Sacroiliac Joint Pain: Patient Selection and Diagnostic/Therapeutic Injections

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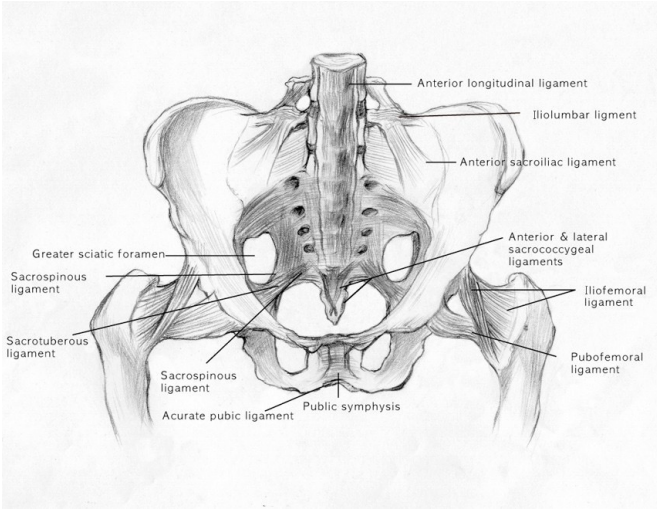
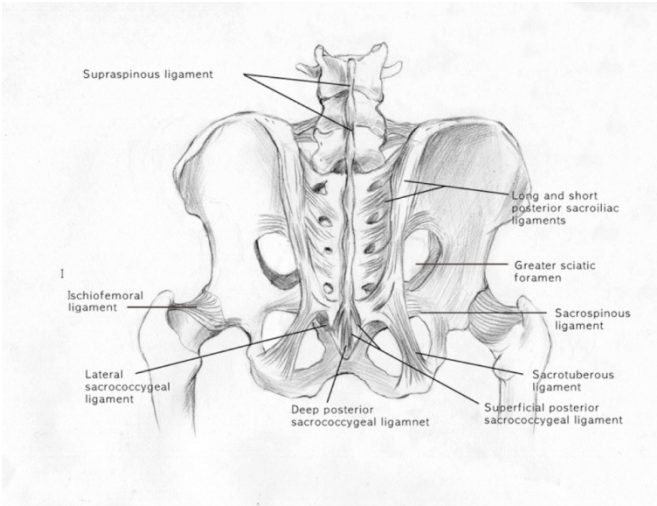
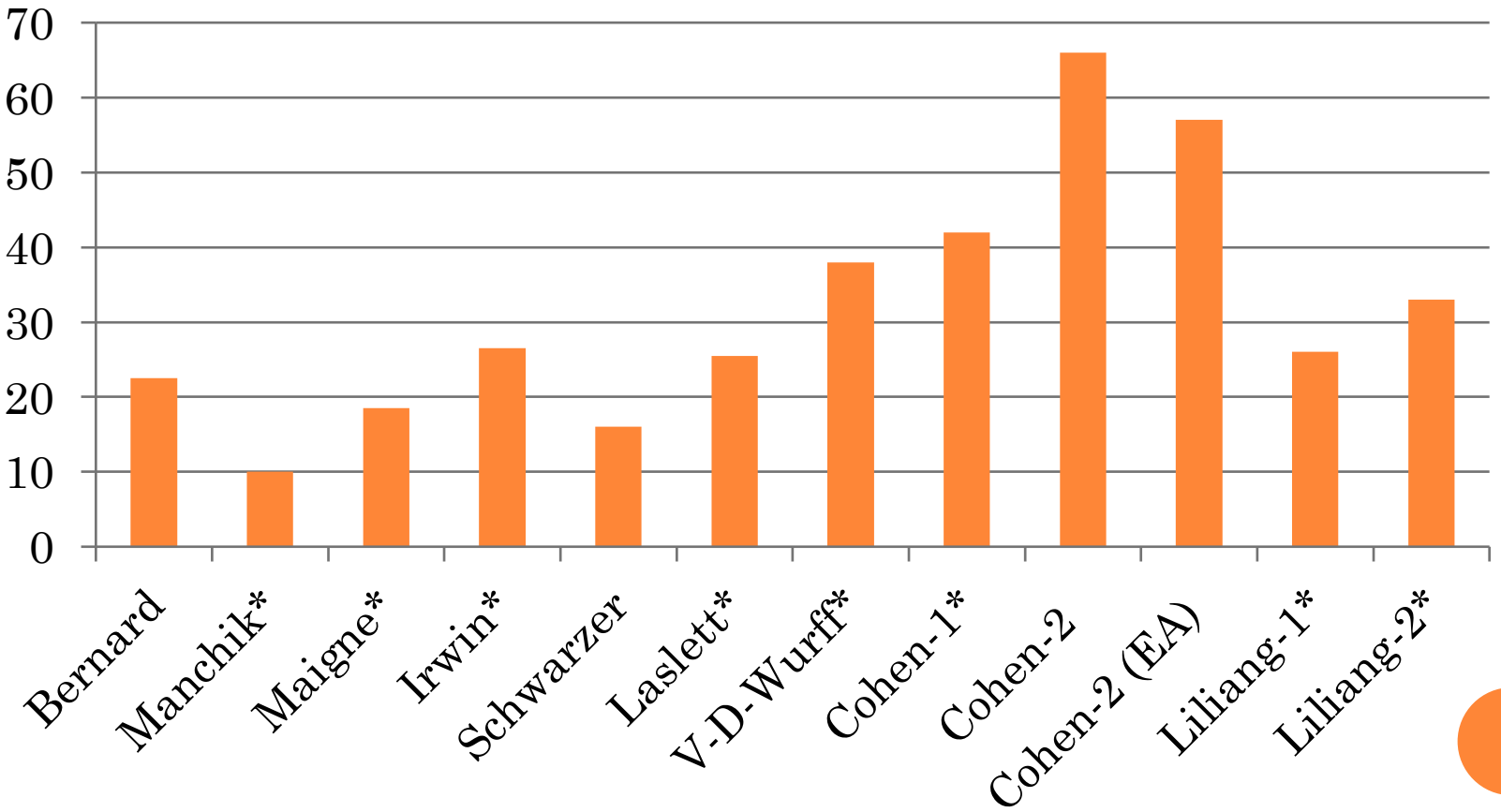
Prevalence Rates

