PAINWEEK®

Sacroiliac Joint Dysfunction: The Forgotten Back Pain

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Disclosure

- Consultant/Independent Contractor: Abbott, Avanos, Biotras, Biotronik, Boston Scientific, Nalu, Nevro, SI-Bone, Vertos Medical
- Grant/Research Support: Avanos, Biotronik, Nevro, Saluda, SPR Therapeutics
- Advisory Board: Biotras
- Stock Shareholder: Nalu

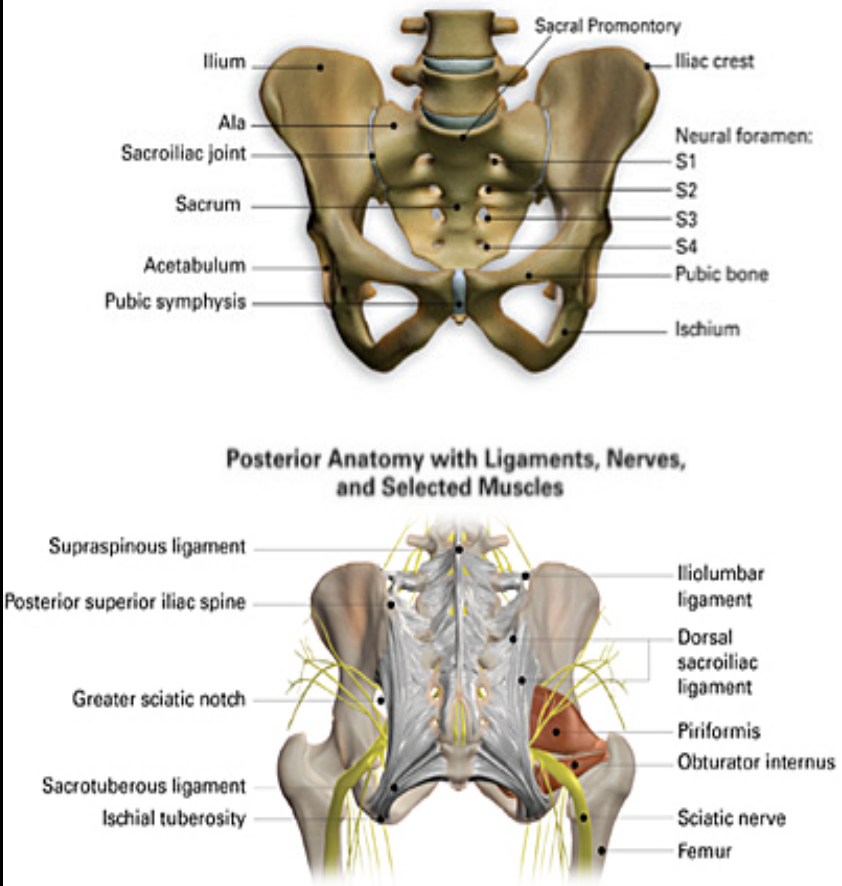
Learning Objectives

- Describe patients who may benefit from pain pumps and neural stimulation
- Cite the epidemiology SI joint pain
- Describe pathophysiology SI joint pain
- Review diagnosis of SI joint pain
- List treatment options

Outline

- Anatomy
- Biomechanics
- Epidemiology
- Pathophysiology
- Diagnosis
- Treatment options
- Review of evidence

Sacroiliac Joint Anatomy

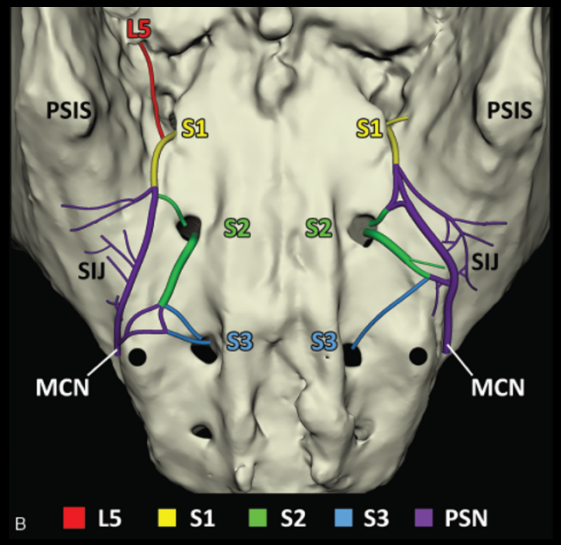


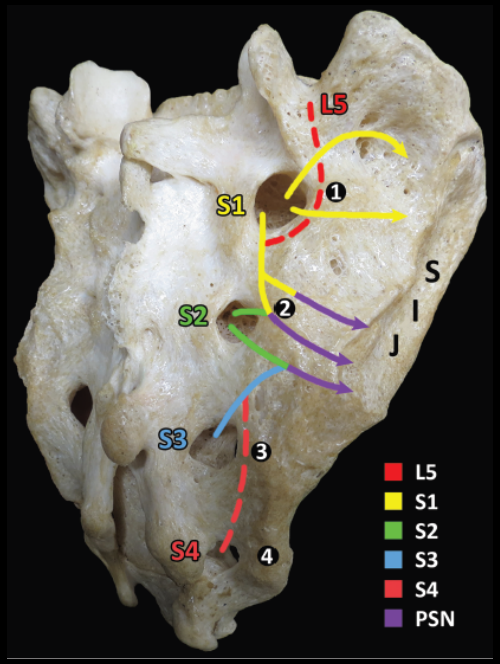
- Largest axial joint
- Average 17.5 cm^2
- Diarthrodial joint
- Anterior: true synovial joint
- Posterior: syndesmosis
- Innervation
  - L4, L5 dorsal rami
  - S1-S3 lateral branches

1. *Cohen, S., Anesth Analg, 2005*
2. *Vanelderen, P., et al., Pain Practice, 2010*

SI Joint Innervation

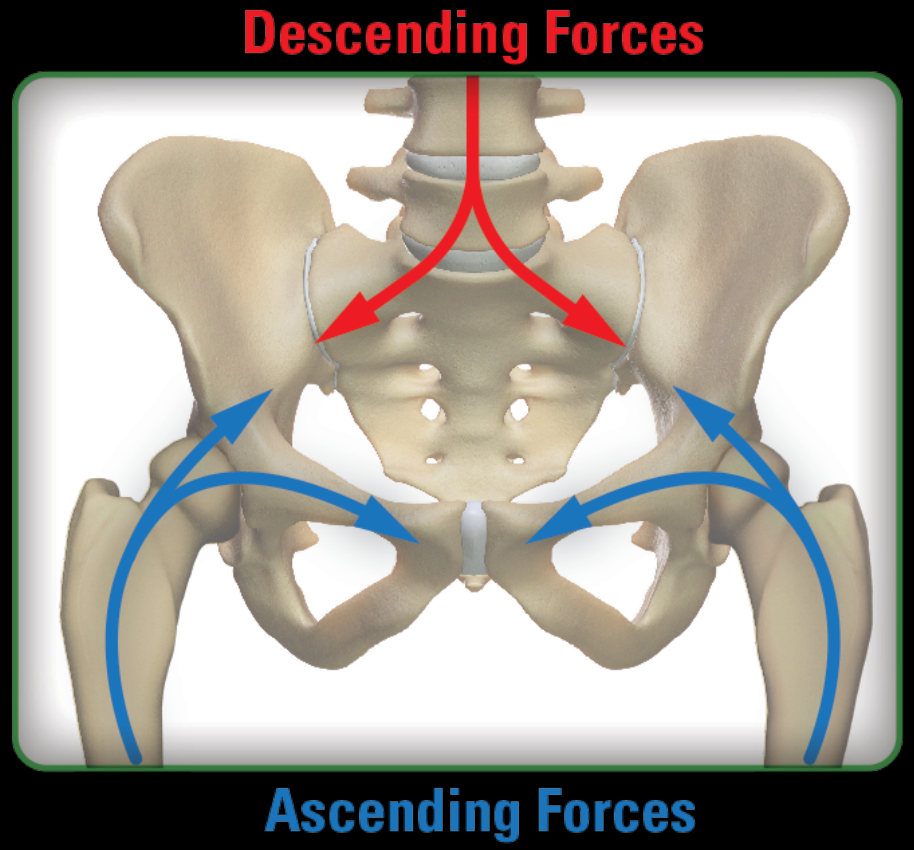
- **SI joint is highly innervated** [1-3]
  - Subchondral bone
  - Capsule
  - Ligaments
  - Surrounding soft tissues
- **Multiple nociceptors** [4-6]
  - Free nerve endings
  - Substance P
  - Calcitonin gene-related peptide (CGRP)





1. Ikeda – *Nippon Ika Daigaku Zasshi* 1991
2. Grob – *Z Rheumatol* 1995
3. Fortin – *Am J Orthop* 1999
4. Fortin – *Spine* 1994a (Part I)
5. Szadek – *Reg Anesth Pain Med* 2008
6. Szadek – *Clin Anat* 2010

Sacroiliac Joint Biomechanics



- Load bearing joint
- Stability > motion
- Motion in all 3 axes
- Transmission, dissipation
- Limiting X-axis rotation
- Facilitating parturition

1. *Cohen, S., Anesth Analg, 2005*
2. *Sembrano, J., et al., Current Orthopaedic Practice, 2011*

Chronic Pain in America

- 1 in 5 Americans suffer from chronic pain
- Large economic impact: ~$600 billion/year
- Loss of productivity: ~$300 billion/year
- Opioid epidemic: #1 health crisis in America
- National health survey by NIH 2012
  - 50 million adults experience pain every day
  - Pain→ worse overall health status
  - Female, elderly, non-Hispanics (Asians less likely)

A Controlled Trial to Improve Care for Seriously Ill Hospitalized Patients.
http://jama.ama-assn.org/cgi/content/abstract/274/20/1591

