The patient is instructed to retract and depress the shoulders.
• The examiner assesses changes in the radial pulse.

Wright Test
• Patient is seated and examiner palpates radial pulse.
• The patient is instructed to hyper-abduct his or her arm.
• Position held for 1 to 2 minutes

### Table III. Diagnostically usefulness of provocative tests evaluated using the final diagnosis as the reference.

<table>
<thead>
<tr>
<th>Provocative test</th>
<th>SE</th>
<th>SP</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adson (n = 463)</td>
<td>79%</td>
<td>76%</td>
<td>85%</td>
<td>72%</td>
</tr>
<tr>
<td>Hyperabduction (n = 333)</td>
<td>52%</td>
<td>99%</td>
<td>92%</td>
<td>47%</td>
</tr>
<tr>
<td>Hyperabduction (symptom reproduction) (n = 46)</td>
<td>84%</td>
<td>40%</td>
<td>74%</td>
<td>55%</td>
</tr>
<tr>
<td>Wright (pulse abolition) (n = 47)</td>
<td>70%</td>
<td>53%</td>
<td>72%</td>
<td>50%</td>
</tr>
<tr>
<td>Wright (symptom reproduction) (n = 47)</td>
<td>90%</td>
<td>29%</td>
<td>69%</td>
<td>63%</td>
</tr>
<tr>
<td>ROOS (n = 48)</td>
<td>84%</td>
<td>60%</td>
<td>68%</td>
<td>50%</td>
</tr>
<tr>
<td>Tinel (n = 42)</td>
<td>46%</td>
<td>63%</td>
<td>39%</td>
<td></td>
</tr>
</tbody>
</table>

### Table V. Evaluation of provocative test combinations and contribution of Doppler ultrasonography.

<table>
<thead>
<tr>
<th>Without Doppler US</th>
<th>SE</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 provocative tests</td>
<td>90%</td>
<td>6%</td>
</tr>
<tr>
<td>3 provocative tests</td>
<td>90%</td>
<td>29%</td>
</tr>
<tr>
<td>4 provocative tests</td>
<td>87%</td>
<td>38%</td>
</tr>
<tr>
<td>5 provocative tests</td>
<td>84%</td>
<td>84%</td>
</tr>
</tbody>
</table>
Physical Examination Shoulder:

Impingement

The Hawkins Kennedy Test

- The examiner brings the patient’s arm into 90 degrees of shoulder/elbow flexion and forcefully internally rotates the arm.
- Test is positive if pain occurs with internal rotation.

- *Calis et al:*
  - Sens = .92, Spec = .25
  - +LR = 1.23, -LR of .32

The Neer Test

- The examiner stabilizes the scapula while forcing the patient’s arm into maximal elevation.
- Test is positive if pain is reproduced.

- *Calis et al*
  - Sens = .89, Spec = .31
  - +LR = 1.29, -LR of .35

Internal Rotation Resisted Strength Test (IRRST)

- Patient’s arm is held in 90 degrees of abduction and 80-85 degrees of ER with the elbow flexed. Examiner applies resistance against ER and then IR in same position.
- Test is positive for intra-articular disease if patient exhibits greater weakness in IR when compared to ER
- Test is positive for impingement syndrome if patient has greater weakness with ER.

- *Zaslav KR*
  - Sens = .88, Spec = .96
  - +LR = 22, -LR of .13

Rotator Cuff Tear
Lift Off Sign/ IR Lag Test

- Patient is seated. Examiner brings shoulder to maximum IR by placing patient’s forearm behind the back. With elbow in 90 degrees of flexion, examiner extends shoulder 20 degrees. Patient is instructed to maintain position when examiner releases arm.
- Positive for Subscap tear if lag or drop of arm occurs when arm is released.

- **Hertel et al**
  - Sens = .97, Spec = .96
  - +LR= 24.3, -LR= .03

Rent Test

- Wolf and Agrawl:
  - Sens=.96

- Lyons and Tomlinson:
  - Sens=.91

Diagnostic Accuracy of Clinical Tests for the Different Degrees of Subacromial Impingement Syndrome

- Analyzed the combination of tests:
  - Hawkins/Kennedy
  - Painful arc sign
  - Infraspinatus muscle tests

<table>
<thead>
<tr>
<th>Category</th>
<th>Sens</th>
<th>Spec</th>
<th>PPV</th>
<th>NPV</th>
<th>LR+</th>
<th>LR-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Impingement positive</td>
<td>.89</td>
<td>.96</td>
<td>.96</td>
<td>.89</td>
<td>16.2</td>
<td>0.05</td>
</tr>
<tr>
<td>All three tests positive</td>
<td>.89</td>
<td>.96</td>
<td>.96</td>
<td>.89</td>
<td>16.2</td>
<td>0.05</td>
</tr>
<tr>
<td>One of three tests positive</td>
<td>.86</td>
<td>.94</td>
<td>.86</td>
<td>.94</td>
<td>12.4</td>
<td>0.24</td>
</tr>
<tr>
<td>None of three tests positive</td>
<td>.65</td>
<td>.60</td>
<td>.65</td>
<td>.60</td>
<td>0.46</td>
<td>0.63</td>
</tr>
<tr>
<td>Overall Impingement negative</td>
<td>.41</td>
<td>.51</td>
<td>.41</td>
<td>.51</td>
<td>0.85</td>
<td>0.30</td>
</tr>
<tr>
<td>All three tests negative</td>
<td>.41</td>
<td>.51</td>
<td>.41</td>
<td>.51</td>
<td>0.85</td>
<td>0.30</td>
</tr>
<tr>
<td>One of three tests negative</td>
<td>.41</td>
<td>.51</td>
<td>.41</td>
<td>.51</td>
<td>0.85</td>
<td>0.30</td>
</tr>
<tr>
<td>None of three tests negative</td>
<td>.24</td>
<td>.34</td>
<td>.24</td>
<td>.34</td>
<td>0.48</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Instability
Anterior Release Test

