Orthopedic Manual Therapy of the Sacroiliac Joint and Pelvis: An Evidence Based Approach to Success

Dr. Eric (Rick) Douglass, PT, DPT, OCS, KTCC, FAAOMPT
Objectives

- Review mechanoreceptors and pain production
- Review histology of common tissues in lesion
- Review common SIJ and pelvic pathology
- Discuss tissue specific lesion examination
- Discuss designing a tissue specific treatment plan
Neuropathology & Mechanoreceptors

- Mechanoreceptors: located in capsules of synovial joints
  - Found to have a profound effect on both muscle tone and pain sensation

- Types I, II, III, and IV
Neuropathology & Mechanoreceptors

Figure 1
Mechanoreceptors

- **Type I: Proprioception**, slow adapting, and inhibit pain
  - Help provide stability → higher concentration in areas that require stability such as shoulder, neck, and hip
  - Stimulate with quick stretch; tension on capsule
  - Active in beginning and end range of collagen tension
- **Type II: Dynamic sensation**, fast adapting, and inhibit pain
  - Help provide mobility → higher concentration in lumbar spine, hand, foot, and TMJ
  - Stimulate with oscillations
  - Active in beginning and midrange of collagen tension
- **Type III: Reflex inhibition** of muscle tone, dynamic, very slow
  - Protective response at extreme end range of collagen tension
- **Type IV: Pain**, non-adapting, receptors fire until noxious stimulus ceases
  - Noxious stimuli include > 3% mechanical deformation, chemical (bradykinins, histamine, prostaglandin), or increased temperature > 44.8°C
  - Only fires once deformity in collagen noted
  - Responds to stretch at end-range
  - **Goal**: Inhibit Type IV receptors to decrease pain and guarding
Histology of Common Tissues in Lesion

- Type 1 Collagen
- Type 2 Collagen
- Type 3 Collagen Scar Tissue
- Bone
Type 1 Collagen

- **Location:**
  - Muscle Tendons, Ligaments, Fascia, Dermis, Fibrous Cartilage and the Annulus of the Intervertebral Disc

- **Main Function:**
  - Resist Tension

- **Optimal Stimulus For Regeneration:**
  - Modified Tension in the Line of Stress
Type 2 Collagen

- **Location**
  - Articular and Elastic Cartilage, Nucleus of the Intervertebral Disc

- **Main Function**
  - Resist Intermittent Pressure

- **Optimal Stimulus For Regeneration:**
  - Compression and Decompression with Glide
Type 3 Collagen: Scar Tissue

- **Formation**
  - Response to chronic inflammation
  - Increase in connective tissue production
Scar Tissue

• Result
  – Leads to **Tight** and **Short** tissue
  – **Decreased** ROM

• Inhibit Formation
  – Inhibit myofibroblastic activity
  – Goal: make scar as **Small** as possible and increase the capacity of the scar to tolerate tension. Achieved by the providing optimal stimulus for regeneration for the tissue in lesion
Bone

- Composition
  - Type 1 and Type 2 Collagen with Mineralization
- Optimal Stimulus for Regeneration:
  - Compression and Decompression
The Manual Therapy Lesion

1. **Collagen/Tissue Trauma:** Tear in capsule, ligament, tendon, muscle etc. May be acute or slow progression

2. **Receptor Damage:** Structural damage in capsules. Type I tonic and stability receptors most easily damaged due to its superficial placement. Type II also damaged

3. **Reduced Muscle Fiber Recruitment:** Type I tonic muscles reduced ability to recruit muscle fibers secondary to trauma

4. **Tonic Fiber Atrophy:** Decreased recruitment and trauma leads to atrophy of the muscle. Type I tonic more easily affected. Type II phasic
5. **Reduced Anti-Gravity Stability:** Atrophy and reduced ability to recruit desired musculature leads to decreased stability and support in the joint.

6. **Motion Around Nonphysiological Axis:** The stabilizing muscles are no longer able to support the joint around a physiologic axis and creates alteration in motion. See compensatory motion.