Epidemiology

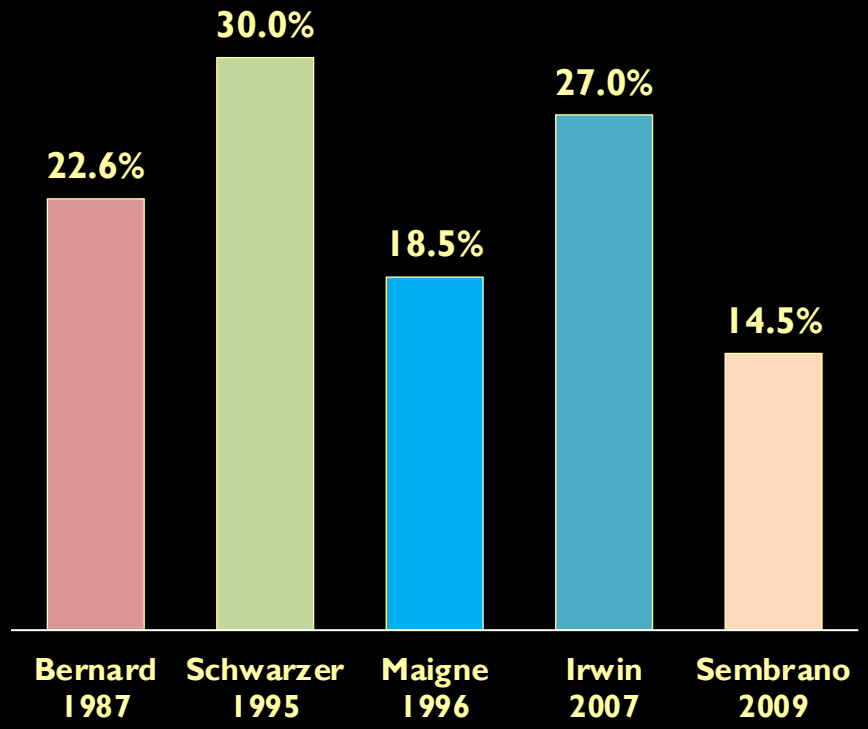
- LBP most common reported pain complaint in adults
- $200 billion/year in medical expenses, lost wages, and productivity
- 16-30% prevalence among LBP
- Post lumbar fusion: 61% prevalence of SI joint pain

1. Sembrano, J., et al., Current Orthopaedic Practice, 2011

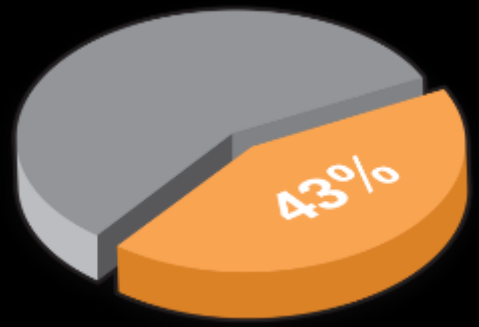
2. Cummings, J., and Capobianco, R., Annals of Surgical Innovation and Research, 2013

Prevalence of SI Joint Pain

15-30%
Component of chronic LBP



32-43%
Symptomatic Post-Lumbar Fusion



DePalma – *Pain Med* 2011

32% Katz 2003
35% Maigne 2005
43% DePalma 2011
40% Liliang 2011

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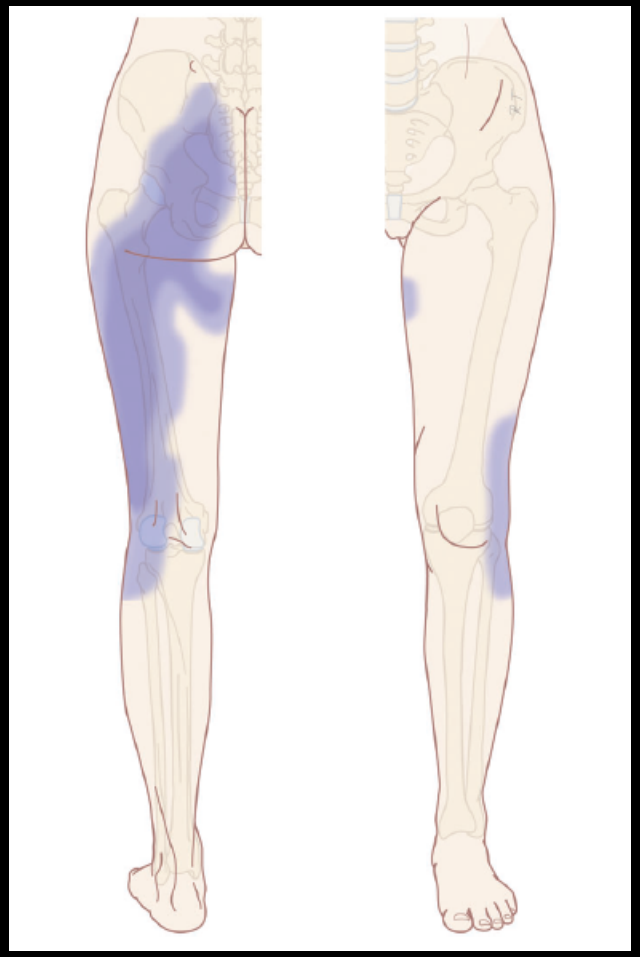
Pathophysiology



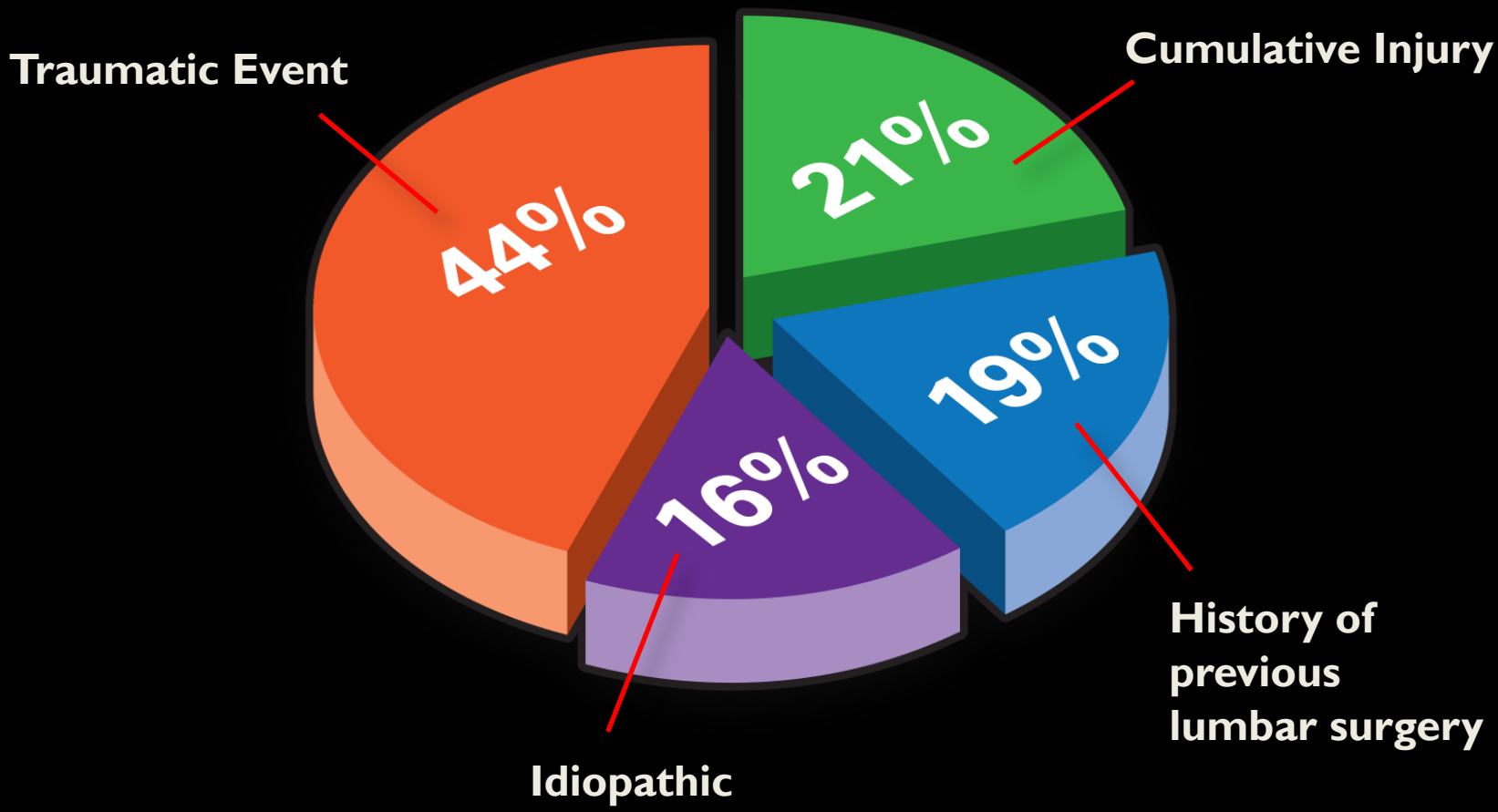
- **Intra-articular**: infection, arthritis, malignancy
- **Extra-articular**: enthesopathy, fracture, ligament, myofascial
- **Risk factors**: leg length discrepancy, trauma, gait disturbance, scoliosis, lumbar fusion, physical exertion, pregnancy

1. *Cohen, S., Anesth Analg, 2005*
2. *Vanelderen, P., et al., Pain Practice, 2010*

Potential Causes of SIJ Pain

- **Laxity of the SI joint / Pregnancy**
- **Repetitive Forces on SI joint and Supporting Structures**
- **Biomechanical Abnormalities**
  - Leg length inequality
  - Pelvic obliquity/scoliosis
  - Iliac crest bone graft
- **Adjacent Segment Degeneration**
  - After lumbar spinal fusion
- **Post Infection Degeneration**

Potential Causes of SIJ Pain



Chou – *Pain Med* 2004

SIJ Pain Post Lumbar Fusion

75% of post-lumbar fusion patients showed SI joint degenerative changes on CT scan 5 years after

vs.

only 38% age- and gender-matched controls without prior lumbar fusion

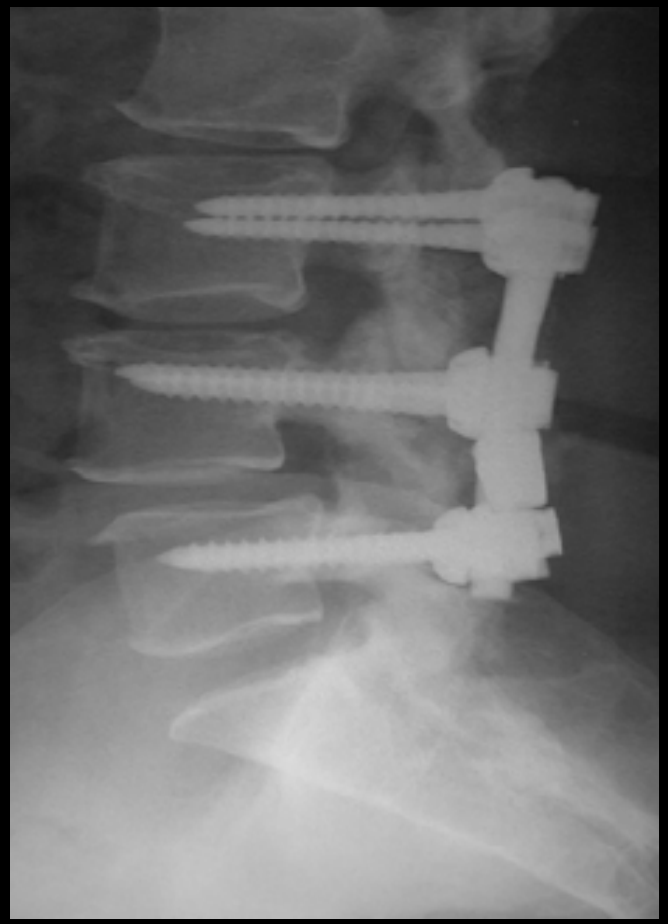
Ha et al. 2008

Lumbar fusion leads to increases in angular motion and stresses at the SI joint.