- Underestimated by surgeons & PCPs
- Heterogeneous condition
- Represents 15%-25% of cases of axial LBP below L5
- Bi-modal peaks in prevalence rates

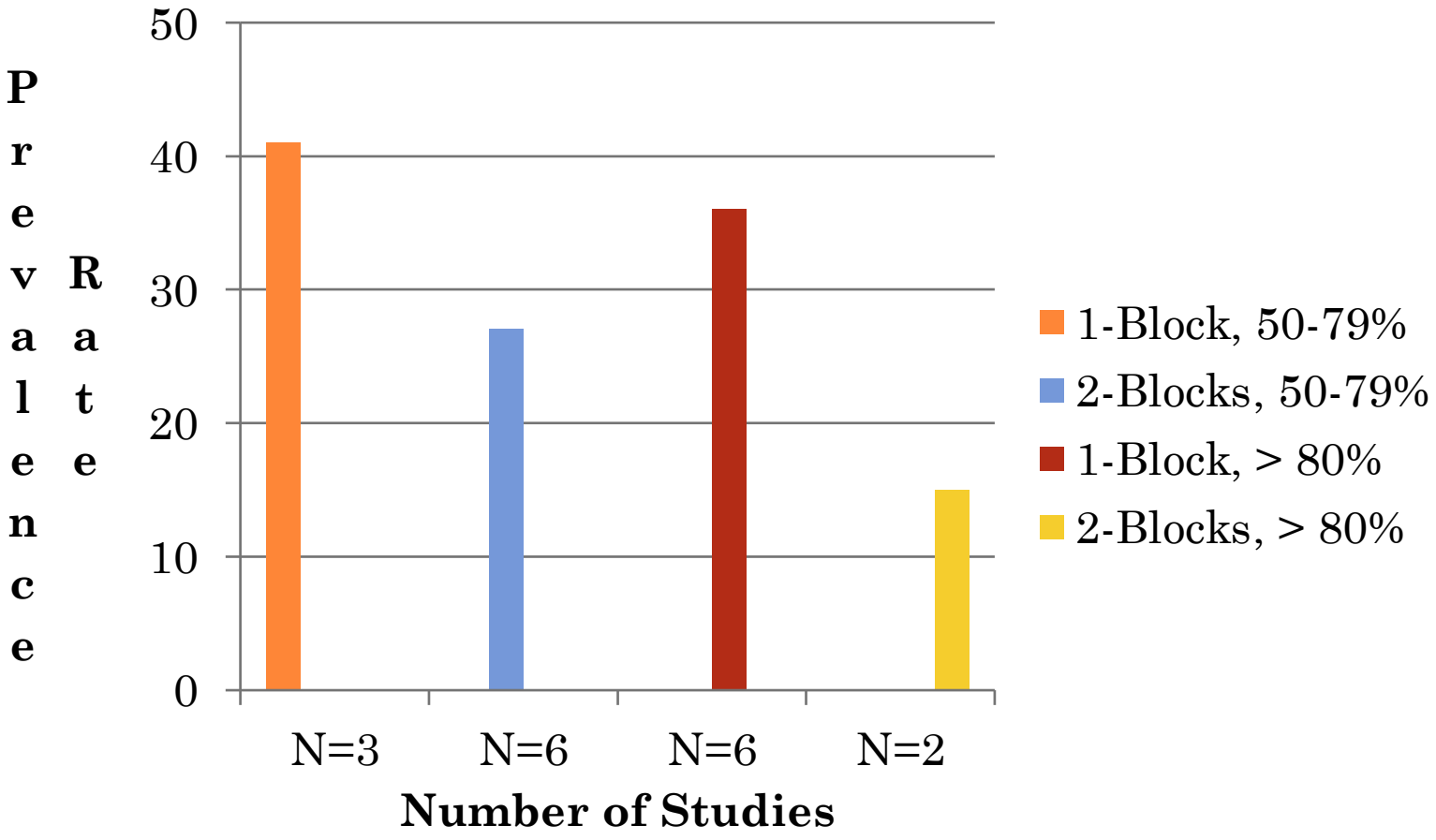




Prevalence Rates of SI Joint Pain



Is Prevalence Rate Affected by the Number & Cutoff Threshold of Diagnostic Blocks?