-Performed in supine with affected shoulder over edge of table. Arm is abducted 90 degrees with elbow flexed 90 degrees and a posterior force is placed on the humeral head while the arm is maximally ER. Humeral head is then released.
-Test is positive if a sudden pain or typical sx is reproduced.
-\textit{Gross et al} -- Sens = .92, Spec = .89

Labral Tear

Biceps Load Test

- Patient is supine with examiner grasping wrist and elbow. Arm is abducted to 90 degrees with elbow flexed to 90 degrees and forearm supinated. Examiner ER arm until patient becomes apprehensive and then the patient is asked to flex the elbow against the examiner’s resistance.
- Test is positive if patient’s apprehension remains or pain is produced.
- \textit{Kim et al} -- Sens = .90, Spec = .97
  -- +LR = 30, -LR of .10

Biceps Load II

- Patient is supine with examiner grasping wrist and elbow. Arm is elevated 120 degrees and fully ER with elbow held in 90 degrees of flexion and forearm supinated. Examiner then resists elbow flexion by the patient.
- Test is positive if resisted elbow flexion causes pain.
- \textit{Kim et al} -- Sens = .90, Spec = .97
  -- +LR = 30, -LR of .10

Labral Tear

Biceps Load II

- Patient is supine with examiner grasping wrist and elbow. Arm is elevated 120 degrees and fully ER with elbow held in 90 degrees of flexion and forearm supinated. Examiner then resists elbow flexion by the patient.
- Test is positive if resisted elbow flexion causes pain.
- \textit{Kim et al} -- Sens = .90, Spec = .97
  -- +LR = 30, -LR of .10

What about the AC joint?
Active Compression Test

- While standing, patient is asked to flex arm to 90 degrees with elbow in full extension. Patient then adducts arm 10 degrees and IR humerus. Examiner applies downward force to arm as patient resists. Patient then fully supinates arm and repeats procedure.
- Positive if pain localized to AC

Cross-Body Abduction Test

- Therapists flexes shoulder to 90 degrees and adducts across body
- Positive if pain is elicited at the AC joint
- Sens = .77
- Spec = .79

AC Resisted Extension Test

- Patient is standing with arm flexed to 90 degrees and elbow bent to 90 degrees
- Patient is asked to extend arm against resistance
- Positive if pain is reproduced in the AC joint
- Sens = .72
- Spec = .85

Questions?

Structural Differentiation Diagnosis of the Upper and Lower Quarter

Concurrent Criterion-Related Validity of Acromioclavicular Joint Physical Examination Tests: A Systematic Review

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive prediction value</th>
<th>Negative prediction value</th>
<th>Positive likelihood ratio</th>
<th>Negative likelihood ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC positive test</td>
<td>0.75 (231/315)</td>
<td>0.90 (101/112)</td>
<td>0.74 (221/296)</td>
<td>0.17 (10/64)</td>
<td>1.00 (221/221)</td>
<td>0.00</td>
</tr>
<tr>
<td>3 positive tests</td>
<td>0.95 (234/245)</td>
<td>0.92 (213/233)</td>
<td>0.97 (230/235)</td>
<td>0.51 (4/13)</td>
<td>0.96 (230/232)</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Franklin Pierce
Concord NH, USA

Duke University
Durham NC, USA
Where do we start?

Prevalence of Low Back Pain

- In 2002, point prevalence was 26.4% (Deyo et al. Spine 2006) (lifetime = 70%)
- 45 and older > than 44 and younger
- Three year incidence predicted by
  - Depression (OR = 2.3)
  - Nerve root contact on MRI (OR = 1.9)
  - Central Stenosis (OR = 1.8)


Epidemiology

- 39% Discogenic Pain (Schwarzer et al. 1995)
- 15-40% Zygapopyseal joints (Schwarzer et al. 1995; Manchikanti et al. 1999)
- 6-13% Sacroiliac Pain (Schwarzer et al. 1995; Bogduk 1995)
- 2-10% (Deyo et al. 1994; Govind 2004)
- 33% Undefined (Bogduk)


Ruling out the Lumbar Spine

- Should focus here first since the prevalence is high
- Low back pain is not homogenous
- Factors outside physical components can amplify or are associated with LBP

History and Examination Combined?

- Pain not relieved by supine sensitivity = 80 for ankylosing spondylitis
- Morning back stiffness sensitivity = 64 for ankylosing spondylitis
- Pain duration >3 months sensitivity = 71 for ankylosing spondylitis
- Pseudoclaudication sensitivity = 60 for stenosis


Discogenic Pain

- Centralization or peripheralization sensitivity = 92-95 (Donelson et al. 1997)
- Sciatica sensitivity = 95
- Ankle dorsiflexion weakness sensitivity = 35
- Great toe weakness sensitivity = 50
- Impaired ankle reflex sensitivity = 50
- Plantar flexion weakness sensitivity = 6

Straight Leg Raise

The Slump Sit Test

Ruling out the Zygapophyseal Joints

5/7 Revel’s Criteria sensitivity = 13
- age over 65 years
- pain well relieved by recumbency
  no exacerbation of pain with:
  - coughing and sneezing,
  - forward flexion,
  - extension,
  - rising from flexion
  - extension-rotation test

Laslett et al. BMC Musculoskeletal Disorders 2004, 5:43

Ruling out Stenosis

- Age > 65 years sensitivity = 77%
- Pain below buttocks sensitivity = 88
- Leg symptoms worse with walking, better sitting sensitivity = 81
- Best posture for symptoms is sitting sensitivity = 89
- Worst posture for symptoms is walking or standing sensitivity = 89


Ruling out Stenosis

- Age >65 sensitivity = 77
- Severe lower extremity pain sensitivity = 65
- Symptoms worsen when walking sensitivity = 71
- Numbness sensitivity = 63


Quadrant?

