Evidence-Based Evaluation & Treatment of the Sacroiliac Joint

James R. Scifers, DScPT, PT, SCS, LAT, ATC
Western Carolina University
Athletic Training Education Program

Pelvic Anatomy

- Innominates
  - ischium
  - ilium
  - pubis
  - Sacrum

Important Bony Landmarks

- ASIS
- PSIS
- Pubis
- Ischial Tuberosities
- Iliac Crests
- Greater Trochanters

Articulations

- Sacroiliac Joints
- Pubic Symphysis
- Lumbo-Sacral Joint

Ligamentous & Soft Tissue Structures

- Sacrotuberous Ligament
- Piriformis
- Rectus Femoris
- Hamstrings
- Gluteus Medius
- Erector Spinae
- Abdominals

Biomechanics of the Pelvis

- Function of the SI Joint
  - transmit vertical forces
  - transmit ground reaction forces
Sacral Motions

- During trunk flexion...
  - Initially, sacral flexion occurs (base of sacrum moves anterior)
  - Later, sacral extension occurs with continued trunk flexion (base of sacrum moves posterior)

Arthrokinematics of the SI Joint

- Sacral Base (S1)
- Sacral Apex (S5)
- Flexion (nutation) occurs during exhalation
- Extension (counternutation) occurs during inhalation

Dysfunction Classification

- Sacroiliac Joint (SIJ)
  - Any injury to SIJ
- Ilio-Sacral (IS)
  - ilium (innominate) moving on sacrum
- Sacro-Iliac (SI)
  - sacrum moving on ilium
- Pubic Shear
  - Pubic symphysis / Pubic shear lesion

Ilio-Sacral (IS) Dysfunctions

- Named for motion at PSIS
  - anterior rotation
  - posterior rotation
  - up-slip
  - down-slip (rare)
  - in-flare
  - out-flare

Sacro-Iliac (SI) Dysfunctions

- Sacral Rotations
  - Named for “direction facing on axis”
  - Forward Rotations
    - right on right
    - left on left
  - Backward Rotations
    - right on left
    - left on right

Pubic Shear Lesions

- Named for any movement at pubic symphysis
- Indicates injury to pubic symphysis
Muscular Influences

- Hamstrings
  - Tight (posterior rotation) or weak (anterior rotation)
- Iliopsoas / Rectus Femoris
  - Tight (anterior rotation) or weak (posterior rotation)
- Gluteus Medius / Minimus
  - Weak (outflare) or tight (inflare)
- Piriformis
  - Stretch (forward sacral rotations)
- Abdominals
  - Weak (all SIJ conditions)

SI Evaluation

- History*
- Observation**
- Palpation**
- AROM / PROM
- MMT
- Special Tests*
- Neurologic Exam

Evidence-Based Practice (EBP)

- Reliability (k) is reproducibility of test results, can be intra-tester (within one clinician) or inter-tester (between multiple clinicians)
- Sensitivity (sens) is the ability of test to RULE OUT a condition. The higher the sensitivity, the greater chance that a NEGATIVE test means the condition is absent
  - High sensitivity + negative test = rule condition out (SnNout)
- Specificity (spec) is the ability of test to RULE IN a condition. The higher the specificity, the greater chance that a POSITIVE test means the condition is present
  - High specificity + positive test = rule condition in (SpPin)

Evidence-Based Practice (EBP)

- Positive Likelihood Ratio (+LR) indicates the likelihood that a POSITIVE test means the condition is present
- Negative Likelihood Ratio (-LR) indicates the likelihood that a NEGATIVE test means the condition is absent

Strength of Recommendation Taxonomy (SORT)

<table>
<thead>
<tr>
<th>SORT Category</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SORT A</strong></td>
<td>Consistent, good-quality, patient-oriented evidence</td>
</tr>
<tr>
<td><strong>SORT B</strong></td>
<td>Inconsistent or limited-quality, patient-oriented evidence</td>
</tr>
<tr>
<td><strong>SORT C</strong></td>
<td>Consensus, disease-oriented evidence, usual practice, expert opinion, or case series</td>
</tr>
</tbody>
</table>

History

- SI pain typically unilateral, may refer
- Pain typically localized to involved SI joint
  - Sens = .76, Spec = .47, +LR = 1.4, -LR = 0.51
- Pain may increase with trunk rotation, sidegiding, trunk/hip extension or sidelying
- MOI may include falling or twisting
- MOI more often insidious (48 hour rule to assess for cause)
- Aggravating Activities usually includes sitting
  - Sens = .03, Spec = .90, +LR = 0.3, -LR = 1.07

Clinical Application #1: Failure to report pain at the PSIS is a good predictor for patient NOT suffering from SIJ pathology
Clinical Application #2: Pain increased with sitting is a good indicator that patient may be suffering from SIJ pathology
### Pain Referral Patterns