Prevalence Rates Based on Pain Relief & Injection Number

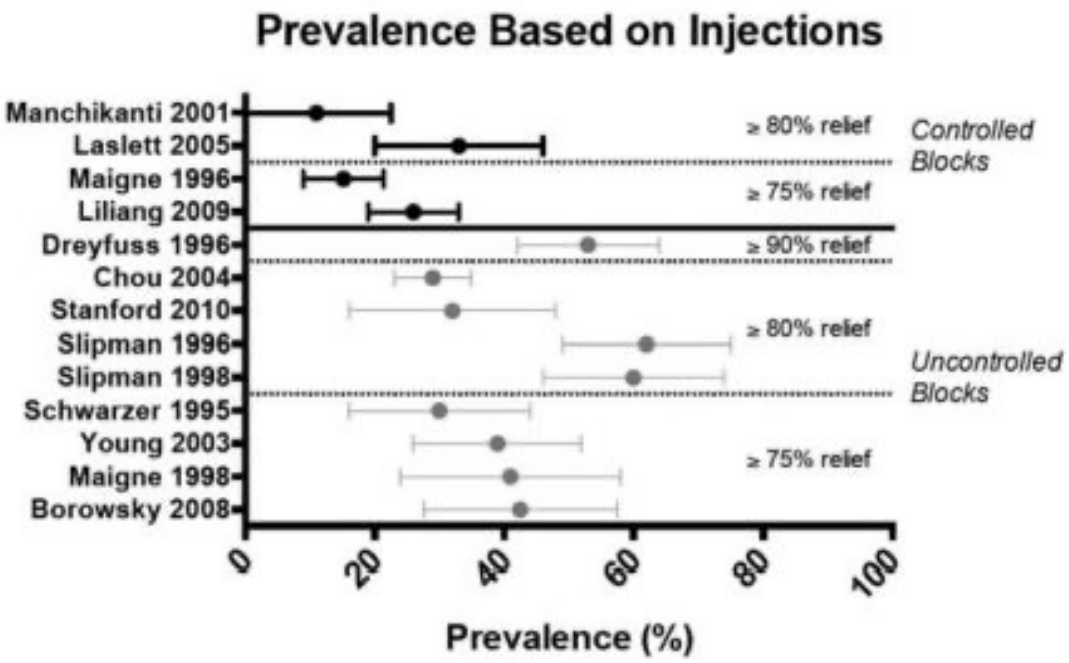