7. **Trauma/Acute Locking/Degeneration:** The movement around a nonphysiologic axis increases trauma and may lead to locking or degeneration of the joint.

8. **Pain/Guarding:** The deformity leads to firing of type IV mechanoreceptors, thus causing pain and guarding.
Tissue Specific Evaluation

- PURPOSE
  - To identify:
    1. **Load sensitivity** of key ligamentous and fascial structures
    2. **Abnormal function at articulations** between the ilia, the sacrum and the pubis
SIJD: What is the “Tissue in Lesion”

- Levangie, PK (Phys Ther 1999; 79: 1043-1057) presented two hypotheses:
  1. **Asymmetry** of the pelvis *causes* a nociceptive mechanical stress on the structures attached to the innominate bone or within the SIJ.
  2. **SIJ hypomobility**, *with or without* positional abnormalities, places painful mechanical stress on surrounding tissues.
Force Distribution

- Form closure
  - Wedge shape of the sacrum

Force Closure – 4 Components for force distribution
1. Transmit forces from vertebral body to lower limbs
2. Ground reaction forces partly transmitted through acetabulum
3. Partly cross horizontal ramus of pubic bone
4. Counterbalanced through pubic from the opposite side
SIJD: What is the “Tissue in Lesion”

- Peter O'Sullivan
- https://www.youtube.com/watch?v=RbSF3-b7bl&app=desktop
Differential Diagnosis- Maigne’s Syndrome

- Low Back Pain of Thoracolumbar Origin (T11-T12-L1) from the book *Diagnosis and Treatment of Pain of Vertebral Origin* by Robert Maigne
Differential Diagnosis - Maigne’s Syndrome

- **Anatomic Review:** T12 is a *transitional vertebra* and is therefore the sight of the *majority of trunk rotation* which is limited by the ribs above and facet orientation below.
Differential Diagnosis- Maigne’s Syndrome

- **Pain Referral Pattern:** multiple studies clearly reveal that the innervation of the subcutaneous tissues of the superior part of the buttocks is innervated by T12, L1, and L2 (#2 posterior ramus, cluneal nerve)
Differential Diagnosis- Maigne’s Syndrome

- **Clinical Presentation:**
  1. Pain is *practically never* felt at its *origin* (T12/L1)
  2. It is *generally unilateral* but sometimes bilateral
  3. The pain can be *acute* but *most often* it is *chronic*
  4. **Contralateral sidebending** is often *provocative*
Differential Diagnosis: SI Lipoma

- SI Lipomata - an often unrecognized cause of LBP (Sengewald ’65)
- Lipoma: a benign tumor consisting of fat tissue
Differential Diagnosis: SI Lipoma

**Clinical Presentation:**

1. (-) Neuro
2. (-) SLR
3. Forward bending mildly restricted
4. Small, palpable tender area over posterior iliac crest
5. Sometimes irritated with supine lying, sitting against hard surfaces
Differential Diagnosis: SI Lipoma

- **Clinical Description:**
  - **Sequence of Events**
    1. Fatty tissue herniates through the weak, deeper layers of TL fascia,
    2. Fatty tissue becomes entrapped between deep and superficial layers of fascia,
    3. Can become edematous and unyielding
    4. Therefore painful with tension

- **Treatment:**
  - Massage and Exercise to:
    - increase blood flow, increase drainage, relieve congestion, injection, tissue dry needling
Tissue Specific Evaluation Flow of Procedures

- Initial observation
- History/Interview
- Structural inspection
- Active motion
- Passive motion
- Resisted motion
- Palpation
- Neurology tests
- Special Tests
- Joint Play
- Segmental Play
- X-ray, MRI, Labs, EMG
History/Subjective: Where is your pain?


  Lower lumbar 72%
  Buttock 94%
  Thigh 48% (99% medial thigh)

Only 28% experienced pain in the lower leg
History/Subjective: What makes it better/worse?