Ivanov et al. 2008

1. Ha – *Spine* 2008
2. Ivanov – *Spine* 2009

SI Joint Pain and Lumbar Fusion



- Failure rate of lumbar surgery: 5-30%
- L4-S1 fusion generated max stress over SI joints
- N=130, lumbar fusion patients, 40% with LBP after lumbar fusion responded to 2 SI joint blocks
- Increases angular motion and stress at the SI joint
- 75% post fusion patients show SI joint degeneration on CT in 5 years

1. *Ivanov, , A., et al., Spine, 2009*
2. *Liliang, P., et al., Pain Medicine, 2011*

Diagnosis of SI Joint Pain

- **Common pain patterns from multiple conditions**
  - Spine (stenosis, facet, spondy, disc herniation, DDD, etc.)
  - SI Joint
  - Hip (OA, FAI, early AVN, *etc.*)
  - Pelvis (Glut tear, piriformis, pelvic floor)
- **Imaging not routinely helpful**
- **History and Physical Examination**
  - Provocative maneuvers
  - SI joint ROM & Position testing not reliable
- **Diagnostic Injection**

History and Common Complaints

History

When did the pain start?

- Prior trauma
  - A fall on the buttock
  - Car accident (T-bone, rear-end, head-on)
  - Lift/Twist
  - Other
- Prior lumbar fusion
  - Prior iliac bone graft harvest
- Pregnancy

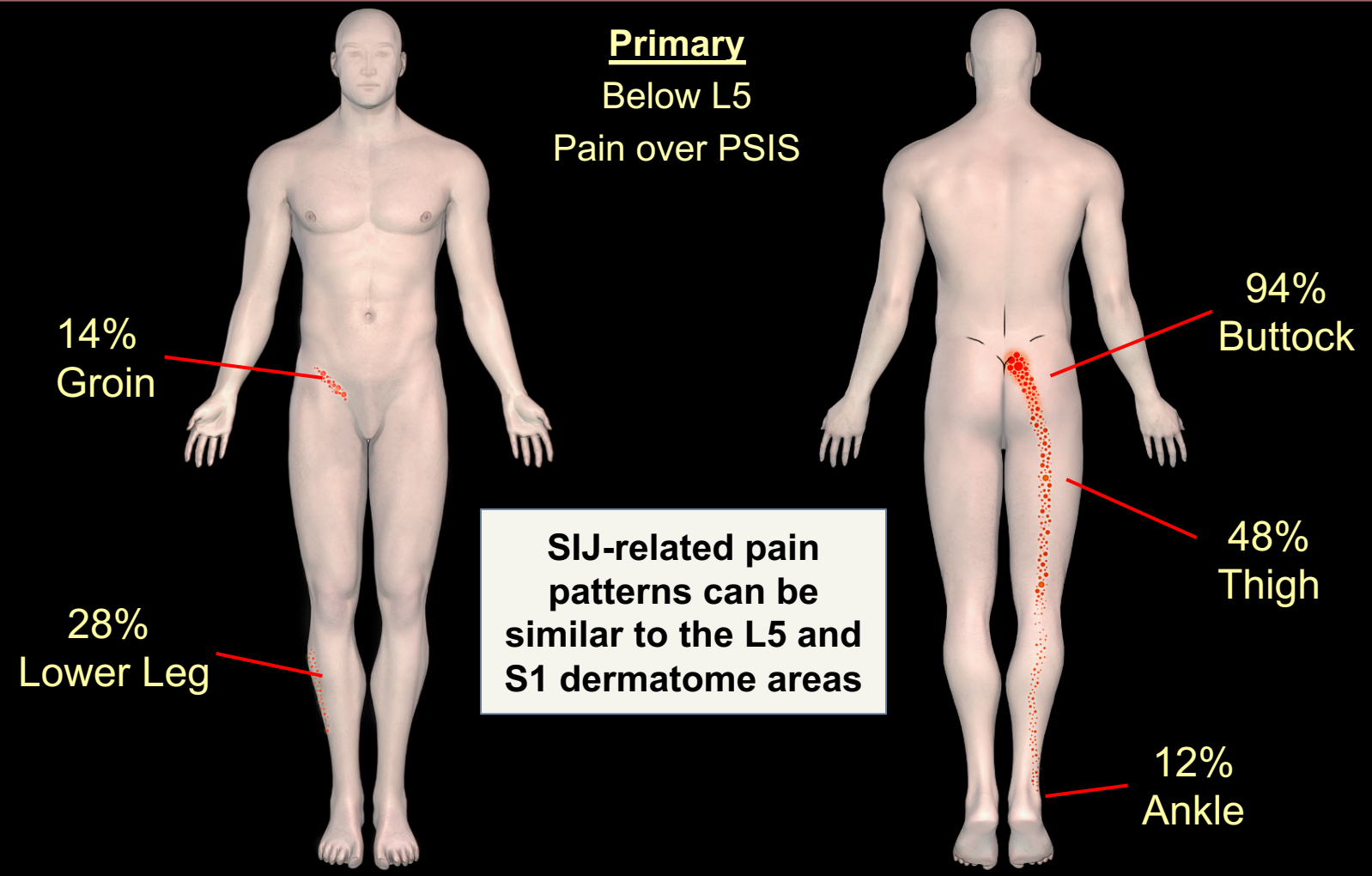
Complaints

- Lower back pain
- Sensation of lower extremity numbness, tingling, weakness
- Pelvis / buttock pain
- Hip / groin pain
- Feeling of unilateral leg instability (buckling, giving way)
- Disturbed sleep patterns
- Disturbed sitting patterns (unable to sit for long periods, on one side)
- Pain going from sitting to standing

Differential Diagnosis

- Spondyloarthropathy
- Lumbar radiculopathy
- Facetogenic low back pain
- Hip pathology
- Pelvic pathology (endometriosis)
- Myofascial pain
- Piriformis syndrome

SI Joint Referred Pain Pattern



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Slipman, et al. Sacroiliac Joint Syndrome. Pain Physician 2001;4:2, pp 143-152

Patient Localization of Pain

- **Fortin Finger Test**
- Point to pain while standing
  - Able to localize pain with one finger
  - Within 1 cm of PSIS (inferomedial)
  - Consistent over at least 2 trials
- Tenderness over SI joint sulcus
- Posterior SI joint tender to palpation

Fortin – *Am J Orthop* 1997

SI Joint: Provocative Tests

The following five provocative tests, when performed in combination, are proven to have a high degree of sensitivity and specificity:

1. **Distraction*** (Highest PPV**)
2. **Thigh Thrust***
3. **FABER**
4. **Compression***
5. **Gaenslen's Maneuver**

* Most sensitive of tests
** PPV = *positive predictive value*

	Laslett[1,2]	Szadek[3]
	3 or more positive tests	
Sensitivity	**91%**	**85%**
Specificity	**78%**	**76%**

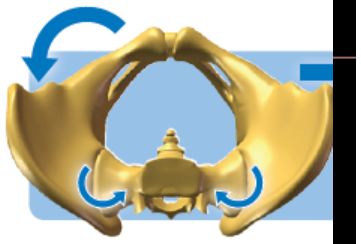
1. Laslett – *Man Ther* 2005
2. Laslett – *J Man Manip Ther* 2008
3. Szadek – *J Pain* 2009

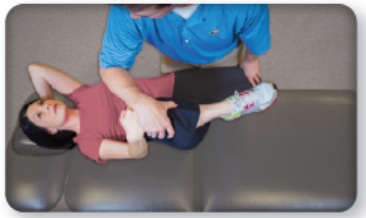
FABER
(Flexion, ABduction, External Rotation)

Applies tensile force on the anterior aspect of the SI joints

The patient lies supine as the examiner crosses the same-side foot over the opposite-side thigh. The pelvis is stabilized at the opposite ASIS with the hand of the examiner.

A gentle force is steadily increased on the same-side knee of the patient, exaggerating the motion of hip flexion, abduction, and external rotation.



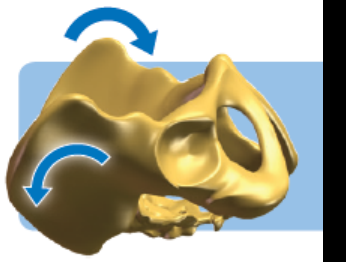


Gaenslen

Applies torsional stress on the SI joints

The patient lies supine near the edge of the table and is asked to flex the opposite hip grasping their knee. This action "locks" the SI joint in position prior to the next step.

The examiner then slides the near-side leg (typically starting with the painful side) off the table and applies a steady extension force while simultaneously applying a flexion force through the opposite leg. The patient assists with the opposite-side hip flexion.



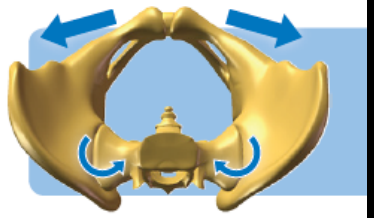
Distraction

Applies tensile forces on the anterior aspect of the SI joints

The patient lies supine and is asked to place their forearm behind their lumbar spine to support the natural lordosis.

A pillow is placed under the patient's knees. The examiner places their hands on the anterior and medial aspects of the patient's left and right ASIS with arms crossed and elbows straight.