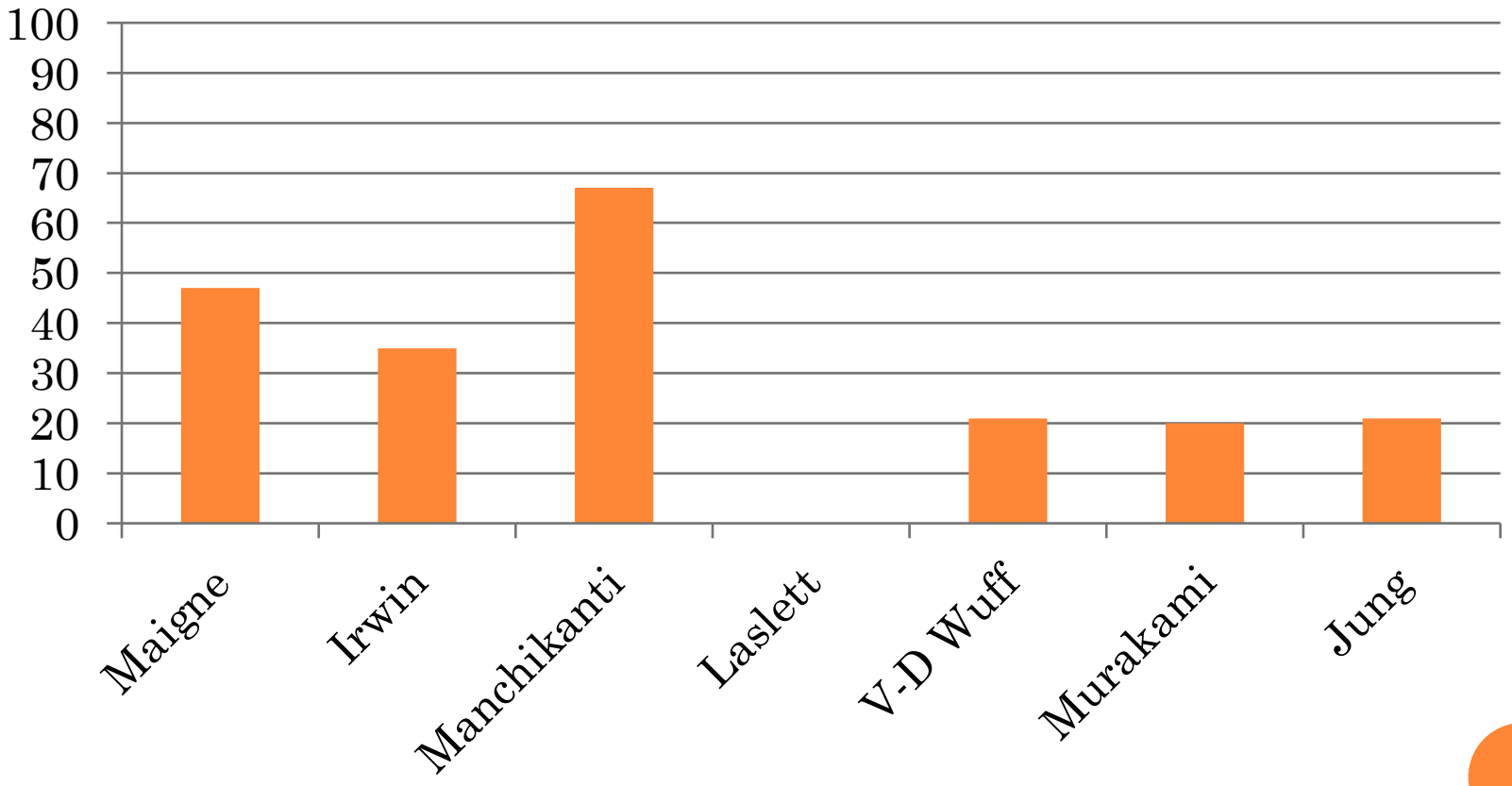


Figure 1 Prevalence based on injections.