- Used to clear the lumbar spine
- Compresses the foramen on one side
**Provocative Mobilization (PA’s)**

**Overpressures?**

---

**SIJ Definition**

- SIJ Dysfunction is associated with pain that arises from the sacroiliac joint and is caused by asymmetry, or alteration in the stability of the Sacroiliac joint.

**Pelvic Girdle Pain Definition**

- PGP arises in relation to pregnancy, trauma, osteo-arthritis and arthrosis.
- Pain is experienced between the posterior iliac crest and gluteal fold, particularly in the vicinity of the SIJ.
- Pain may radiate in the posterior thigh and can also occur in conjunction with/or separately in the symphysis.
- The diagnosis of PGP can be reached after exclusion of lumbar causes.
  - Vleeming et al. European Guidelines on the Diagnosis and Treatment of Pelvic Girdle Pain. 2005

---

**Pseudodisease Findings**

- CT scan demonstrates 57.5% sensitivity and 69% specificity (Elgafy et al. CORR 2001)
- Does asymmetry truly equate to pathology?
- If we look hard enough, can’t we find something; especially if we know it’s there

**Special Tests**

- No examination movements are exclusive to the SIJ/Pelvis (Cook 2007)
- Most special tests (when performed in isolation) are poorly diagnostic and lack reliability (Cook 2007a and b)
- For screening, the lower prevalence (6-13%) requires higher sensitivities for better screening accuracy
Clinical Examination Findings

<table>
<thead>
<tr>
<th>Examination Finding</th>
<th>Sens</th>
<th>Spec</th>
<th>LR+</th>
<th>LR-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralization</td>
<td>.24</td>
<td>.83</td>
<td>1.41</td>
<td>.92</td>
</tr>
<tr>
<td>Step Up</td>
<td>.29</td>
<td>1.0</td>
<td>---</td>
<td>.71</td>
</tr>
<tr>
<td>Single Leg Stance</td>
<td>.35</td>
<td>.67</td>
<td>1.1</td>
<td>.97</td>
</tr>
<tr>
<td>Lunge</td>
<td>.44</td>
<td>.83</td>
<td>2.63</td>
<td>.68</td>
</tr>
<tr>
<td>Sit to Stand</td>
<td>.13</td>
<td>1.0</td>
<td>---</td>
<td>.88</td>
</tr>
</tbody>
</table>

Cook et al. 2007. Classification of PGP. JMPT, 2007

Clinical Examination Findings

<table>
<thead>
<tr>
<th>Examination Finding</th>
<th>Sens</th>
<th>Spec</th>
<th>LR+</th>
<th>LR-</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMT Hip</td>
<td>.33</td>
<td>.83</td>
<td>2.0</td>
<td>.8</td>
</tr>
<tr>
<td>Hip PROM</td>
<td>.55</td>
<td>1.0</td>
<td>---</td>
<td>.45</td>
</tr>
<tr>
<td>Deep Squat</td>
<td>.24</td>
<td>1.0</td>
<td>---</td>
<td>.76</td>
</tr>
<tr>
<td>Rot Innom</td>
<td>.27</td>
<td>.83</td>
<td>1.6</td>
<td>.88</td>
</tr>
<tr>
<td>Pubic Symphys Palp</td>
<td>.59</td>
<td>.50</td>
<td>1.2</td>
<td>.82</td>
</tr>
</tbody>
</table>

Cook et al. 2007. Classification of PGP. JMPT, 2007

Thigh Thrust


ASLR


Resisted Hip Abduction


Fortin Finger Test

Pubic Symphysis Palpation


Motion Palpation Tests?


Combinations of Findings

<table>
<thead>
<tr>
<th>Study</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>ODDS Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thigh Thrust, Rotation, Sural Thrust, and Compression Tests</td>
<td>12</td>
<td>72</td>
<td>12</td>
</tr>
<tr>
<td>Distraction Test, Compression Test, Thigh Thrust, Patrick Sign, Sneddon</td>
<td>90</td>
<td>72</td>
<td>12</td>
</tr>
<tr>
<td>ASLR, Rotation, or Thigh Thrust</td>
<td>95</td>
<td>67</td>
<td>11</td>
</tr>
<tr>
<td>ASLR, Lunge, or Thigh Thrust</td>
<td>90</td>
<td>60</td>
<td>11</td>
</tr>
</tbody>
</table>

Prevalence of Hip Pain

- **Period Prevalence (1 year)**
  - Men = 7.1%
  - Women = 12.7%
- **Point Prevalence**
  - Men = 4.3%
  - Women = 10%
- **Persistent Chronic Pain**
  - Men = 1.9%
  - Women = 4.7%


Ruling out the Hip

- Hip Labrum
  - Pain in sitting.
  - Presence of clicking or popping during gait, squatting or other activities.
  - Presence of a click during active or passive motion of the hip
- Femoral Acetabular Impingement
  - <i>R during hip flexion.
  - Mechanical groin pain (Laude et al. 2007)

Scour/Impingement Test

**Posterior Impingement Test**

**FABER Test**

**Capsular Pattern**

**Screening of OA in General**

- Sensitivity = 86
- Signs and Symptoms involve 1) hip pain, 2) IR < 15 degrees, 3) pain with IR, 4) morning stiffness up to 60 minutes, and 5) age > 50 years (Altman et al.) (QUADAS=8)
- Sensitivity = 54-81
- Two to three planes of ROM loss and radiographic changes (Birrell et al.) (QUADAS=8)

**Hip Dysplasia**

- Clinical examination
  - and
- History of swaddling
- Female
- Breech delivery
- Positive family history
- Sensitivity = 97%

**Putting it all Together: Are we Passed the Treatment Threshold Yet?**

Josh Cleland, PT, PhD, OCS, FAAOMPT
Assistant Professor
Franklin Pierce College
Treatment Threshold

- The point at which the examination and evaluation process stops and treatment begins.
- How do we determine this?