- In studies by Schwarzer et al (Spine 1995; 20: 31-37) and Dreyfus (Spine 1996; 21: 2594-2602) the authors concluded that
  - No aggravating or relieving factor was of value for the dx of SIJ related pain
  - None of the history items reached significance → None were able to discriminate between patient groups
AROM tests: Of what? In which direction?

- Studies by two different authors, Schwarzer et al (Spine 1995; 20: 31-37) and Maigne et al (Spine 1996; 21: 1889-1892) revealed:
  - Testing the planes of trunk motion (flexion, extension and bilateral sidebending, bilateral rotation and bilateral rotation with contralateral extension) did not provide any useful information as predictors of low back pain.
Special Tests: Which Ones Work?

- “Sacroiliac joint dysfunction: Evidence-based diagnosis”- Peter Huijbregts, PT, MSc, MHSc, DPT, OCS, MTC, FAAOMPT, FCAMT, Orthopedic Division Review, May/June 2004

  - **GOAL**: discuss **reliability** and **validity** of history items and physical tests thought relevant for making a diagnosis of SIJD

FIOMPT
**Feature Article**

**Sacroiliac joint dysfunction: Evidence-based diagnosis**

*Peter Huijbregts, PT, MSc, MHS, DPT, OCS, MTC, FAAOMPT, FCAMT*

Assistant Online Professor, University of St. Augustine for Health Sciences, St. Augustine, FL, USA
Consultant, Shelbourne Physiotherapy Clinic, Victoria, BC, Canada

*This article will be published in Dutch in Rehabilitacja Medyczna (Vol. 8, No. 1, 2004).*

**Introduction**

Low back pain (LBP) is a health problem with a major societal impact. Histology and injection studies have established the nociceptive potential and clinical reality of LBP originating in the sacroiliac joint (SIJ) and its peri-articular tissues. Table 1 lists the pathological processes, which can involve the SIJ. This article mainly deals with the diagnostic entity of sacroiliac joint dysfunction (SIJD). Paris defined a joint dysfunction as a state of altered mechanics, characterized by an increase or decrease from the expected normal or by the presence of an aberrant motion. This positions SIJD as a patho-mechanical rather than pathological diagnosis.

The accepted gold standard or reference test for the diagnosis of SIJ-related pain is the fluoroscopically guided intra-articular anaesthetic injection or joint block. Data on the prevalence of SIJ-related pain, therefore, is limited to highly selected populations of patients with chronic LBP referred for injection studies. Schwarzer et al. found a 30% prevalence with single blocks. Maione et al. reported a

<table>
<thead>
<tr>
<th>Table 1. Pathologies affecting the sacroiliac joint</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traumatic conditions</strong></td>
</tr>
<tr>
<td>Fracture-dislocation</td>
</tr>
<tr>
<td>Stress fracture</td>
</tr>
<tr>
<td>Insufficiency fractures</td>
</tr>
<tr>
<td><strong>Infectious conditions</strong></td>
</tr>
<tr>
<td>Bacterial infections (Staphylococcus aureus, Streptococcus, Pseudomonas, Cryptococcus neoformans)</td>
</tr>
<tr>
<td>Tuberculosis</td>
</tr>
<tr>
<td>Brucellosis</td>
</tr>
<tr>
<td><strong>Inflammatory conditions</strong></td>
</tr>
<tr>
<td>Ankylosing spondylitis</td>
</tr>
<tr>
<td>Psoriatic arthritis</td>
</tr>
<tr>
<td>Reiter’s syndrome</td>
</tr>
<tr>
<td>Inflammatory bowel disease</td>
</tr>
<tr>
<td>Undifferentiated spondylarthropathy</td>
</tr>
<tr>
<td>Juvenile rheumatoid arthritis</td>
</tr>
</tbody>
</table>
“Sacroiliac joint dysfunction: Evidence-based diagnosis” - Huijbregts

- Accepted **Gold Standard** – *fluoroscopically* guided intra-articular *anaesthetic injection* or *joint block*

- Therefore: the only **TRUE SI** related LBP patients are that **small subset** who were **referred for** and got **better with injection**