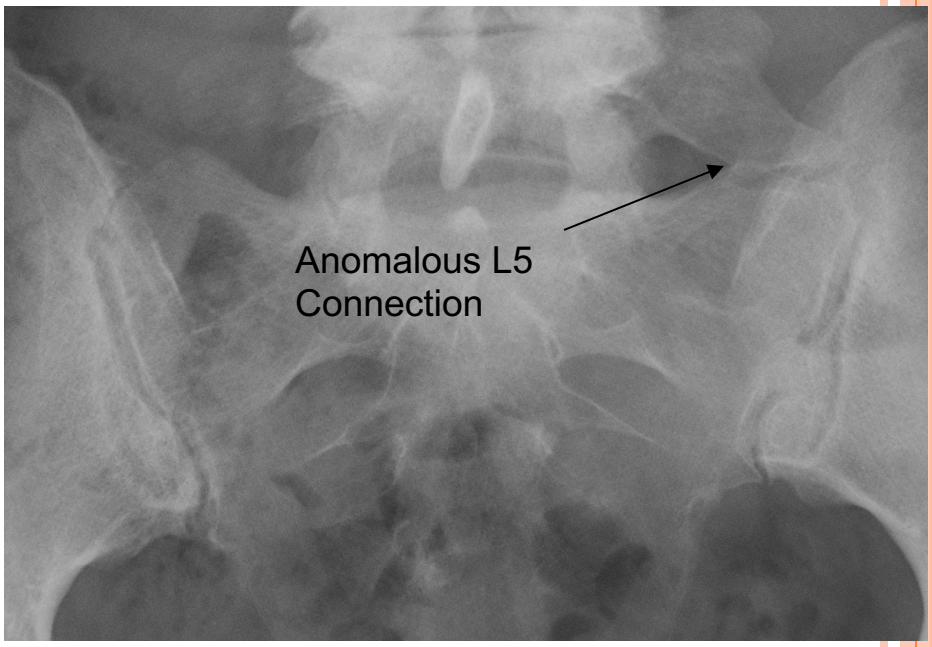
Kennedy et al. Pain Med 2015

Diagnostic Utility: > 20% False-Positive Rate of Uncontrolled SI Joint Blocks



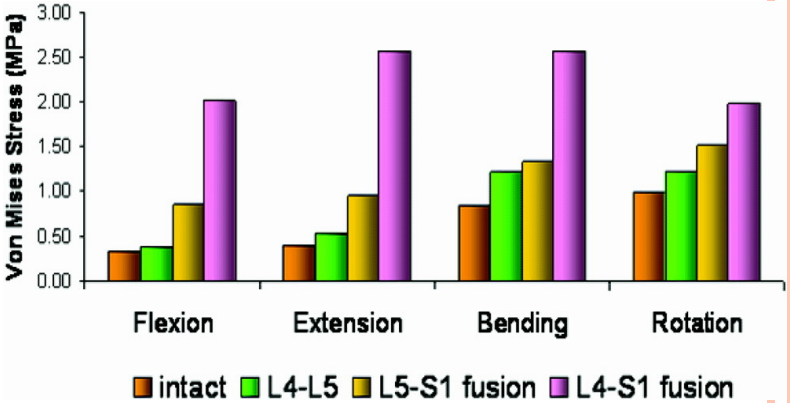
Inciting Events

- Chou et al. 2004 (n=54)
  - 44% trauma (13 MVA, 6 falls, 3 postpartum)
  - 11% cumulative stress
  - 35% “spontaneous” (10 had FBSS)
- Cohen et al. 2009 (n=78)
  - 40% traumatic
    - Falls and MVA
- Schwarzer 1995 (n=43)
  - 42% work related
  - 37% after MVA



Sacroiliac Joint Pain & Fusion

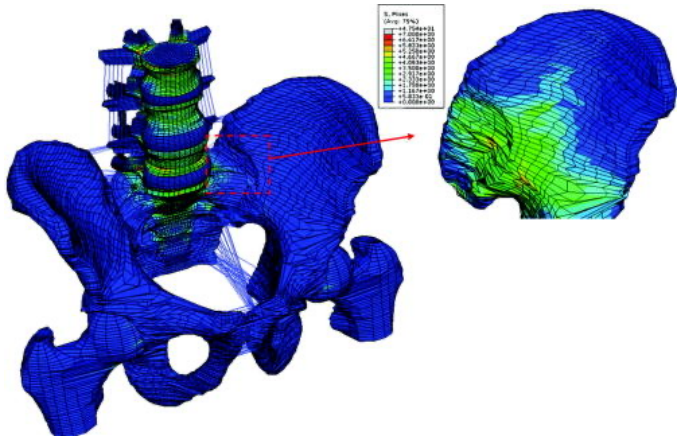
- Ivanov et al. 2009: Computer simulated model demonstrating increased angular motion & stress after fusion
- Ha et al. 2008: SI joint degeneration accelerated after fusion
  - Sacral > floating > control
  - Effects evident within 1 year & continue through 5 years



Avg. stress across SIJ articular surfaces after compressive load & bending movements