Likelihood Ratios

- Quantify the direction and magnitude of change in the pretest probability based on the test result.
- Provide the best information needed to select the test that will surpass the threshold for action.

<table>
<thead>
<tr>
<th>+LR</th>
<th>-LR</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 10</td>
<td>&lt; .1</td>
<td>Large and conclusive shifts in probability</td>
</tr>
<tr>
<td>5-10</td>
<td>.1-.2</td>
<td>Moderate shifts in probability</td>
</tr>
<tr>
<td>2-5</td>
<td>.2-.5</td>
<td>Small shifts in probability</td>
</tr>
<tr>
<td>1-2</td>
<td>.5-1</td>
<td>Rarely alters probability to an important degree</td>
</tr>
</tbody>
</table>

Pretest Probability

Based on a number of factors

- Age
- Symptoms
- Epidemiological data
- Clinical experience
Evidence to Practice

• Nomogram
  – Graphical tool
  – Estimates overall probability of disease based on diagnostic testing results
  – Pretest probability = 20%
  – +LR = 8
  – Posttest probability ???

Case Example

• A 19 year-old baseball pitcher
• Shoulder pain 3 months duration.
• Symptoms are exacerbated during any overhand throwing motion.
• Reports hearing a “click” in his shoulder during the wind-up phase of pitching.
• 15% pretest probability of a labral tear.
• You select the O’Brien test as described by Guanche and Jones.
• +LR = 2.33.

But as clinicians we use combinations of tests and measures?

Clinical Prediction Rules

• Decision-making tools for clinicians, containing variables from the history, physical exam, and simple diagnostic tests.
• Improves the clinician’s accuracy in predicting a diagnosis or expected outcome.
• Combines the diagnostic properties of sensitivity, specificity and likelihood ratios.
Developing a CPR

Step 1 Derivation
Id. Factors with predictive value

Step 2 Validation
Evidence of reproducible accuracy
Narrow validation vs. Broad validation
Apply to pop. & similar setting in step 1
Multiple settings with varying prevalence.

Step 3: Impact analysis
Evidence the rule changes behaviors & improves pt outcomes &/or reduces costs.

Can We Use CPRs to Guide Decision-Making in Patients with Upper Quarter Symptoms?

Can we surpass the Treatment Threshold for the Identification of Cervical Radiculopathy?

Reliability and Diagnostic Accuracy of the Clinical Examination and Patient Self-Report Measures for Cervical Radiculopathy

Purposes
• To determine the measurement properties of clinical examination items used in the management of CR
  – Reliability
  – Validity (concurrent)
• To develop a clinical prediction rule for the diagnosis of CR

Subject Recruitment
• Referred for EMG/NCS testing of suspected CR or CTS
• No prior EMG/NCS test for condition
• Aged 18 – 70 yrs*
• Sx duration ≥ 1 month
• No condition limiting UE function
• No prior surgery or fracture of neck or wrist
• No peripheral neuropathy
• Not off work > 6mo
• No bilateral radiating arm pain
Reference Criterion: EMG/NCS Procedures

- EMG
  - Needle EMG: selected extremity

- NCS
  - Median & Ulnar sensory/motor studies

Clinical Examination: Tests & Measures

- Conventional Neurologic Examination of the UE
  - Muscle-stretch Reflexes
  - Sensory status (dermatome & median nerve field, sharp/dull)
  - Motor status (MMT)
- Scaled Measurements
  - Cervical ROM and wrist diameter

But what is the best combination of tests and measures?

<table>
<thead>
<tr>
<th>TEST</th>
<th>Sn</th>
<th>Sp</th>
<th>LR-</th>
<th>LR+</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Where most bothersome&quot; neck/scapula</td>
<td>.36</td>
<td>.84</td>
<td>--</td>
<td>2.3</td>
</tr>
<tr>
<td>&quot;Neck mvmnt improves&quot;</td>
<td>.65</td>
<td>.71</td>
<td>--</td>
<td>2.2</td>
</tr>
<tr>
<td>Derm C5</td>
<td>.29</td>
<td>.86</td>
<td>**</td>
<td>2.1</td>
</tr>
<tr>
<td>MMT Biceps</td>
<td>.24</td>
<td>.95</td>
<td>**</td>
<td>4.9</td>
</tr>
<tr>
<td>Spurling’s A</td>
<td>.50</td>
<td>.86</td>
<td>**</td>
<td>3.5</td>
</tr>
<tr>
<td>Shild Abd</td>
<td>.17</td>
<td>.92</td>
<td>**</td>
<td>2.1</td>
</tr>
<tr>
<td>Valsalva</td>
<td>.22</td>
<td>.94</td>
<td>**</td>
<td>3.5</td>
</tr>
<tr>
<td>Distraction</td>
<td>.44</td>
<td>.90</td>
<td>**</td>
<td>4.4</td>
</tr>
<tr>
<td>ULTT A</td>
<td>.97</td>
<td>.22</td>
<td>.12</td>
<td>1.3</td>
</tr>
<tr>
<td>Cervical Flex &lt;55</td>
<td>.89</td>
<td>.41</td>
<td>.27</td>
<td>**</td>
</tr>
<tr>
<td>Involved side Cervical Rot &lt;60</td>
<td>.89</td>
<td>.49</td>
<td>.23</td>
<td>**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Positive Findings</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>.39</td>
<td>.56</td>
<td>.88</td>
</tr>
<tr>
<td>3</td>
<td>.39</td>
<td>.94</td>
<td>6.1</td>
</tr>
<tr>
<td>4</td>
<td>.24</td>
<td>.99</td>
<td>30.3</td>
</tr>
</tbody>
</table>
Ok- so we are pretty sure this patient has cervical radiculopathy now what?