A slow and steady pressure is applied by leaning toward the patient.

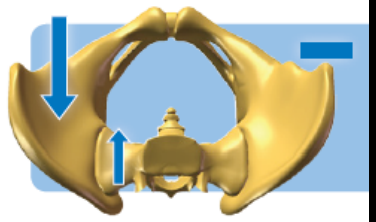


Thigh Thrust

Applies anteroposterior shear stress on the SI joint

The patient lies supine with one hip flexed to 90 degrees. The pelvis is stabilized at the opposite ASIS with the hand of the examiner.

The examiner stands on the same side as the flexed leg. The examiner provides steady increasing pressure through the axis of the femur.

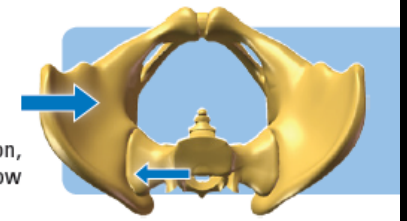


Compression

Applies lateral compression force across the SI joints

The patient is placed in a side-lying position, facing away from the examiner, with a pillow between the knees.

The examiner places a steady downward pressure through the anterior aspect of the lateral ilium, between the greater trochanter and iliac crest.



Imaging Studies

Septic Sacroiliitis

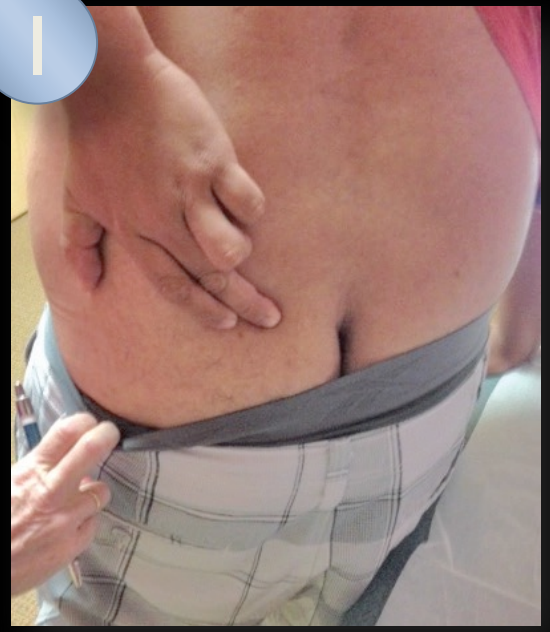
- Help rule out “red flags”
- No correlation between radiographic findings and SI joint pain
- MRI may show inflammation despite normal clinical exam

1.Vanelderen, P., et al., Pain Practice, 2010

2.Attarian, D., J South Orthp Assoc., 2001

IASP: SI Joint Pain Diagnosis Criteria

1

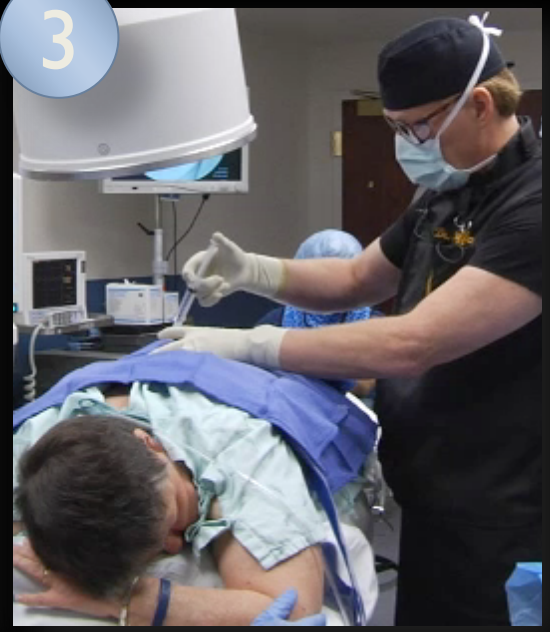


Pain is present in the region of the SI joint

2

Provocative testing: reproduces patient's pain

3



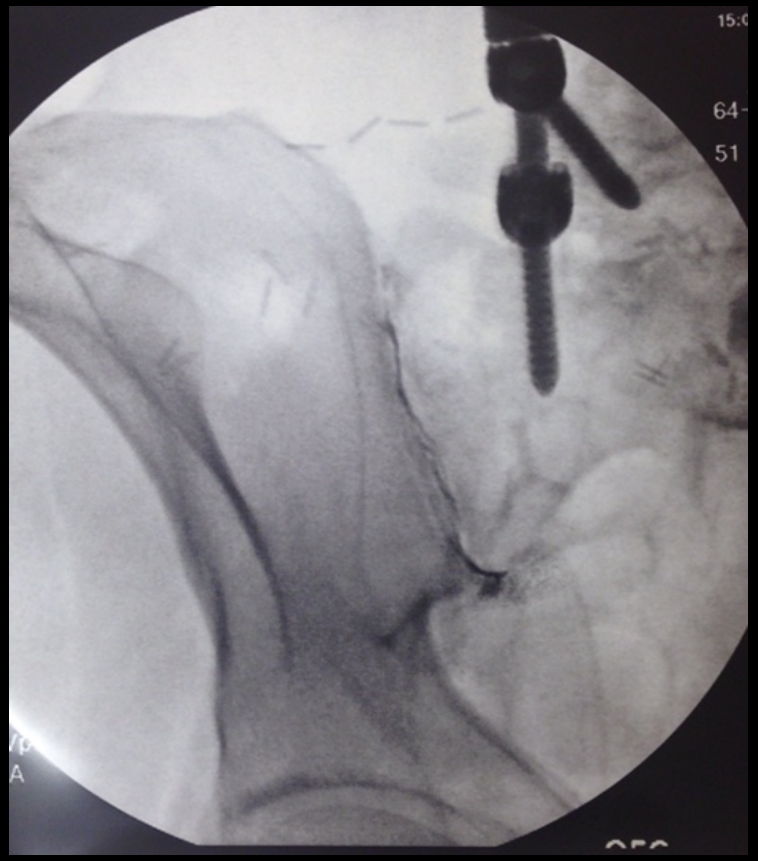
SI Injecting relieves the patient of pain

Merskey 1994

Pain Relieved with Anesthetic Injection

- **SI joint diagnostic injection is the reference standard**
  - Fortin 2000, Szadek 2009, Laslett 2005
  - Guidelines from multiple pain societies
    - (IASP, AAMP&R, ASIPP-IPM, ASA, ASRA, SIS, WIP)
  - Guidelines from surgeon societies: ISASS, NASS

Diagnostic Block



- SIJ block, assumed “gold standard”
- SIJ blocks have yet to be validated
- Lateral branch block?
- High false-positive rate, 17%
- “Double block”, not cost effective
- 22% accurate with blind injection
- Image guided is recommended

1. Cohen, S., Anesth Analg, 2005

2. Bogduk, N., Pain Medicine, 2009

3. Maigne, Y., et al, Spine, 1996

4. Rosenberg, J., Clin J Pain, 2000

ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2014;95:330-7

ORIGINAL ARTICLE

Ultrasound-Guided Versus Fluoroscopy-Guided Sacroiliac Joint Intra-articular Injections in the Noninflammatory Sacroiliac Joint Dysfunction: A Prospective, Randomized, Single-Blinded Study

Haemi Jee, PhD,[a] Ji-Hae Lee, MD,[b] Ki Deok Park, MD,[c] Jaeki Ahn, MD, PhD,[d] Yongbum Park, MD[d]

- N=120 patients, with chronic non-inflammatory SI joint pain
- US-guided approach was as effective but less accurate
- Fluoro: 98.2% vs. US: 87.3%

Assessment: Post-Injection

- **Positive clinical response**

  ≥ 50% VAS reduction during anesthetic phase indicates positive diagnosis of SI joint as pain generator.

  Relief during previously painful functional / provocative movements.

- **Minimal or no relief**

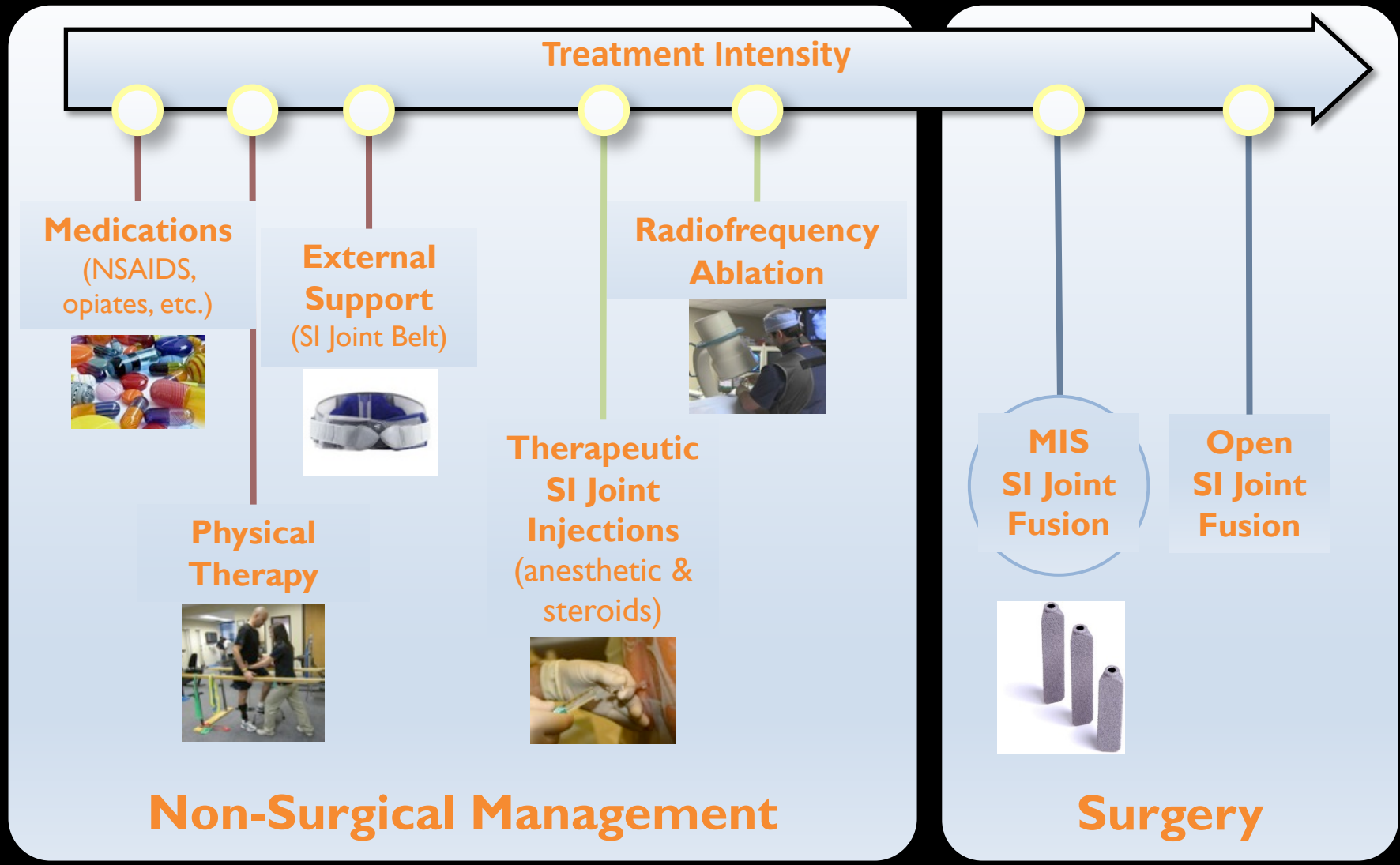
  < 50% May have SI joint pain, consider other pain sources.