<table>
<thead>
<tr>
<th>Pain Location</th>
<th>Frequency</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar Spine</td>
<td>72%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Buttock</td>
<td>94%</td>
<td>0.80</td>
<td>0.14</td>
<td>0.9</td>
<td>1.42</td>
</tr>
<tr>
<td>Groin</td>
<td>14%</td>
<td>0.19</td>
<td>0.63</td>
<td>0.01</td>
<td>1.29</td>
</tr>
<tr>
<td>Thigh</td>
<td>48%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Lower Leg</td>
<td>28%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Foot</td>
<td>12%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Clinical Application:** Failure to report buttock pain is a good predictor for patient NOT suffering from SIJ pathology.

### Observation

- Observe for spasm of erector spinae
- Observe muscle tone of gluteals
- Observe symmetry:
  - PSIS
  - Iliac Crests
  - ASIS
  - Greater Trochanter
  - Pubic Tubercle

### Palpation

- **Standing:**
  - ASIS
  - PSIS (k = .13 - .37)
  - Iliac Crests (k = .23 - .41)
  - Greater Trochanters
- **Prone:**
  - Sacrum
  - Inf Lat Angle of Sacrum (k = .69)
  - Sacral Sulcus (k = .24)
  - Sacrotuberous Ligament
  - Piriformis (or sidelying)
- **Supine:**
  - Pubic Tubercle

### Palpation Location of Pain

<table>
<thead>
<tr>
<th>Locations</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacral Sulcus &amp; PSIS</td>
<td>0.49</td>
<td>0.60</td>
<td>1.2</td>
<td>0.85</td>
</tr>
<tr>
<td>Sacral Sulcus &amp; Groin</td>
<td>0.11</td>
<td>0.73</td>
<td>0.40</td>
<td>1.22</td>
</tr>
<tr>
<td>PSIS &amp; Groin</td>
<td>0.16</td>
<td>0.85</td>
<td>1.10</td>
<td>0.99</td>
</tr>
</tbody>
</table>

**Clinical Application:** Patients reporting pain in the region of the PSIS and the groin are likely to be suffering from SIJ pathology.

### Palpation of Piriformis

### Sacrotuberous Ligament Palpation
Alignment & Symmetry
- Iliac Crest Heights: higher or lower
- PSIS Relationships: superior-inferior, medial-lateral
- ASIS Relationships: superior-inferior, medial-lateral

Greater Trochanter Levels: higher or lower
Sacral Sulcus Depths: deeper or shallower
Inferior Lateral Angle of Sacrum: deeper or shallower

Very low inter-tester reliability values (k = .13 - .37) with exception of inferior lateral angle of sacrum (k = .69)

Active / Passive Range of Motion
- AROM tested in standing or sitting
- PROM tested in supine or prone

Stress at SI Joint:
- Spine flexion 40-60°
- Spine extension 20-35°
- Spine rotation 3-18°
- Spine side glide 15-20°
- Hip flexion 100-120°
- Hip extension 0-15°

Clinical Application: Pain increased with AROM or PROM Hip Extension to end-range can help differentiate SIJ pathology from Lumbar Spine pathology

Manual Muscle Testing
- As needed (not usually necessary for diagnosis)
  - Trunk flexion
  - Abdominals
  - Hip flexion
  - Hip abduction
    - Gluteus Medius
    - Gluteus Minimus
  - Hip adduction
  - Hip extension
  - Knee flexion
  - Trunk extension
  - Bridging

Clinical Application: Pain increased with bridging is often indicative of SIJ pathology

Neurologic Assessment
- Should be normal in presence of SIJ dysfunction
  - Dermatomes (L1-S2)
  - Myotomes (L1-S2)
  - Reflexes
    - Patellar Tendon (L3-L4)
    - Achilles Tendon (S1-S2)

Special Tests

Pain Provocation Tests
- Straight Leg Raise Test
- Gaenslen Test
- Thigh Thrust Test
- Flamingo Test
- FABER / Patrick’s Test
- Gapping Test
- Compression Test
- Sacral Spring / Sacral Thrust Test
- SI Rock Test

Positional Tests
- Trunk Flexion Test
- March Test
- Supine to Sit Test
- True LLD Test
- Apparent LLD Test
- Trendelenburg’s Sign
- Thomas Test

Clinical Application: SIJ special tests should always be used diagnostically in combination & not in isolation

Special Test Literature
- Provocation Tests have little predictive value in isolation or combination
- Inter-tester Reliability of Positional Special Tests is low
- Positional Special Tests performed in combination greatly increase value of findings
  - 3/6 positive Special Tests (distraction, compression, thigh thrust, Gaenslen, sacral spring) had .91 sensitivity & .78 specificity, + LR = 4.16, - LR = 0.12
  - 219 patients, 4 Special Tests (standing flexion, PSIS palpation, supine to sit, prone knee flexion) had .82 sensitivity & .88 specificity, + LR = 6.82, - LR = 0.20