Am I screening out or ruling in the disorder?

- ULTT A
- Decreased Biceps MSR + 4 Items of the TIC

Case Series, N=15, cervical radiculopathy
- 12 weeks of treatment (mean = 11 sessions)
  - Start 18#, increase 1-2 # / session based on response
  - Duration 15 minutes: Cycle 30 sec on / 10 sec off
- 7 of 15 (53%) got complete resolution of symptoms (sxs <12 wks) and 3 no change
  6 Patients also received mobilization/manipulation

Results
- Mean age: 51.7 (sd 8.2)
- Duration of symptoms: 20.4 weeks (range 8-52)
- Average number of PT sessions: 7.1 (range 6-10)

Interruption Cervical Traction
Can we Identify Patients with Mechanical Neck Pain?

- Purpose: to determine if a clinician could identify patients with neck pain
Clinical Tests

- Manual Procedures:
  - OA
  - AA
  - C2-C7
- Spurling test
- CROM

Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Sens</th>
<th>Spec</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP</td>
<td>72.2</td>
<td>90.9</td>
<td>9</td>
<td>.3</td>
</tr>
<tr>
<td>Spurling’s</td>
<td>77.8</td>
<td>77.3</td>
<td>3.4</td>
<td>.29</td>
</tr>
<tr>
<td>Total CROM</td>
<td>88.9</td>
<td>9.1</td>
<td>.97</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Ok- so the patient has mechanical neck pain: Now What?

The Use of Spinal Manipulation in the Management of Neck Pain

Can CPRs help to identify patients with neck pain that are likely to benefit from thrust manipulation?

The Cervical Spine Thrust Manipulation Rule

Variables in C-spine CPR

- NDI < 11.5
- Bilateral involvement
- Not performing sedentary work > 5h/day
- Feeling better with neck movement
- Extension does not worsen
- No cervical radic
Thoracic Spinal Manipulation: A Possible Alternative?

- Perhaps disturbances in joint mobility in the thoracic spine contribute to mechanical neck pain.  
- Can you obtain similar benefits while reducing the associated risks by directing techniques to the thoracic spine instead of the neck?

Development of a Clinical Prediction Rule for Guiding Treatment of a Subgroup of Patients With Neck Pain: Use of Thoracic Spine Manipulation, Exercise, and Patient Education

Reference Standard for Success

Cervical Spine Manipulation

- Only 37% of therapists who manipulate target the cervical spine in this patient population?  
  - (Hurley et al 2002)

The Explanation?

- Survey of 129 manipulative therapists in UK  
  Adams and Sims (Physiother Res Int, 1998)

#1 - Anxiety about possible complications

Perhaps clinicians believe that the potential benefits do not outweigh the risk?

Immediate effects of thoracic manipulation in patients with neck pain: a randomized clinical trial

Joshua A. Cleland, John D. Childs, John M. Fritz, Julie M. Whitman, Sarah E. Huber

2005

20 received thoracic manip 19 received placebo

P < .01

Change Scores

Manipulation: 15.5 mm  
Placebo group: 4.2 mm

Exposure Outcome

Reference Standard for Success

Please rate the overall condition of your neck from the time that you began treatment until now

A very great deal worse  
A great deal worse  
Quite a bit worse  
Somewhat worse  
A little bit worse  
A tiny bit worse  
About the same  
A great deal better  
Quite a bit better  
Somewhat better  
A little bit better  
A tiny bit better  
(almost the same)  
(almost the same)

Jaeschke et al, Controlled Clinical Trials, 1989
Informed Consent

Examination

Visit 1

Visit 2

Visit 3

Non-
Success

Success

THORACIC MANIPULATION

Success on
GROC

NO

Success

THORACIC MANIPULATION

Success on
GROC

YES

YES

Success

Baseline Examination

• Numerous self report measures
  – NDI
  – NPRS
  – Body diagram
  – FABQ
  – TSK
• Demographics
• Extensive Standardized History
• Extensive Physical Examination

• 22 patients participated in a second clinical exam
  – Laupacis et al, JAMA, 1997

First Treatment Session

Thoracic Manipulation

1

2

3

Range of Motion Exercise

• 10 repetitions each side; 3-4 times daily
• Maintain Usual Activity Within Limits of Pain

Second Treatment

• If Global rating of Change is rated as;
  – “a very great deal better”
  – “a great deal better”
  – “quite a bit better”

SUCCESS

If not then

SUCCESS
3rd Treatment

- If Global rating of Change is rated as:
  - “a very great deal better”
  - “a great deal better”
  - “quite a bit better”

**SUCCESS**

If not then

**Nonsuccess**

At this time patients participation in the study was complete.

---

6 Variables in the CPR

<table>
<thead>
<tr>
<th>Prediction Variable</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms &lt; 30 days</td>
<td>NA</td>
</tr>
<tr>
<td>No symptoms distal to shoulder</td>
<td>NA</td>
</tr>
<tr>
<td>Looking up does NOT aggravate symptoms</td>
<td>.80 (95% CI .55, 1.0)</td>
</tr>
<tr>
<td>FABOPA ≤ 11</td>
<td>.85 (95% CI .55, .80)</td>
</tr>
<tr>
<td>Decreased T3-T5 kyphosis</td>
<td>.58 (95% CI .22, .95)</td>
</tr>
<tr>
<td>Cervical Extension &lt; 30 degrees</td>
<td>.74 (95% CI .48, .88)</td>
</tr>
</tbody>
</table>