ISASS and ASIPP utilize ≥ 50% reduction in pain as a threshold

NASS utilizes ≥ 75% reduction in pain as a threshold

Maugars – *Br J Rheumatol* 1996; Maigne - *Spine* 1996; Pauza – *AAPM&R* 2001; Fritz – *AJR Am J Roentgenol* 2008; Rupert – *Pain Physician* 2009; Liliang – *Pain Med* 2011; Manchikanti – *Pain Physician* 2013;

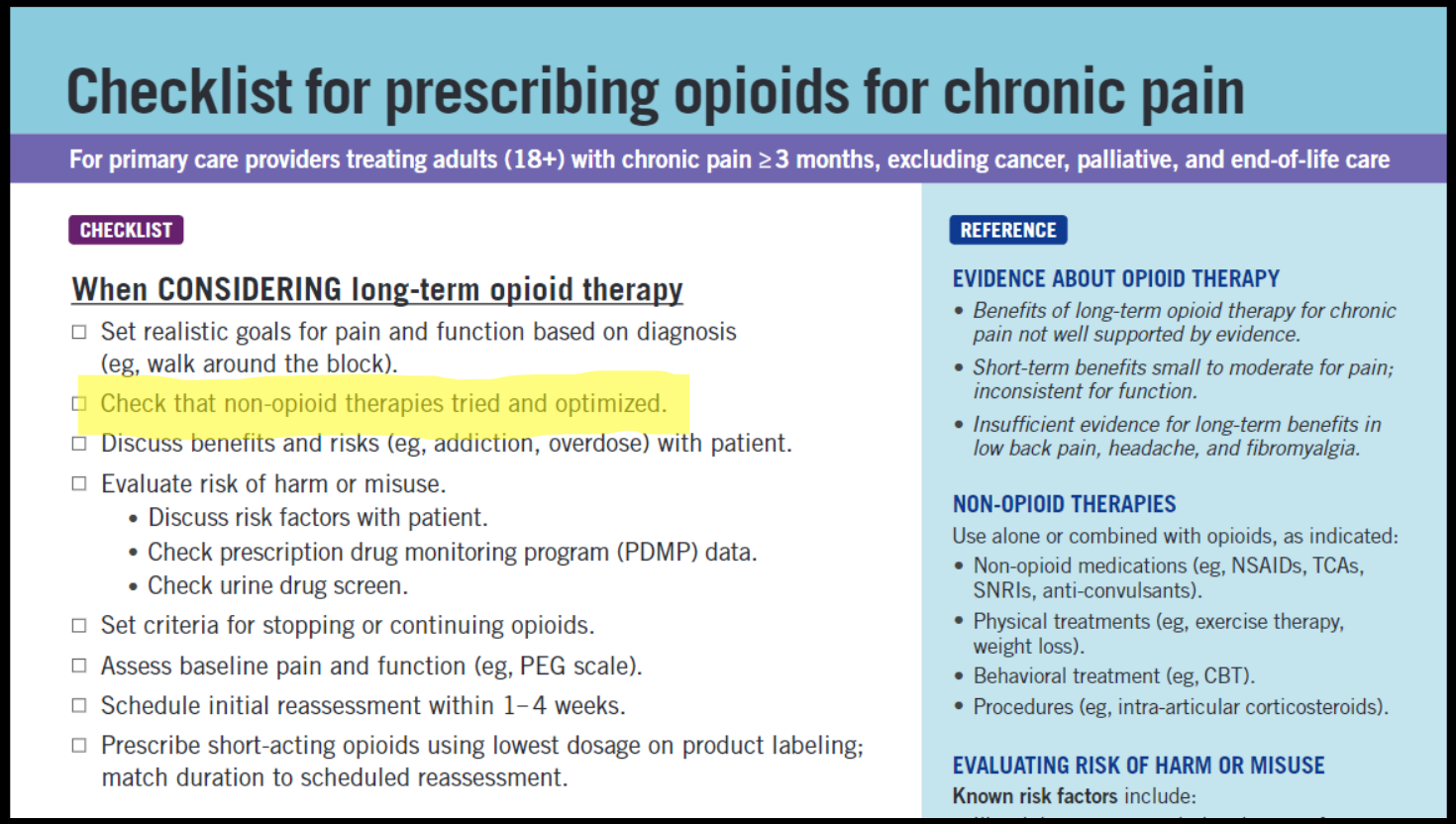
SI Joint Treatment Continuum



Treatment Options

- Conservative management
  - Physical therapy
  - Medications
  - SI brace
- Interventional management
  - SI joint injection
  - Radiofrequency ablation
- Surgical management
  - Minimally invasive SI joint fusion
  - Open SI joint fusion

CDC Guidelines for Chronic Opioids



Checklist for prescribing opioids for chronic pain

For primary care providers treating adults (18+) with chronic pain ≥3 months, excluding cancer, palliative, and end-of-life care

CHECKLIST

When CONSIDERING long-term opioid therapy

- ☐ Set realistic goals for pain and function based on diagnosis (eg, walk around the block).
- ☐ Check that non-opioid therapies tried and optimized.
- ☐ Discuss benefits and risks (eg, addiction, overdose) with patient.
- ☐ Evaluate risk of harm or misuse.
  - Discuss risk factors with patient.
  - Check prescription drug monitoring program (PDMP) data.
  - Check urine drug screen.
- ☐ Set criteria for stopping or continuing opioids.
- ☐ Assess baseline pain and function (eg, PEG scale).
- ☐ Schedule initial reassessment within 1–4 weeks.
- ☐ Prescribe short-acting opioids using lowest dosage on product labeling; match duration to scheduled reassessment.

REFERENCE

EVIDENCE ABOUT OPIOID THERAPY

- *Benefits of long-term opioid therapy for chronic pain not well supported by evidence.*
- *Short-term benefits small to moderate for pain; inconsistent for function.*
- *Insufficient evidence for long-term benefits in low back pain, headache, and fibromyalgia.*

NON-OPIOID THERAPIES

Use alone or combined with opioids, as indicated:

- Non-opioid medications (eg, NSAIDs, TCAs, SNRIs, anti-convulsants).
- Physical treatments (eg, exercise therapy, weight loss).
- Behavioral treatment (eg, CBT).
- Procedures (eg, intra-articular corticosteroids).

EVALUATING RISK OF HARM OR MISUSE

Known risk factors include:

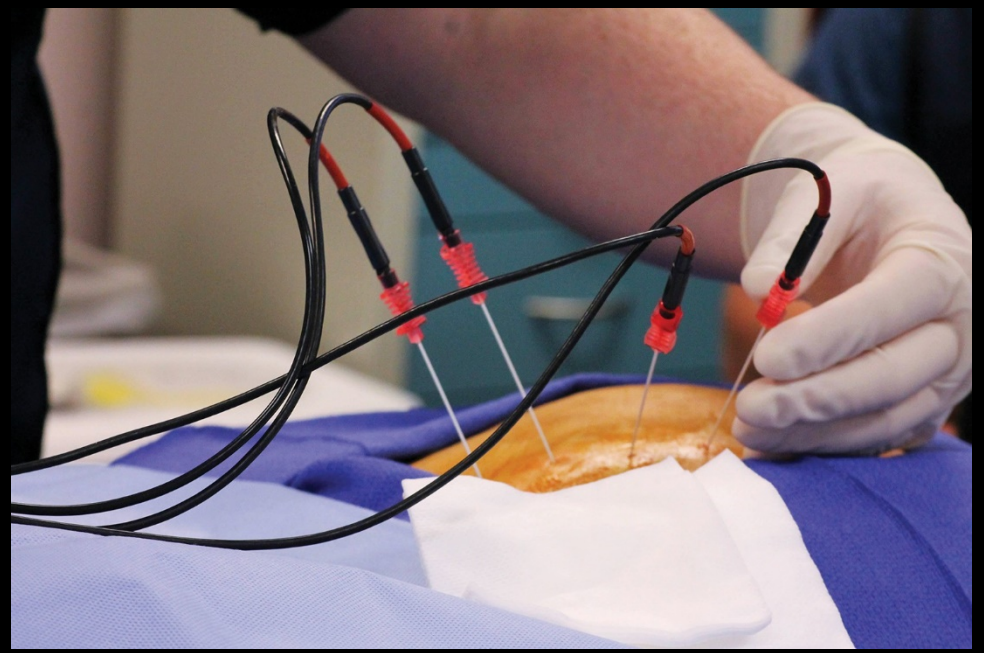
https://stacks.cdc.gov/view/cdc/38025

Current Controversies

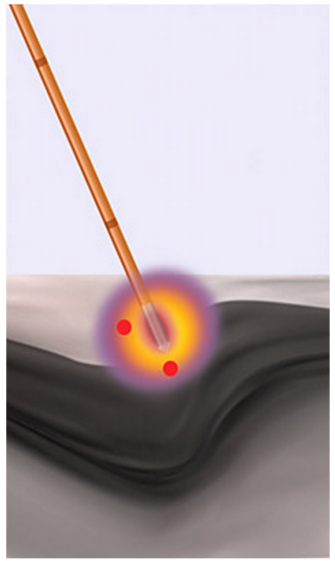
- Diagnostic block “gold standard”
- Conventional RF versus cooled RF
- Open SI fusion versus percutaneous SI fusion
- Lateral SI fusion versus posterior SI fusion

