Evidence-Based Evaluation & Treatment of the Sacroiliac Joint

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Moravian College
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Pelvic Anatomy

- Innominates
  - ischium
  - ilium
  - pubis
  - Sacrum

Articulations

- Sacroiliac Joints
- Pubic Symphysis
- Lumbo-Sacral Joint

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 (countermutation)
  - 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

**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>SORT A</td>
<td>Consistent, good-quality, patient-oriented evidence</td>
</tr>
<tr>
<td>SORT B</td>
<td>Inconsistent or limited-quality, patient-oriented evidence</td>
</tr>
<tr>
<td>SORT C</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, side gliding, 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

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>Buttok</td>
<td>54%</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>0.51</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>

Observation
- Observe for spasm:
  - Erector Spinae
- Observe muscle tone:
  - Gluteals
- Observe symmetry:
  - PSIS
  - Iliac Crests
  - ASIS
  - Greater Trochanter
  - Pubic Tubercle

Palpation
- Standing:
  - ASIS
  - PSIS (κ x 13 - .37)
  - Iliac Crests (κ x 23 - .41)
  - Greater Trochanters
- Prone:
  - Sacrum
  - Inf Lat Angle of Sacrum (κ x 69)
  - Sacral Sulcus (κ x 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>1/LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacral Sulcus &amp; PSIS</td>
<td>0.49</td>
<td>0.68</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>0.48</td>
<td>1.22</td>
</tr>
<tr>
<td>PSIS &amp; Groin</td>
<td>0.06</td>
<td>0.85</td>
<td>1.10</td>
<td>0.96</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.

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### Sacrotuberous Ligament Palpation

![Sacrotuberous Ligament Palpation Image]

### ASIS Palpation

![ASIS Palpation Image]

### PSIS Palpation

![PSIS Palpation Image]

### Iliac Crest Palpation

![Iliac Crest Palpation Image]

### Piriformis Palpation

![Piriformis Palpation Image]
**Alignment & Symmetry**

- Iliac Crest Heights
  - higher or lower
- PSIS Relationships
  - superior-inferior
  - medial-lateral
- ASIS Relationships
  - superior-inferior
  - medial-lateral

Very low inter-tester reliability values \((k = 0.13 - 0.37)\) with exception of inferior lateral angle of sacrum \((k = 0.69)\).

**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°

**Manual Muscle Testing**

- As needed (not usually necessary for diagnosis)

**Neurologic Assessment**

- Should be normal in presence of SI dysfunction

**Special Tests**

**Pain Provocation Tests**

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

**Positional Tests**

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

**Special Test Literature**

- Provocation Tests have little predictive value in isolation or combination\(^1\)
- Inter-tester Reliability of Positional Special Tests is low \(^6,8\)
- Positional Special Tests performed in combination greatly increase value of findings \(^7,10,22-23\)

**Clinical Application:** SIJ special tests should always be used diagnostically in combination & not in isolation.
**Special Test Literature**

- Laslett, et al (2005)\(^{23}\)
  - 2 of 4 Positive Special Tests
  - Thigh Thrust, Distraction, Compression & Sacral Spring

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<th>Sens.</th>
<th>Spec.</th>
<th>+ LR</th>
<th>- LR</th>
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<tbody>
<tr>
<td>.88</td>
<td>.78</td>
<td>4.00</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Take Home Message:
- In combination, tests are good for ruling in and ruling out SIJ dysfunction

- Van der Wuff, et al (2006)\(^{22}\)
  - 3 of 5 Positive Special Tests
  - Thigh Thrust, Distraction, Compression, Patrick’s & Gaenslen’s

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<th>+ LR</th>
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<tbody>
<tr>
<td>.85</td>
<td>.79</td>
<td>4.02</td>
<td>0.19</td>
</tr>
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Take Home Message:
- In combination, tests are good for ruling in and ruling out SIJ dysfunction

- Laslett, et al (2003)\(^{7}\)
  - 3 of 5 Positive Special Tests
  - Thigh Thrust, Distraction, Compression, Gaenslen’s & Sacral Spring

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<tr>
<td>.91</td>
<td>.87</td>
<td>4.16</td>
<td>0.11</td>
</tr>
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Take Home Message:
- In combination, tests are excellent for ruling in and ruling out SIJ dysfunction

- Cibulka & Koldehoff (1999)\(^{9}\)
  - 4 of 4 Positive Special Tests, 219 subjects
  - Standing Flexion, Sitting PSIS Palpation, Supine to Sit & Prone Knee Flexion Test

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<th>Sens.</th>
<th>Spec.</th>
<th>+ LR</th>
<th>- LR</th>
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<tbody>
<tr>
<td>.82</td>
<td>.88</td>
<td>6.83</td>
<td>0.20</td>
</tr>
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Take Home Message:
- In combination, tests are good to excellent for ruling in and ruling out SIJ dysfunction

**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

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<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
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<tbody>
<tr>
<td>0.78-0.97</td>
<td>0.10-0.57</td>
<td>1.00-1.98</td>
<td>0.05-0.35</td>
</tr>
</tbody>
</table>

(All data for detecting lumbar disc herniation, not SIJ pathology)\(^{21}\)

**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

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<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.21-0.71</td>
<td>0.26-0.77</td>
<td>0.75-2.21</td>
<td>0.65-1.12</td>
</tr>
</tbody>
</table>

(\(^{8}\) = .54 - .76, \(^{11}, 16, 8, 20\))
**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