Clinical Application: SIJ special tests should always be used diagnostically in combination & not in isolation
**Straight Leg Raise Test**
- Clinician passively flexes hip with knee extended
- Pain at 0-30 degrees—hip pathology or nerve root
- Pain at 30-50 degrees—sciatic nerve involvement
- Limited ROM of less than 70 degrees—hamstring tightness
- Pain at 70-90 degrees—sacroiliac joint involvement

**Gaenslen Test**
- Patient is supine with both legs extended
- Uninvolved knee is brought to chest while involved hip remains in extension
- Overpressure is applied to involved side
- Positive test is pain indicating SIJ involvement

**Thigh Thrust Test**
- Patient is supine
- Involved hip is flexion and adducted
- Posterior shearing force is applied through femur in varying degrees of hip adduction / abduction
- Positive test is buttock pain indicating SIJ involvement

**Flamingo Test**
- SLS causes or increases pain on involved side—may also include buttock pain
- Patient may be asked to hop on one leg to increase or cause pain
- Positive test is indicative of SIJ pathology or pubic shear lesion

**FABER or Patrick Test**
- Patient supine with hip positioned in flexion, abduction and external rotation
- Clinician applies over-pressure at knee toward table while stabilizing opposite ASIS
- Positive test is pain indicating SIJ pathology
- If patient exhibits a decrease in pain, an out-flare should be suspected

**Gapping or Distraction Test**
- Patient supine
- Clinician applies crossed-arm outward pressure on the ASIS
- Positive test is pain, indicating SIJ pathology
- If patient reports relief of pain, an out-flare should be considered
Compression Test

- Patient is positioned in supine or sidelying
- Clinician applies medial pressure at iliac crests to compress ASIS
- Positive test is pain indicating out-flare
- Relief of pain indicates SIJ pathology

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.60-0.70</td>
<td>0.69-1.00</td>
<td>2.26-7.00</td>
<td>0.33-1.00</td>
</tr>
</tbody>
</table>

K = .26 – .73

Trunk Flexion Test

- Palpate PSIS bilaterally in sitting or standing
- Painful PSIS is lower
- Painful PSIS rises higher during flexion
- Painful PSIS moves first and “most” (PSIS heights are equal at conclusion of test)
- Positive test indicates posterior rotation

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

K = .08 – .68

Gillet or March Test

- Patient brings knee to chest in either standing or sitting
- Clinician looks for downward motion of PSIS
- Uninvolved side will move inferiorly, involved side will move less or not at all
- Positive test indicates posterior rotation

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.43</td>
<td>0.68</td>
<td>1.3</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Intra-tester K = .02 – .31, Inter-tester K = .02 – .50

Supine to Sit

- Patient is supine
- Patient performs a bridge
- Clinician assesses leg length at medial malleolus
- Patient is instructed to sit up while applying traction to bilateral lower extremities
- Positive findings are a change in leg length
  - posterior rotation: short to long
  - anterior rotation: long to short
  - LLD: long to long or short to short

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

K = .19

True Leg Length Measurement

Measured ASIS to medial or lateral malleolus, indicates bony differences between lower extremities

Apparent Leg Length Measurement

Measured Umbilicus to medial or lateral malleolus, indicates innominate rotation
**Trendelenburg’s Sign**

- Patient performs SLS
- Clinician observes pelvic height from behind patient
- Inferior movement of iliac crest on non-stance side indicates weak gluteus medius on stance side
- This is an associated sign in presence of out-flare or SIJ pathology

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Thomas Test**

- Patient is supine at edge of table
- Uninvolved knee is passively brought to chest
- Positive test is involved lower extremity demonstrating:
  - Hip flexion (tight iliofemoral)
  - Associated finding with anterior rotation
  - Knee extension (tight RF)
  - Associated finding with anterior rotation
  - Hip abduction (tight ITB/TFL)
  - Associated finding with in-flare

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Sacral Thrust or Sacral Springing**

- Patient is prone
- Clinician applies downward pressure to sacrum
- Positive test is pain, indicating sacral rotation
- Test can be repeated on four corners of sacrum

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.27-0.75</td>
<td>0.29-1.00</td>
<td>0.75-3.00</td>
<td>0.50-1.62</td>
</tr>
</tbody>
</table>

**SI Rock Test**

- Patient is supine
- Clinician passively brings involved knee to opposite shoulder (combination of hip flexion and internal rotation) and applies overpressure
- Positive test is buttock pain indicating involvement of sacrotuberous ligament
  - Left on right rotation
  - Right on left rotation