Radiofrequency Options

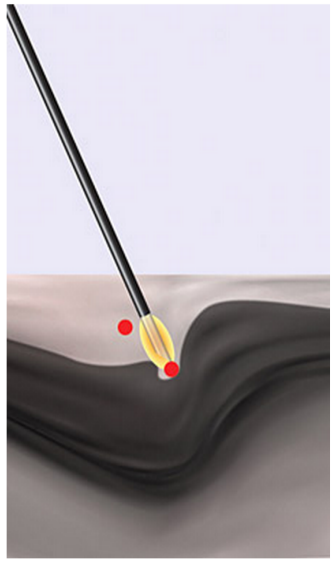
- Conventional radiofrequency (CRF): 55-90 °C
- Pulsed radiofrequency (PRF): <42 °C
- Water-cooled radiofrequency (WCRF): 55-60 °C
- Intra-articular leapfrog technique
- Sacral lateral branch neuroablation
- Retractable RF needles
- Multi-electrode probe

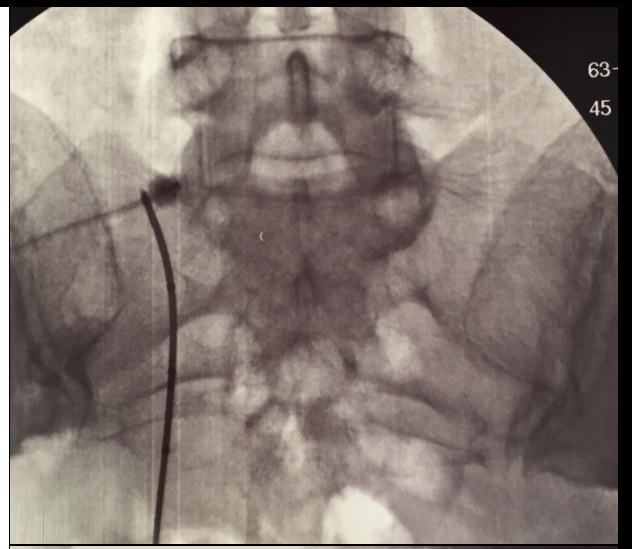


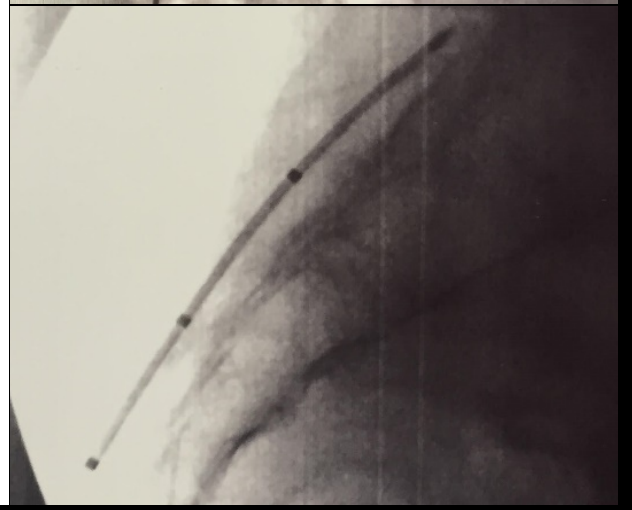
Cooled RF

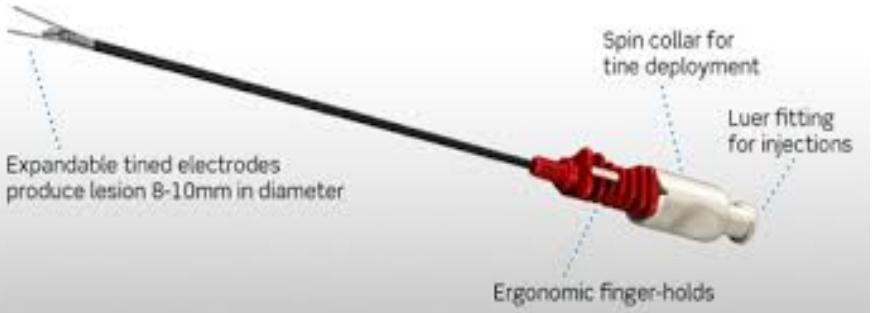


Standard RF









Randomized Placebo-Controlled Study Evaluating Lateral Branch Radiofrequency Denervation for Sacroiliac Joint Pain

Steven P. Cohen, M.D. [Associate Professor]*, Robert W. Hurley, M.D., Ph.D. [Assistant Professor]**, Chester C. Buckenmaier III, M.D. [Associate Professor]#, Connie Kurihara, R.N. [Research Assistant]##, Benny Morlando, R.N. [Research Assistant]##, and Anthony Dragovich, M.D. [Assistant Professor]*#

- N=28, randomized sham-controlled study
- Utilizing Cooled RF
- 57% reported greater than 50% pain relief at 6 month
- 14% at 1 month for placebo group
- Crossover, n=11: 36% at 6 months

Cohen, S., et al., Anesthesiology, 2008

A Randomized, Placebo-Controlled Study to Assess the Efficacy of Lateral Branch Neurotomy for Chronic Sacroiliac Joint Pain

- N=51, randomized sham-controlled study
- 2:1, 34 treatment and 17 sham
- Cooled radiofrequency technique
- 3 months: 50% versus 8% (sham)
- 6 months: 40%
- 9 months: 60%
- 12 months: 56% reported >2.5 reduction of VAS

Patel, et. al., Pain Medicine, 2012

ORIGINAL ARTICLE

Comparative Outcomes of Cooled Versus Traditional Radiofrequency Ablation of the Lateral Branches for Sacroiliac Joint Pain

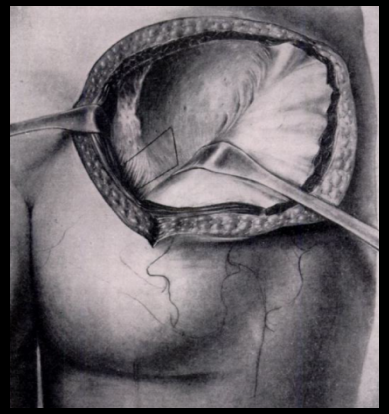
Jianguo Cheng, MD, PhD, Jason E. Pope, MD,* Jarrod E. Dalton, MA,†‡ Olivia Cheng, BA,* and Albatoul Bensitel, MD‡*

- Retrospective study, N=88
- Both c-RF and t-RF provided >50% pain relief 3-6 months
- No difference between cooled and traditional RF

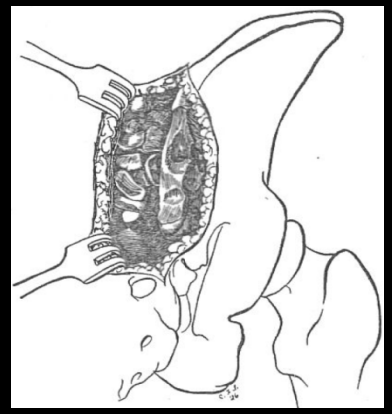
Cheng, J., et al., Clin J Pain, 2013

- Actively enrolling patients with SI joint pain
- Cooled RF ablation vs. medical management
- 12-month, prospective, randomized, open-label study
- Cross-over at 3 month if fail medical management

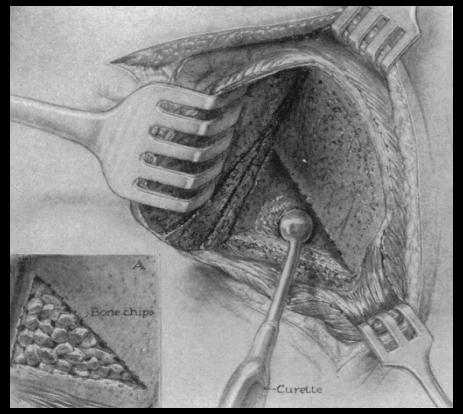
Surgical Treatment Options



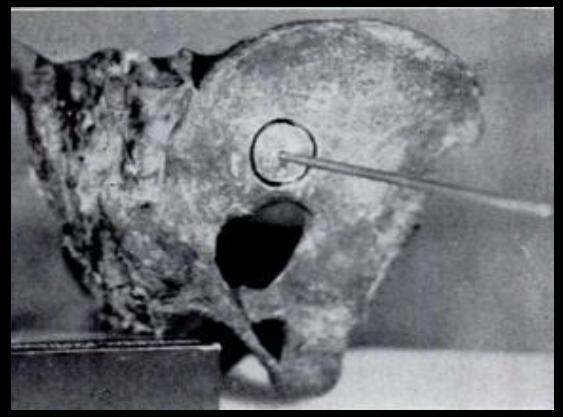
Smith-Petersen 1926

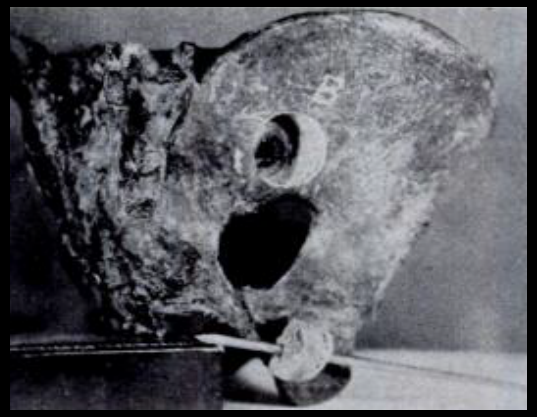


Campbell 1927



Gaenslen 1927





Bloom 1937

Percutaneous

SI Joint Fusion

- **Open**
  - Invasive
  - Lengthy recovery
  - Rarely performed
- **Minimally Invasive**
  - Small incision
  - Low blood loss
  - Short procedure (~ 1 hour)
  - No need for bone grafting

Minimally invasive surgical SI joint fusion with the iFuse Implant System

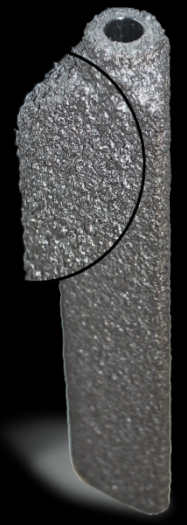
The Open Orthopaedics Journal, 2012, *6*, 495-502