Nagelkerke’s $R^2 = .68$

---

Combination of Predictor Variables with Associated Accuracy Statistics

<table>
<thead>
<tr>
<th>Number of variables</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+LR</th>
<th>Prob of success</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>.05 (.00, .19)</td>
<td>1.0 (.97, 1.0)</td>
<td>Infinite</td>
<td>100%</td>
</tr>
<tr>
<td>5+</td>
<td>.12 (.04, .22)</td>
<td>1.0 (.94, 1.0)</td>
<td>Infinite</td>
<td>100%</td>
</tr>
<tr>
<td>4+</td>
<td>.33 (.26, .35)</td>
<td>.97 (.89, .91)</td>
<td>12 (2.3, 70.8)</td>
<td>93%</td>
</tr>
<tr>
<td>3+</td>
<td>.76 (.67, .82)</td>
<td>.86 (.75, .83)</td>
<td>5.5 (2.7, 12.0)</td>
<td>86%</td>
</tr>
<tr>
<td>2+</td>
<td>.93 (.84, .97)</td>
<td>.56 (.46, .61)</td>
<td>2.1 (1.5, 2.5)</td>
<td>71%</td>
</tr>
<tr>
<td>1+</td>
<td>1.0 (.95, 1.0)</td>
<td>.17 (.11, .17)</td>
<td>1.2 (1.1, 1.2)</td>
<td>58%</td>
</tr>
</tbody>
</table>

Pretest Probability of Success = 54%

---

The Rule

**3 or more present:**

- Recent onset (<30 days)
- Low FABOP (≤11)
- No symptoms distal to the shoulder
- Looking up does NOT aggravate symptoms
- Cervical ext < 30
- Flat T3-T5

---

Thoracic Techniques
The Cervical Spine Thrust Manipulation Rule

Variables in C-spine CPR
- NDI < 11.5
- Bilateral involvement
- Not performing sedentary work > 5h/day
- Feeling better with neck movement
- Extension does not worsen
- No cervical radic

Variables in T-spine CPR
- FABQPA < 11
- Onset < 30 days
- Decreased kyphosis T3-T5
- Cervical extension < 30
  Looking up does not aggravate
  No symptoms distal to shoulder

Can CPRs be useful in determining the prognosis of patients with shoulder pain?

587 patients with first episode of shoulder pain
- Workload
- Physical activity
- Coping
- Fear-avoidance
- Kinesiophobia

Score chart for prediction of persistent shoulder symptoms at 6 weeks

<table>
<thead>
<tr>
<th>Duration of complaints</th>
<th>Total score</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤6 weeks</td>
<td>0</td>
<td>20% - 30%</td>
</tr>
<tr>
<td>&gt;6 weeks</td>
<td>7</td>
<td>10% - 20%</td>
</tr>
</tbody>
</table>

Physiological complaints
- Cervical extension < 30
- Looking up does not aggravate
- No symptoms distal to shoulder

Clinical prediction rules for the prognosis of shoulder pain in general practice

587 patients with first episode of shoulder pain
- Workload
- Physical activity
- Coping
- Fear-avoidance
- Kinesiophobia

Score chart for prediction of persistent shoulder symptoms at 6 weeks

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Physiological complaints
- Cervical extension < 30
- Looking up does not aggravate
- No symptoms distal to shoulder

Move It and Move On

Timothy W. Flynn, PT, PhD, OCS, FAAOMP

US Army-Baylor University Graduate Program in Physical Therapy
Guest Editorial

Journal of Orthopaedic & Sports Physical Therapy

PAIN

350 patients workers with first episode of shoulder pain

- Age
- Gender
- Education
- Duration
- Onset
- Precipitating cause
- Prior history
- Neck pain
- Shoulder pain
- Workload
- Physical activity
- Coping
- Fear-avoidance
- Kinesiophobia

Low Back Pain Classifications

**Original Classification Criteria**

- Manipulation
- Specific Exercise
- Stabilization
- Traction

- SI special tests: "closing" and "opening"
- Centralization phenomenon
- Frequent prior episodes
- Hypomobility
- Lower limb neurological signs
- Manipulation and exercise

What about the use of CPRs and a classification system for the management of LBP?
Spinal Manipulation Intervention

- Translate the pelvis towards you and maximally side-bend the patient’s lower extremities and trunk to the right.
- Without losing the right sidebending lift & rotate the trunk so the patient rests on their left shoulder.
- Contact the patient’s right ASIS with your left hand.
- Grasp the top shoulder and scapula with your right hand and rotate the trunk to the left while maintaining the right side-bending.
- Once the right ASIS starts to elevate, perform a smooth thrust in an anterior to posterior direction.

Spinal Manipulation CPR

- Symptoms < 16 days
- No symptoms distal to the knee
- Hip IR > 35 degrees
- FABQWK < 19
- Lumbar hypomobility

Predicting Success with Manipulation

**4 or more present:**
- Recent onset (<16 days)
- Low FABQ (<19)
- No symptoms below knee
- Lumbar stiffness
- Good hip IR (>35°)

**Pre-test Probability of Dramatic Success with Manipulation**

- 45% (4 or more present)

**Post-test Probability of Dramatic Success with Manipulation**

- 95% (+LR = 24.3)

**Pre-Test Probability of Success**

- 45%

**Post-Test Probability of Success**

- 95%

At least 4/5 in CPR

(+ LR = 24.4)
Manipulation Treatment Group

- First two sessions (wk 1):
  - Spinal manipulation
  - AROM exercise
- Final 3 sessions:
  - Stabilization exercises

Validation of the Rule

4 or more present:
- Recent onset (<16 days)
- Low FABQ (<19)
- No symptoms below knee
- Lumbar stiffness
- Good hip IR (>35°)

Pre-test Probability of Dramatic Success with Manipulation
45%

Post-test Probability of Dramatic Success with Manipulation
92%

Group*CPR*Time Interaction
*Significant differences between +CPR/manip group and +CPR/exercise group and –CPR/manip group. No difference between +CPR/exercise and –CPR/exercise groups

Do Subgroups Matter?