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<th>Specificity</th>
<th>+LR</th>
<th>-LR</th>
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<tbody>
<tr>
<td>0.36-0.88</td>
<td>0.55-1.00</td>
<td>0.70-2.80</td>
<td>0.20-1.28</td>
</tr>
</tbody>
</table>

**FABER or Patrick Test**
- Patient supine with hip positioned in flexion, abduction and external rotation
- Clinician applies overpressure 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

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<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+LR</th>
<th>-LR</th>
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</thead>
<tbody>
<tr>
<td>0.10-0.77</td>
<td>0.16-1.00</td>
<td>0.41-0.82</td>
<td>0.23-1.94</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.55-0.60</td>
<td>0.81-1.00</td>
<td>3.20</td>
<td>0.49</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
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<th>Sensitivity</th>
<th>Specificity</th>
<th>+LR</th>
<th>-LR</th>
</tr>
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<tbody>
<tr>
<td>0.60-0.70</td>
<td>0.69-1.00</td>
<td>2.20-7.00</td>
<td>0.33-1.00</td>
</tr>
</tbody>
</table>

**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>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

**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>
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<th>Sensitivity</th>
<th>Specificity</th>
<th>+LR</th>
<th>-LR</th>
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<tbody>
<tr>
<td>0.43</td>
<td>0.68</td>
<td>1.3</td>
<td>0.84</td>
</tr>
</tbody>
</table>
Supine to Sit
- Patient is supine
- Patient performs a bridge
- Clinician assesses leg length at medial malleoli
- 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

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

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 iliopsoas)
  - Associated finding with anterior rotation
  - Knee extension (tight RF)
  - Associated finding with anterior rotation
  - Hip abduction (tight ITB/TFL)
  - Associated finding with in-flare

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>Supine to Sit</th>
<th>True Leg Length Measurement</th>
<th>Apparent Leg Length Measurement</th>
<th>Trendelenburg’s Sign</th>
<th>Thomas Test</th>
<th>Sacral Thrust or Sacral Springing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient is supine</td>
<td>Measured ASIS to medial or lateral malleolus, indicates bony differences between lower extremities</td>
<td>Measured Umbilicus to medial or lateral malleolus, indicates innominate rotation</td>
<td>Patient performs SLS</td>
<td>Patient is supine at edge of table</td>
<td>Patient is prone</td>
</tr>
<tr>
<td>Patient performs a bridge</td>
<td></td>
<td></td>
<td>Clinician observes pelvic height from behind patient</td>
<td>Uninvolved knee is passively brought to chest</td>
<td>Clinician applies downward pressure to sacrum</td>
</tr>
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<td>Clinician assesses leg length at medial malleoli</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Patient is instructed to sit up while applying traction to bilateral lower extremities</td>
<td></td>
<td></td>
<td>This is an associated sign in presence of out-flare or SIJ pathology</td>
<td>Hip flexion (tight iliopsoas)</td>
<td>Test can be repeated on four corners of sacrum</td>
</tr>
<tr>
<td>Positive findings are a change in leg length</td>
<td></td>
<td></td>
<td></td>
<td>Associated finding with anterior rotation</td>
<td></td>
</tr>
<tr>
<td>posterior rotation: short to long</td>
<td></td>
<td></td>
<td></td>
<td>Knee extension (tight RF)</td>
<td></td>
</tr>
<tr>
<td>anterior rotation: long to short</td>
<td></td>
<td></td>
<td></td>
<td>Associated finding with anterior rotation</td>
<td></td>
</tr>
<tr>
<td>LLD: long to long or short to short</td>
<td></td>
<td></td>
<td></td>
<td>Hip abduction (tight ITB/TFL)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Associated finding with in-flare</td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Sensitivity</th>
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<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.44</td>
<td>0.64</td>
<td>1.37</td>
<td>0.88</td>
</tr>
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</table>

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<th>Sensitivity</th>
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<tr>
<td>N/A</td>
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<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>
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<td>N/A</td>
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</tbody>
</table>

K = .19

K = .30

10

1, 6, 17

-18, 20

Sensitivity
Specificity
+ LR
- LR

0.27-0.75
0.29-1.00
0.75-3.00
0.50-1.62
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 buttoc k pain
- Indicating involvement of sacrotuberous ligament
  - left on right rotation
  - right on left rotation

<table>
<thead>
<tr>
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<td>N/A</td>
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<td>N/A</td>
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</tbody>
</table>

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

<table>
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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

<table>
<thead>
<tr>
<th>Treatment Strategies</th>
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<tbody>
<tr>
<td>Muscle Energy Techniques</td>
</tr>
<tr>
<td>Joint Mobilization Techniques</td>
</tr>
<tr>
<td>Stretching Techniques</td>
</tr>
<tr>
<td>Strengthening Techniques</td>
</tr>
<tr>
<td>Dynamic Lumbar Stabilization</td>
</tr>
</tbody>
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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 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.

**Upslip**

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

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

**In-flare**

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

Left on Left Sacrum

Left on Right Sacrum

Right on Right Sacrum

Right on Left Sacrum

Sacral Mobilizations

- Problem List?
- MET
  - None
- Joint Mobilizations
  - Sacral Springing on inferior right angle of sacrum
- Other
  - Stretch / Treat Right Piriformis & Strengthen Core

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

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

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

- Problem List?
- MET
  - None
- Joint Mobilizations
  - Sacral Springing on superior left angle of sacrum
- Other
  - Address right STL pain & Strengthen Core
Order of Treatment Procedures

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

References


Questions?