Open Access

Sacroiliac Joint Arthrodesis-MIS Technique with Titanium Implants: Report of the First 50 Patients and Outcomes

Leonard Rudolf*

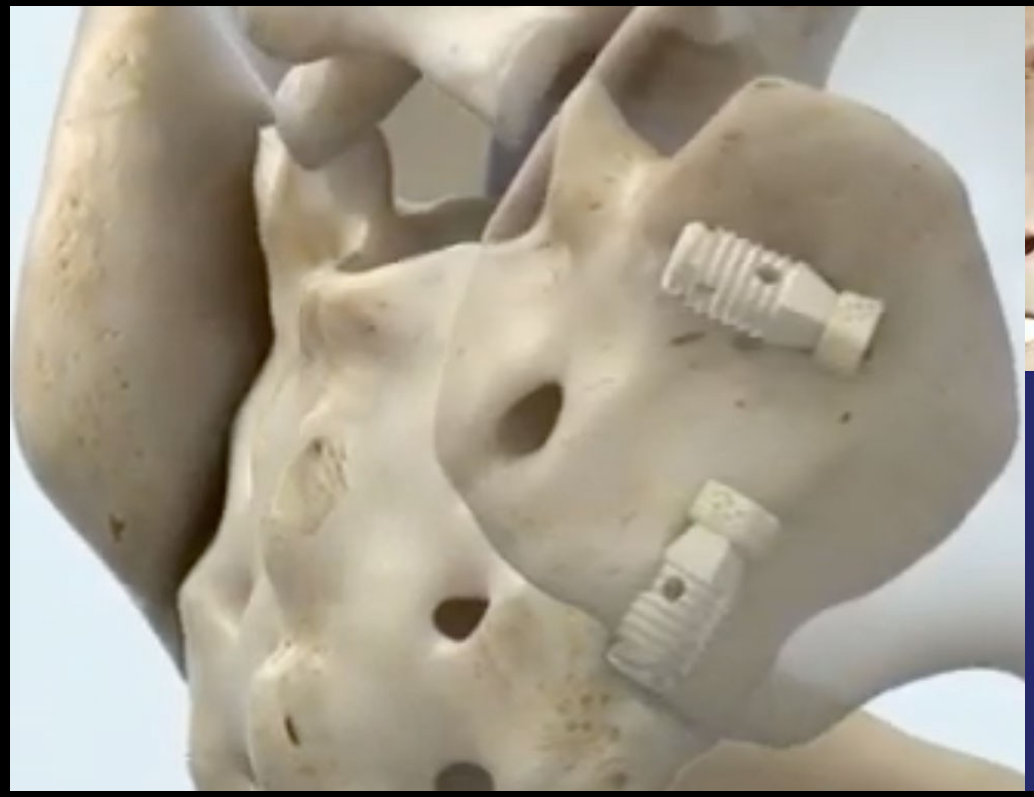
- 50 consecutive MIS fusions
- 6 mo, -4.36 reduction VAS
- 12 mo, -4.29 reduction VAS
- 82% satisfaction @ 24 mo.
- 1 complication at 3 years

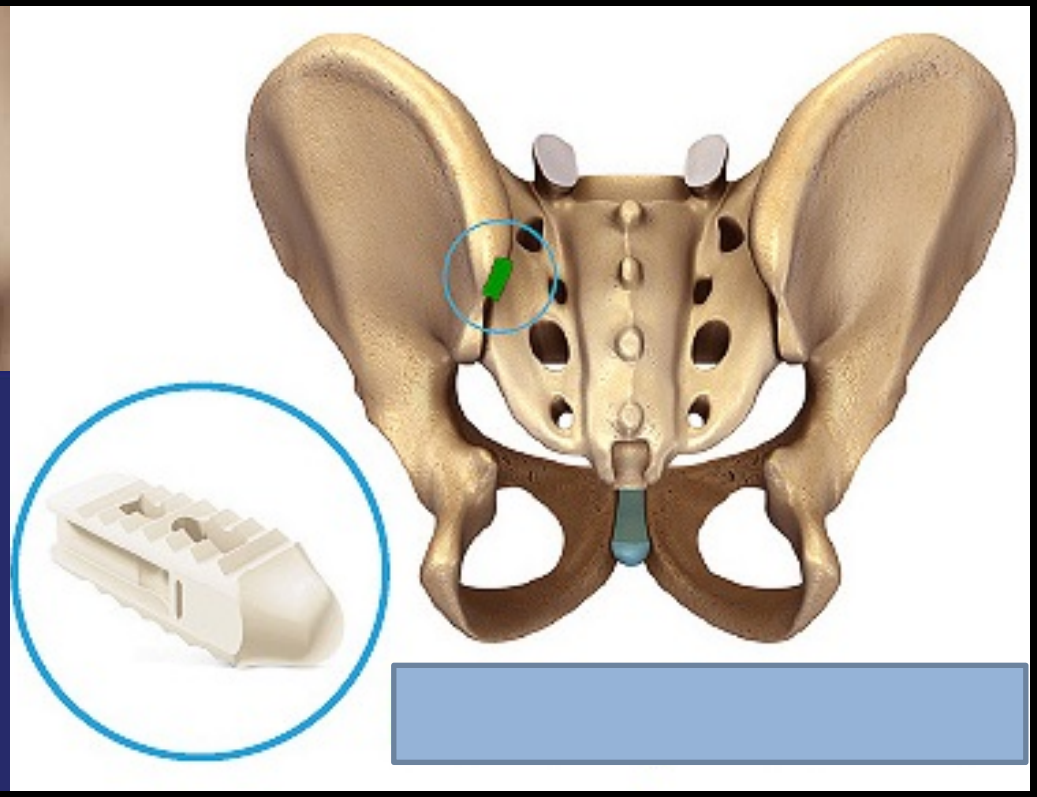


Rudolf, L., The Open Orthopaedics journal, 2012

Percutaneous SI Joint Fusion

Percutaneous Posterior SI Joint Fusion





INSITE: Investigation of Sacroiliac Fusion Treatment NCT01681004

- Prospective, multicenter randomized controlled trial
  - 19 centers in US
  - 148 patients
  - Enrollment from January 2013 to May 2014
  - Follow-up: 1, 3, 6, 12, 18 and 24 month
- Sponsored by device manufacturer (SI-BONE, Inc., San Jose, CA)

MIS SI Joint Fusion
(n=102)

iFuse Implant System®
plus brief post-operative rehab

Non-Surgical Management (NSM)
(n=46)

Medication optimization

Physical therapy (16 sessions)