Significant differences between +CPR/manip group and +CPR/exercise group and –CPR/manip group. No difference between +CPR/exercise and –CPR/exercise groups

Improvement on the ODQ for the 4-week follow-up based on the patient’s status with respect to the spinal manipulation prediction rule.
Validation of the Rule

2 factors present:
- Recent onset (<16 days)
- No symptoms below knee

Pre-test Probability of Dramatic Success with Manipulation

\[ +LR = 12.6 \]

Post-test Probability of Dramatic Success with Manipulation

Low Back Pain Classifications

- Manipulation
- Specific Exercise
- Stabilization
- Traction
- No symptoms below the knee
- Recent symptoms
- Hypomobility
- Low Fear-Avoidance
- More hip IR
- Manipulation and exercise
- Activities to Promote Centralization
- Stabilization exercises
- Mechanical/autotraction
- Centralization phenomenon
- Frequent prior episodes
- Hypermobility
- Leg pain, neurological sign

Admission of Eligible Patient
Chief’s LBP without signs of radiculopathy or prior fusion surgery

BASELINE EXAMINATION
Baseline Oswestry Assessment

Standardized Stabilization Exercise Program
2x/week – 8 weeks

FOLLOW-UP EXAMINATION
Eight-Week Oswestry Assessment

Exercise Intervention
**Stabilization Treatment**

**Multifidus/Erector Spinae**
- Quadruped Arm Lifts with Bracing
- Quadruped Leg Lifts with Bracing
- Quadruped Alternate Arm and Leg Lifts with Bracing

**Stabilization Treatment**

**Transversus Abdominus**
- Abdominal Bracing
- Bracing with Heel Slides
- Bracing with Leg Lifts
- Bracing with Bridging
- Bracing in Standing
- Bracing with Standing Row Exercise
- Bracing with Walking

**Stabilization Treatment**

**Quadratus Lumborum**
- Side Support with Knees Flexed
- Side Support with Knees Extended
- Side Support with Knees Flexed
- Side Support with Knees Extended
- Hanging Leg Lifts

**Predicting Dramatic Success**

3 or more present:
- Prone instability test
- Aberrant motions
- Average SLR >91°
- Age < 40

- Pre-test Probability of Dramatic Success with Stabilization: 33%
- Post-test Probability of Dramatic Success with Stabilization: 67%

**Predicting Improvement**

2 or more present:
- Prone instability test
- Aberrant motions
- Hypermobility
- FABQ-PA ≤ 8

- Pre-test Probability of Some Improvement with Stabilization: 72%
- Post-test Probability of Some Improvement with Stabilization: 94%
Low Back Pain Classifications

Manipulation
- No symptoms below the knee
- Recent symptoms
- Hypermobility
- Low Fear-Avoidance
- More hip IR

Specific Exercise
- Centralization phenomenon
- prone instability test
- Aberrant motions
- Hypomobility
- Younger age
- Greater SLR ROM

Stabilization
- Activities to Promote Centralization
- Stabilization exercises

Traction
- Log-pole neurological sign

Manipulation and exercise

Does it Matter Which Exercise?
A Randomized Control Trial of Exercise for Low Back Pain

- The role of “patient specific” exercises in managing LBP is controversial.
- Multicenter RCT to determine if LBP subgroups respond differently to contrasting exercise prescriptions
  - 312 patients with LBP underwent standardized examination to elicit a “directional preference” (DP)
  - Subjects randomized to: 1) directional exercises “matching” their DP,
    2) exercises directionally “opposite”, or 3) “nondirectional” exercises.
- Outcome measures included pain intensity, location, disability, medication use, degree of recovery, depression, and work interference.

Browder DA, Childs JD, Cleland JC, Fritz JM. Effectiveness of an extension-oriented treatment approach in a subgroup of patients with low back pain: a randomized clinical trial.

- Randomized clinical trial of 48 patients with lumbar radiculopathy:
  - Average age 39 years
  - Median symptom duration ~60 days
  - 56% with symptoms distal to the knee
  - 10% previous back surgery
- Randomized to receive:
  - Extension exercise and mobilization protocol
  - Stabilization exercise protocol

RCT

Adjusted ODI scores at each assessment point (*indicates significant difference between groups in change from baseline scores (p<0.05))

Does it Matter Which Exercise?
A Randomized Control Trial of Exercise for Low Back Pain

- Significantly greater improvements occurred in matched subjects compared with both other treatment groups in every outcome (P<0.001), including a threefold decrease in medication use.

RCT
Subjects

- 76 subjects with work-related low back pain:
  - Less than 3 weeks duration
  - 30 female, 46 male
  - Average age 38.0 ± 10.1 years
  - All subjects placed on work modifications and referred for physical therapy

Oswestry Scores

![Bar graph showing Oswestry Scores](image)

Return to Work Status After Four Weeks

<table>
<thead>
<tr>
<th></th>
<th>Guideline Group (n=36)</th>
<th>Classification Group (n=41)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Work Restrictions</td>
<td>21</td>
<td>34</td>
</tr>
<tr>
<td>Continued Work Restrictions</td>
<td>15</td>
<td>7</td>
</tr>
</tbody>
</table>

** p = 0.017

Purpose

To determine if patients with LBP would demonstrate greater functional improvement based on...
- the initial treatment received (regardless of classification),
- the classification sub-grouping (regardless of treatment),
- or the interaction of the two factors.