- **Bottom Line**: knowing the *clinically applicable special tests* that worked well on the **true SI population** would be great information **BUT** is a **very small data base**
Three categories of **Special Tests** for SIJ dysfunction

1. Positional palpation tests
2. Motion palpation tests
3. Provocation tests

For these tests to be *clinically useful*, the data they yield needs to be **reliable**, **valid** and **responsive** to clinically relevant change.
“Sacroiliac joint dysfunction: Evidence-based diagnosis” - Huijbregts

Looking for:

1. **Test-re-test reliability**: consistency of measures repeated over time
2. **Intra-rater reliability**: stability of measurements taken by one rater across two or more trials
3. **Inter-rater reliability**: the level of agreement between findings of two or more raters measuring the same group of subjects
4. **Validity**: the degree to which a meaningful interpretation can be inferred from this measurement
“Sacroiliac joint dysfunction: Evidence-based diagnosis” - Huijbregts

- **Palpation tests**
  1. **Positional palpation tests** – look for *asymmetry* in pelvic bony landmarks
  2. **Motion palpation tests** – attempt to dx SIJD by detection of *abnormal* relative motion

![Standing PSIS](image)

![Standing Hip Flexion](image)
“Sacroiliac joint dysfunction: Evidence-based diagnosis”- Huijbregts

- **Positional Palpation Tests**: the author looked at 10 different studies examining palpatory landmarks including the Iliac Crest, PSIS, ASIS, ILA, Sacral Spine
- These landmarks were examined in sitting, standing, supine, prone or a combination of these
- **Bottom Line**: All authors concluded that the RELIABILITY of these tests was POOR and should NOT form a basis for clinical decision making
“Sacroiliac joint dysfunction: Evidence-based diagnosis”- Huijbregts

- Support for the lack of support:
  Badii et al (Spine 2003; 28: 1335-1339) reviewed 323 CT scans unrelated to LBP and found an asymmetry of over 5mm for acetabulum to iliac crest difference in 5.3% of subjects

- Other authors point out the effects of muscle imbalances and congenital spinal abnormalities as reasons for abnormal positional palpation findings
“Sacroiliac joint dysfunction: Evidence-based diagnosis”- Huijbregts

- **Motion Palpation Tests**: the author reviewed studies by 14 different authors examining the validity and reliability of motion palpation tests.
- Tests included: *standing hip flexion test, sitting flexion test, supine to sit test, prone knee flexion test* done in a variety of ways and positions.
- **Majority Conclusion**: these *TESTS* were INSUFFICIENTLY RELIABLE to justify their use.
“Sacroiliac joint dysfunction: Evidence-based diagnosis” - Huijbregts

- **Provocation Tests:** aim to provoke the patient’s specific pain complaint by stretching or compressing SIJ periarticular structures

  Thigh Thrust
“Sacroiliac joint dysfunction: Evidence-based diagnosis” - Huijbregts

- **Provocation Tests:** the author reviewed 10 different studies that examined the **reliability** and **validity** of several different provocation tests including: compression, distraction, thigh thrust, pelvic torsion, sacral thrust, cranial shear test, FABER, resisted ER, symphysis pressure, resisted AbD, ASLR

- **Overwhelming Conclusion:** these TESTS, taken IN ISOLATION, were insufficiently reliable
Multiple Test Regimens: the author also reviewed 6 studies that examined different test clusters meant to detect SIJD.

Regimens studied various combinations of the individual palpation, motion palpation and provocation tests.

Conclusion: Although clustering the tests proved more useful than relying on individual tests alone, the predictive value of these test clusters remained less than ideal.
“Sacroiliac joint dysfunction: Evidence-based diagnosis” - Huijbregts

- Limitations of the reviewed studies:
  - “Gold Standard” used to determine reliability and validity, intra-articular anesthetic infiltration, DOES NOT ADDRESS Peri-articular structures thought to contribute to the patho-mechanical dx of SIJD
Conclusions:

1. **Palpation** in standing, prone or supine of the iliac crests, PSIS and ASIS and of the ILA in supine is **NOT a valid descriptor** of SIJD

2. **Standing hip flexion, sitting flexion and standing flexion tests** have a **false positive rate** of near 20%

3. **Positive ASLR test** is **associated with ipsilateral increased SIJ mobility**

"Sacroiliac joint dysfunction: Evidence-based diagnosis" - Huijbregts
Conclusions, cont.:

1. **ASLR** and **thigh thrust** tests have **good predictive validity** for identifying patients with **post partum pelvic pain associated with SIJ laxity**.