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Symphysis Pubis Test**

- Patient is supine
- Examiner places heel of one hand on superior pubic ramus and heel of other hand on inferior pubic ramus
- Examiner applies shearing force to pubic symphysis
- Pain indicates pubic shear lesion

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Special Test Take-Home Points**

- Perform special tests in combination to improve diagnostic accuracy
  - Best tests for ruling-in SIJ pathology are FABER, Thigh Thrust, Gaenslen & Gapping Tests
  - Best test for ruling-out SIJ pathology is Thigh Thrust Test
  - Best tests for ruling-in posterior rotation are March & Supine to Sit Tests
**Special Test Take-Home Points**

- Best test for **ruling-in** an outflare is the Compression Test
- Best test for **ruling-in** an SI Dysfunction is the Sacral Spring Test
- Best test for **ruling-in** a pubic shear lesion is the Flamingo Test

**Treatment Strategies**

- Muscle Energy Techniques
- Joint Mobilization Techniques
- Stretching Techniques
- Strengthening Techniques
- Dynamic Lumbar Stabilization

**Movement / Resistance Key**

- Isometric Patient Generated Force
- Clinician Generated Force

**Anterior Rotation**

- Problem List?
- MET
- Hamstrings
- Joint Mobilizations
  - Posterior Mobilization
- Stretching
  - Rectus Femoris & Hip Flexors
- Strengthening
  - Hamstrings & Core

Also may use Scissoring or Arm Break to treat anterior or posterior rotation

**Posterior Joint Mobilization**

- Problem List?
- MET
- Quadriceps
- Joint Mobilizations
  - Anterior Mobilization
- Stretching
  - Hamstrings
- Strengthening
  - Quadriceps & Core

**Posterior Rotation**

- Problem List?
- MET
- Quadriceps
- Joint Mobilizations
- Anterior Mobilization
- Stretching
  - Hamstrings
- Strengthening
  - Quadriceps & Core

Also may use Scissoring or Arm Break to treat anterior or posterior rotation
Anterior Joint Mobilization

- Typically secondary to trauma
- Problem List?
  - MET
    - None
  - Joint Mobilizations
    - Inferior Glide / Long Axis Distraction
  - Stretching
    - None
  - Strengthening
    - None

Upslip

- 5 degrees hip flexion, 30 degrees hip abduction with hip ER or hip IR

In-flare

- Problem List?
- MET
  - Adductors
- Joint Mobilizations
  - In-flare Mobilization (forced hip adduction with flexion…SI Rock Test)
- Stretching
  - ITB & TFL
- Strengthening
  - Adductors & Core

Alternate In-flare MET

- Problem List?
- MET
  - Abductors
- Joint Mobilizations
  - In-flare Mobilization (force hip abduction with ER…FABER Test)
- Stretching
  - Adductors
- Strengthening
  - Gluteus Medius / Minimus & Core

Out-flare

- Problem List?
- MET
  - Adductors
- Joint Mobilizations
  - In-flare Mobilization (forced hip adduction with flexion…SI Rock Test)
- Stretching
  - Adductors
- Strengthening
  - Gluteus Medius / Minimus & Core

Out-flare Mobilization

- Problem List?
- MET
  - Adductors
- Joint Mobilizations
  - In-flare Mobilization (forced hip adduction with flexion…SI Rock Test)
- Stretching
  - Adductors
- Strengthening
  - Gluteus Medius / Minimus & Core
**Right on Right Sacrum**
- Problem List?
- MET
  - None
- Joint Mobilizations
  - Sacral Springing on inferior right angle of sacrum
- Other
  - Stretch / Treat Right Piriformis & Strengthen Core

**Left on Left Sacrum**
- Problem List?
- MET
  - None
- Joint Mobilizations
  - Sacral Springing on inferior left angle of sacrum
- Other
  - Stretch / Treat Left Piriformis & Strengthen Core

**Right on Left Sacrum**
- Problem List?
- MET
  - None
- Joint Mobilizations
  - Sacral Springing on superior right angle of sacrum
- Other
  - Address left STL pain & Strengthen Core

**Left on Right Sacrum**
- Problem List?
- MET
  - None
- Joint Mobilizations
  - Sacral Springing on superior left angle of sacrum
- Other
  - Address right STL pain & Strengthen Core

**Sacral Mobilizations**

**Pubic Shear Lesions**
- Problem List?
- MET
  - Pubic MET
    - 1. Resist abduction in 0 degrees, 2. Resist abduction in 60 degrees, 3. Resist adduction in 60 degrees
- Joint Mobilizations
  - Pubic Shear Mobilization
Order of Treatment Procedures

- Pubic Lesions
- Sacral Lesions (SI)
- Innominate Lesions (IS)
- Dynamic Lumbar Stabilization
- Function Strengthening / Progression

References


Questions?