Identifying Subgroups of Patients With Acute/Subacute “Nonspecific” Low Back Pain

Results of a Randomized Clinical Trial

Gerard P. Brennan, PhD, PT; Julie M. Fritz, PhD, PT, SC; Stephen J. Hurter, MS, PT, CSCS; Anna Thackeray, PT; Anthony Gilchrist, PhD, PT, FAAOMPT; and Richard E. Ehnaid, DC, PT

SPINE Volume 31, Number 6, pp 623–631 ©2006, Lippincott Williams & Wilkins, Inc
LBP Classification and Treatment Process: Randomized Trial

**Acute Low Back Pain**

**Classification**

**RANDOM ASSIGNMENT**

- Manipulation
- Specific Exercise
- Stabilization

**Match**

**Unmatch**

**Treatment**

- **Manipulation**
- **Specific Exercise**
- **Stabilization**

**Factors favoring**

- More recent onset (<16 days)
- Hypoalgesia
- Positive prone instability test
- Positive signs on spring testing
- Greater SLR ROM (>90°)

**Factors against**

- Hypomobility
- Positive signs on spring testing
- Greater SLR ROM (>90°)

**Factors favoring**

- Preference for one posture
- Centralization with motion testing
- Peripheralization in a direction opposite centralization

**Factors against**

- Low back pain only (no distal sx)

**Sub-group Classification**

- Mobilization
- Immunobilization
- Specific Exercise

- Matched
- Unmatched

**Results**

- 1052 New patients with LBP referred to participating clinics during the recruitment period
- 227 Duration < 20 days
- 203 Age > 65 or < 18
- 178 Neurological signs present
- 119 Oswestry < 25%
- 47 Post-surgical
- 268 Categorized
- 123 Patients consenting
- 146 Patients not consenting
- Patients matched to randomized treatment group
- Patients not matched to randomized treatment group

**Treatment**

- Patients treated 2x/week for Four Weeks
  - Stage I randomly assigned Rx (Manip, SpEx, Stab)
  - (maximum visits = 8)
- Progressed to Stage II if ODI score improved:
  - to <20%
  - or improved 1/3 from initial ODI score
- Stage II was Multi-modal exercise
Results

Discussion

- Hypothesis supported:
  - Outcomes improved when initial treatment matched to a patient’s signs and symptoms using this sub-grouping method.
  - The outcome depended on the 3-way interaction of matching the “right” treatment to the patient’s “right” sub-group over time.
  - Homogenous vs Heterogeneous

What about CPRs for the Lower Extremity?

Development of a CPR to Identify Patients with Knee OA who Are Likely to Benefit from Hip Mobilizations

- Physical Therapy; In Press

Clinical Prediction Rule

<table>
<thead>
<tr>
<th>Item</th>
<th>Sn</th>
<th>Sp</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipsilateral Anterior Thigh Pain</td>
<td>.27</td>
<td>.95</td>
<td>5.1</td>
<td>.77</td>
</tr>
<tr>
<td>Ipsilateral Pain or Paresthesia in Hip/Groin</td>
<td>.20</td>
<td>.98</td>
<td>8.1</td>
<td>.82</td>
</tr>
<tr>
<td>Ipsilateral Knee Flex &lt;122°</td>
<td>.32</td>
<td>.95</td>
<td>6.0</td>
<td>.72</td>
</tr>
<tr>
<td>Ipsilateral Hip IR &lt;17°</td>
<td>.32</td>
<td>.95</td>
<td>6.0</td>
<td>.72</td>
</tr>
<tr>
<td>Pain with Ipsilateral Hip Distraction</td>
<td>.13</td>
<td>.98</td>
<td>5.2</td>
<td>.89</td>
</tr>
</tbody>
</table>

- Combination of any 2 CPR items; +LR=12.9
Results

- With pretest probability = 68%, post-test probability with positive test (any 2 CPR items) = 97%

Patellofemoral Pain

Taping CPR

- Pre-test/post-test design (n=50)
- Responders to CPR
  1. Positive patellar tilt test
  2. Tibial varum >5 degrees
     (+LR 4.4; 1.3, 12.3)

Orthotics and PFPS

- OTC and custom orthotics have been found to relieve anterior knee pain.
  - Sutlive, Phys Ther. 2004; Johnston, JOSPT, 2004
- Orthotic CPR developed to determine which patients would respond to off the shelf orthotics
  1. Forefoot varus of 2 degrees or greater
  2. Great toe extension less than 78 degrees
  3. Navicular drop test 3 mm or less
- No combination of factors resulted in +LR >2.0

Adapted from Sutlive, Phy Ther 2004

Manipulation CPR

- Iverson et al (CSM, 2006) prospective study
- May predict which PFPS pts respond to lumbopelvic manipulation
  - 50 patients with PFPS
  - Intervention was lumbopelvic manipulation
  - Outcomes

Manipulation CPR

- Hip internal rotation difference >14°
- No patient reported stiffness sitting >20 minutes
- Squatting most painful reported activity
- Navicular >3 mm
- Ankle dorsiflexion >16° with knee flexed
- Hip internal rotation difference >14° and any of the 3 remaining 4 predictors is 98% Specific and has a + LR of 10.0.
Clinical Decision Making

- Change in pre-test and post-test probability with subgroups of patients
  - Orthotics
  - Taping
  - Manipulation

Wow! That is a Lot of Evidence: Now What?

The Problem?

- Translation of evidence into clinical practice stalls.

How do we improve translation?

- 3 transitional blocks:
  - Impeded movement from basic science to clinical studies
  - Impeded progress of clinical evidence into practice standards
  - Progress of clinical evidence into routine practice stalls

1st Translational Block

Effects of Iontophoresis Current Magnitude and Duration on Dexmethasone Deposition and Localized Drug Retention

Time to abandon the “tendinitis” myth

Painful, overuse tendon conditions have a non-inflammatory pathology

2nd Translational Block
3rd Translational Block

- Translation of evidence and guidelines into clinical practice stalls.


Implementation Research

Time

Users

Innovators 2.5%

Early Adopters 13.5%

Early Majority 34%

Late Majority 34%

Laggards 16%

Skeptics

Trend setters

Opinion leaders

Time

The Problem?

- The process of implementing research or guidelines into practice requires significant behavior changes.

- Usually those that are required to change are expected to do so without compelling financial or other advantageous.

Two Reasons People Will Change

- 1. They think something really good will happen if they do

- 2. They think something really bad will happen if they don’t
Questions?