2. **Cluster of 5 Tests**: **Compression, Distraction, Pelvic Torsion, Sacral Thrust and Thigh Thrust tests**
   - When 3/5 POSITIVE = **SUBSTANTIAL Inter-Rater Agreement**

3. **Further research** on the level of **patient outcomes** with **manual medicine** is **needed** to validate claims of **manual medicine’s diagnostic and therapeutic efficacy**
“Sacroiliac joint dysfunction: Evidence-based diagnosis”- Huijbregts

Compression Test

Distraction Test
"Sacroiliac joint dysfunction: Evidence-based diagnosis" - Huijbregts

Pelvic Torsion

Sacral Thrust
“Sacroiliac joint dysfunction: Evidence-based diagnosis” - Huijbregts

Thigh Thrust
The Function of the Long Dorsal Sacroiliac Ligament

Its Implication for Understanding Low Back Pain

Andry Vleeming, PhD,* Annelies L. Pool-Goudzwaard, BSc,* Dilara Hammudoglu, MD,* Rob Stoecbart, PhD,* Chris J. Snijders, PhD,* and Jan M. A. Mens, MD*

Study Design. In embalmed human bodies the tension of the long dorsal sacroiliac ligament was measured during incremental loading of anatomical structures that are biomechanically relevant.

Objectives. To assess the function of the long dorsal sacroiliac ligament.

Summary of Background Data. In many patients with specific low back pain or peripartum pelvic pain, pain is experienced in the region in which the long dorsal sacroiliac ligament is located. It is not well known that the ligament can be easily palpated in the area directly caudal to the posterior superior iliac spine. Data on the functional and clinical importance of this ligament are lacking.

Methods. A dissection study was performed on the sacral and lumbar regions. The tension of the long dorsal sacroiliac ligament (n = 12) was tested under loading. Tension was measured with a buckle transducer. Several structures, including the erector spinae muscle, the posterior layer of the thoracolumbar fascia, the sacrotuberous ligament, and the sacrum, were incrementally loaded (with forces of 0–50 newtons). The sacrum was loaded in two directions, causing motion (ventral extension of the sacrum relative to the ilium, and...

Introduction

The understanding of low back pain will be seriously
Objective: assess function of the long dorsal SI ligament

Methods: dissection study – tension on the long dorsal SIJ ligament was measured during incremental loading of anatomical structures that are biomechanically relevant.

**Findings:**
- **LDSIJI** connects sacrum to PSIS
- **Sacrotuberus** connects sacrum to ischial tuberosity with *some fibers* originating from the *ilium*. These *ilial fibers* function as a site of *origin* for *Gluteus Maximus* muscle

- LDSIJL close anatomical relationships with:
  - ES muscle
  - Posterior layer of the thoracolumbar fascia
  - Sacrotuberous ligament (specific part)
  - Biceps Femoris (through sacrotuberous ligament)

- **Ligament**
  - Counternutation = Tensed
  - Nutation = Slackened
  - REVERSE of the sacrotuberous ligament

- Sustained counternutation (relative anterior rotation of the ilium) will therefore stress it

- Increases LDSIJL Tension:
  - **Loading** ipsilateral sacrotuberous and erector spinae

- Decreases LDSIJL Tension:
  - **Contraction**: ipsilateral Gluteus Maximus, ipsilateral and contralateral posterior layer of the T/L fascia (ie.contraction of the Latisimus Dorsi)
    - These tense the sacrotuberous ligament