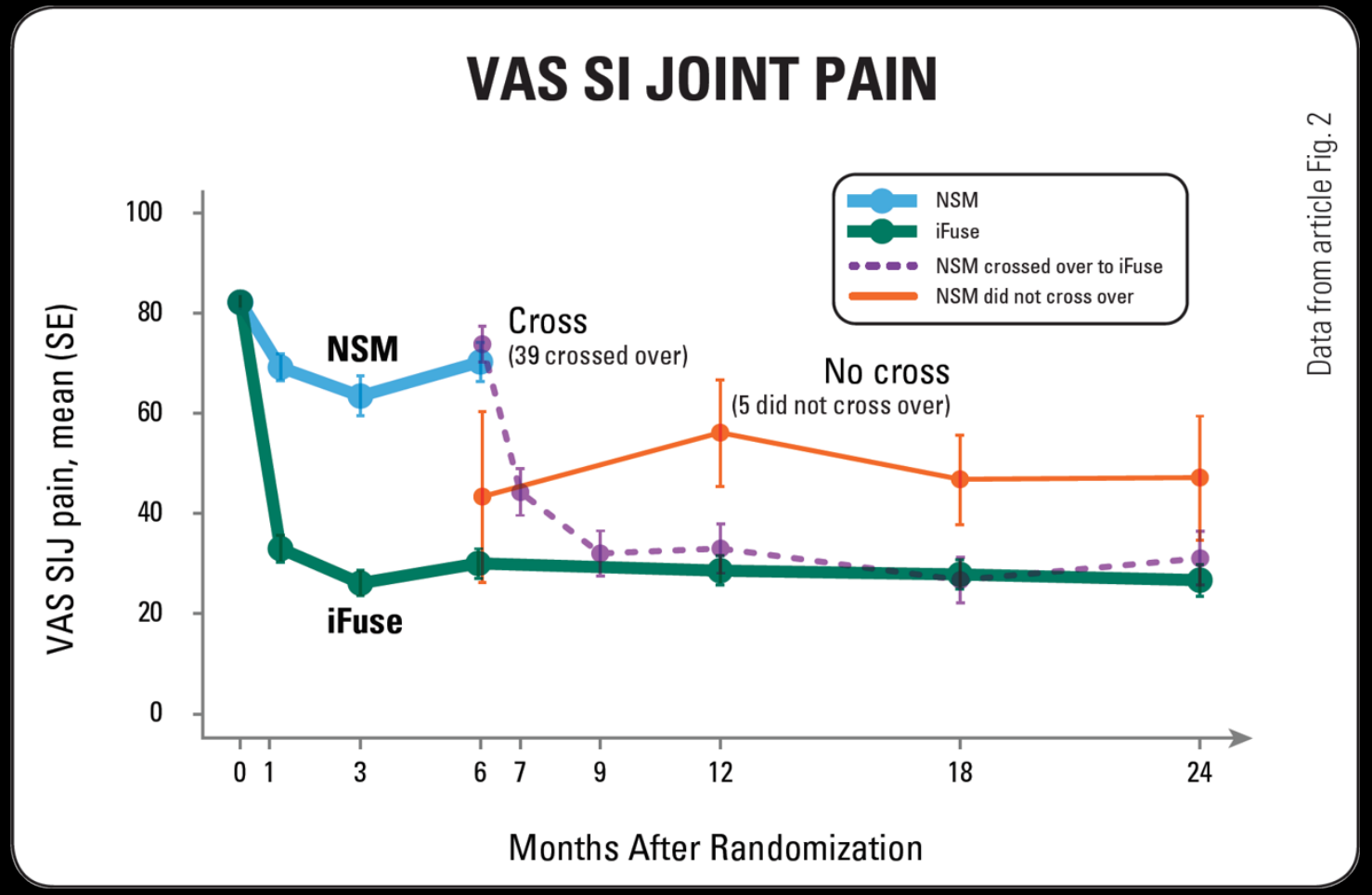
SI joint steroid injections

RF ablation

ClinicalTrials.gov ID
NCT01681004

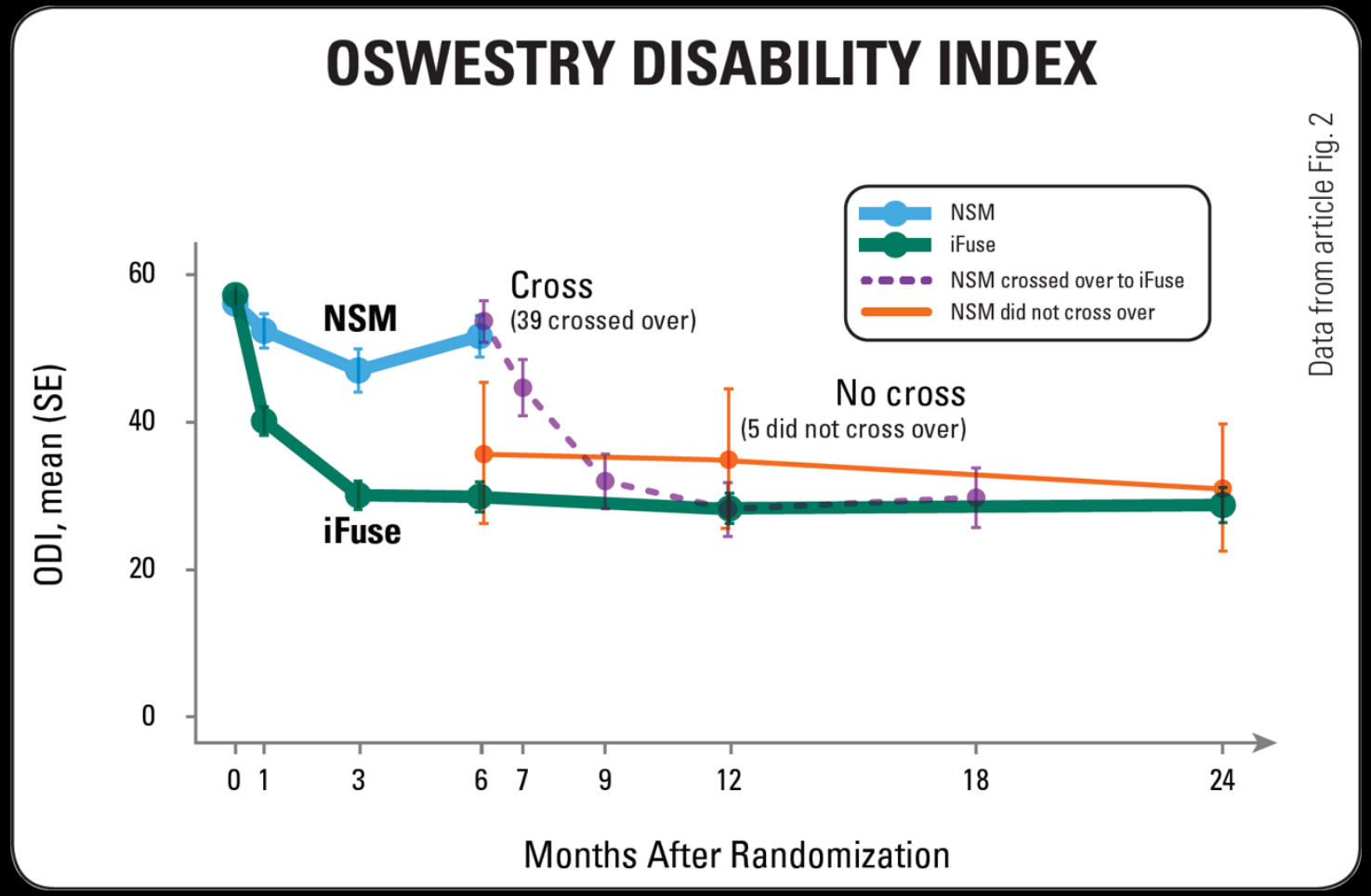
PainWeek®

INSITE 2-year Results: VAS SI Joint Pain



Polly – *Int J Spine Surg* 2016 (INSITE 2yr)

INSITE 2-year Results: Disability



Polly – *Int J Spine Surg* 2016 (INSITE 2yr)

INSITE 2-year Results

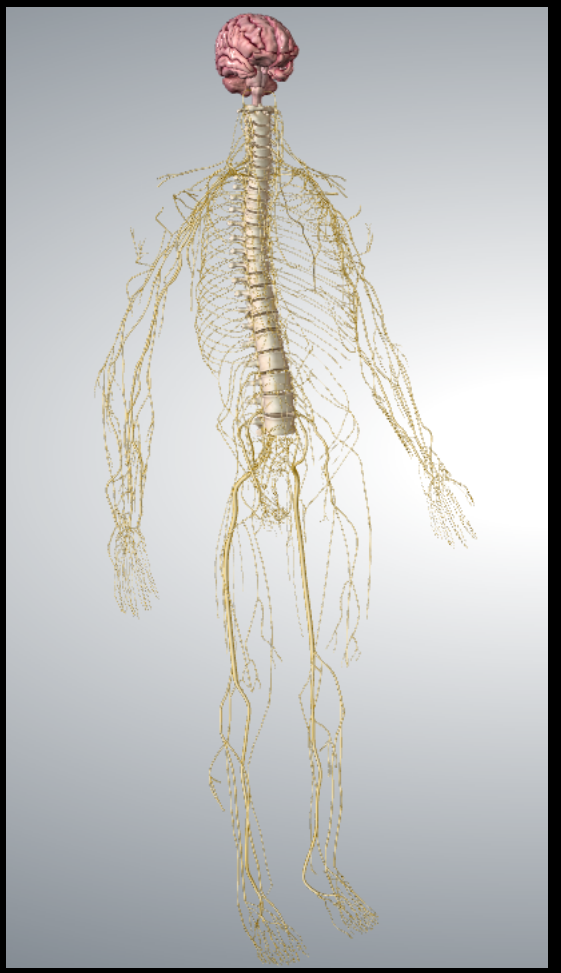
		iFuse % subjects	NSM % subjects
Primary Endpoint *	Success @ 6 mo	82%	26%
Patient Satisfaction	Very or somewhat satisfied	90% (6 mo) 88% (2 yr)	61% (6 mo)
Clinical Improvement (Minimum Clinically Important Difference)	VAS improvement ≥ 20pt	83% (2 yr)	10% (2 yr)
	ODI improvement ≥ 15pt	68% (2 yr)	7.5% (2 yr)
Opioid Use	% change in number of subjects taking opioids	30% ↓ (baseline to 2 yr)	7.5% ↑ (baseline to 6 mo)

* Binary success/failure composite measure. Success if all criteria met: VAS SI joint pain reduction ≥ 20 points, no device-related SAEs, no neurological worsening, and no surgical re-intervention for SI joint pain.

Polly – *Int J Spine Surg* 2016 (INSITE 2yr)

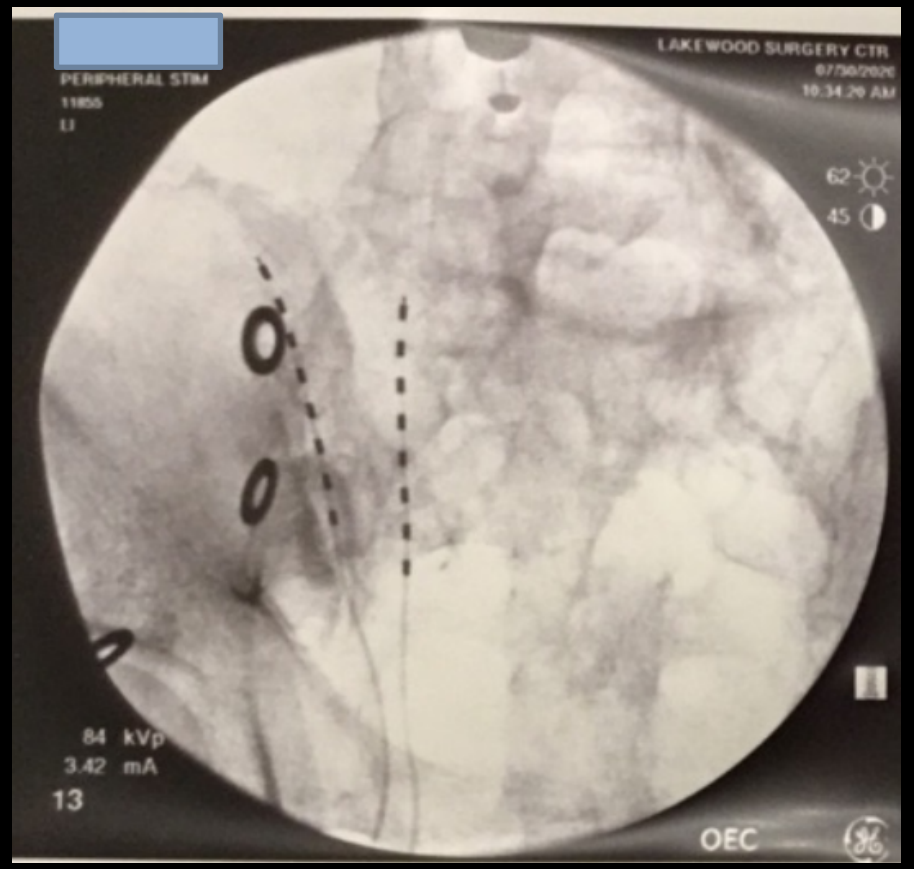
Peripheral Nerve Stimulation

- Form of neuromodulation
- Stimulation of peripheral nervous system
- Direct peripheral nerve stimulation (PNS)
- Peripheral Nerve Field Stim (PNFS)



PNS for SI Joint Pain

- 75-year-old male with refractory SI joint pain
- H/o lumbar laminectomy
- Failed lateral SI joint fusion
- Cooled RF, short duration of pain relief
- Posterior fusion was denied
- Percutaneous PNS of lateral branch nerves



Summary

- Prevalence of SI Joint Pain – 15 to 30% of all LBP
- Clinical association with lumbar surgery
- Diagnosis
  - Localization of pain
  - Battery of provocative tests
  - Diagnostic SI joint injection
- Treatment options
  - Non-surgical care: Meds, PT, SI Joint Injections, RFA
  - MIS SI Joint Fusion (clinical evidence)

Thank You