- Counterbalances of the LDSIJL
  1. **ES muscle** induces nutation because of caudal aspect is **connected to sacrum** → **should slacken**
  2. **Anatomical connection** between ES and LDSIJL and function of **sacrotuberous ligament** → **prevents this slackening**

Conclusion:

- Anatomical connections between the ligaments and muscles with opposing functions serve as a mechanism to promote stability of the SIJ
- Therefore, LDSIJL should be considered when developing a stabilization program
DOSED EXERCISE CONCEPTS

CMPT Labs
DOSED EXERCISE CONCEPTS
CMPT Labs

Development of STEP

- Oddvar Holten (1960s)
  - MET
- Ola Grimsby Institute (1980s–present)
  - STEP
  - Post Graduate DMT/PhD Programs
DOSED EXERCISE CONCEPTS

CMPT Labs

Holten’s Curve/ Diagram

[Holten diagram]

- Percentage of 1 RM
- Frequency
- Speed:
  - > 60%
  - 60-40%
  - 40-30%
  - 30%

Areas:
- 100% 1 rep.
- 95% 2
- 90% 4
- 85% 7
- 80% 11
- 75% 16
- 70% 22
- 65% 25
- 60% 30

Strength
Strength/Endurance
Endurance

Explosive
Breathing Rhythm
25-30 reps/min
Tissue related
DOSED EXERCISE CONCEPTS
CMPT Labs

Variables In Exercise Performance

1. Specific Exercise/Start position
2. Apparatus / Equipment
3. Resistance where in the Range
   4. Range Of Motion
5. Type Of Contraction and Duration
   6. Resistance Amount
   7. Speed Of Motion
8. Sets and Repetitions
   9. Work : Rest Ratio
10. Exercise Frequency
Mobilizing Exercises

- Focus on arthrokinematic motions of distraction/translation
- Exercise performed for viscoelastic changes in joint capsules
- Sustained mobilizing force of greater than 10 seconds for plasticity
- < 50% of 1 RM
Mobilizing Exercises: SIJ Dysfunction
Stage 1 Dosage based on

- Signs and symptoms
- Stages of healing of specific tissues/tolerance to stress
- Selective tissue training: bone, collagen, cartilage, disc, muscle, nerve
- The functional quality you are trying to achieve
- Functional progressions
Stage 1 Potential Tissue States

- Reduced arthrokinematic motion
- Decrease in active and passive range
- Joint pain
- Pain w weight bearing
- Edema/increased temp
- Muscle guarding
- Poor coordination
Dosage outline Stage 1

- 3-5 exercises
- Many repetitions, minimal resistance
- < 60% 1 RM for vascularity, < 40% 1RM tonic atrophy
- Low speed
- Hypomobile: train in outer range
- Hypermobile: train in mid to inner range
- Start contraction from length/tension position
Stage 1 Exercises: SIJ
Stage 2 Training

- Increase repetitions with additional exercises (5-10)
- Increase repetitions with additional sets
- Increase speed – not weight
- Combine concentric and eccentric work for further tissue tension accommodation
- Remove external supports, progress to dependent positions
- Progress to full range of motion
Stage 2 Exercises: SIJ
Stage 3 Training

- Increase weight (60 to 80% of 1RM) therefore decreased repetitions
- Eccentric emphasis to stabilize new range
- Diagonal/triplanar motions
- End range isometrics
Stage 3 Potential tissue states

- Full, pain-free motion
- Full weight-bearing is tolerated
- Excessive repetitions or resistance may provoke pain
- Edema and muscle guarding have resolved
- Continues with deficits in strength, endurance, fast coordination, power
Stage 3 Exercises: SIJ
Stage 4 potential tissue states

- Full active and passive motion
- Pain-free joint motion even with a significant level of exercise
- Basic movements are coordinated
- Continues with deficits in endurance and functional strength
Stage 4 training

- Triplanar motion through full range of motion
- Strength, speed and power (75 to 90% 1RM)
- Function/task/sport specific training
Stage 4 Exercises: SIJ
References

- Levangie, PK (Phys Ther 1999; 79: 1043-1057)