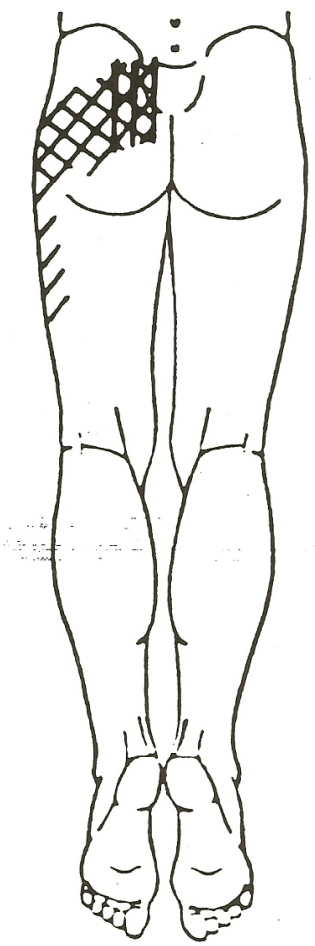
Clinical Studies

- Katz et al. 2005: Between 32% and 61% of 34 post-fusion pts had (+) SI joint block
- Maigne et al. 2005: 35% of 40 post-fusion pts had (+) SI joint block
  - L5-S1 fusion ≥ floating fusion
- Heary et al. 2002: 34% of fusion pts have persistent iliac crest donor site pain
- Ebraheim et al. 2000: IC bone grafts can disrupt ligamentous or synovial part of SI joint
  - SI joint degeneration: Synovial disruption > ligamentous disruption > no disruption

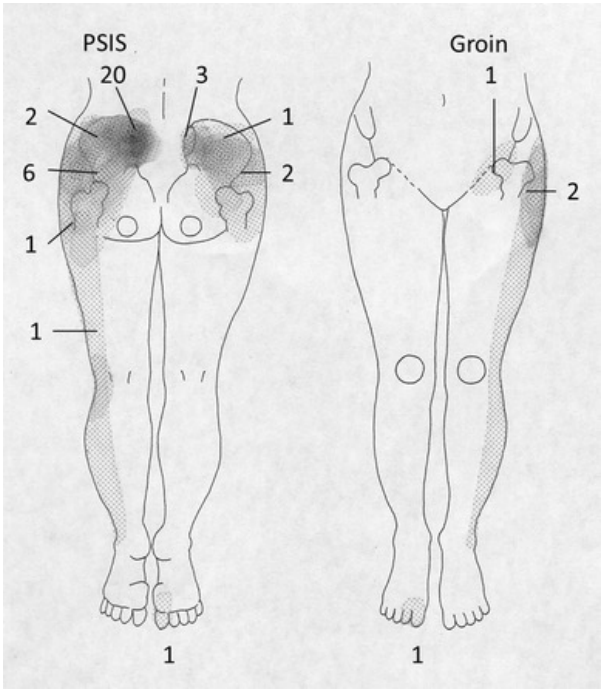


SI Joint Pain Referral Zones

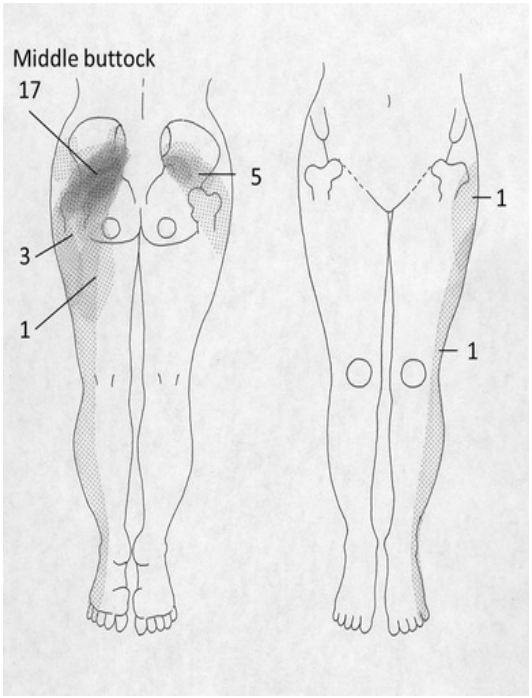
- Retrospective analysis in 50 pts dxed with SIJ pain based on diagnostic blocks (Slipman et al. 2000)
  - 47 described buttock pain (94%)
  - 36 described lower lumbar pain (72%)
  - 25 had lower extremity pain (50%)
  - 14 had leg pain distal to the knee (28%)
  - 7 described groin pain (14%)
  - 6 reported foot pain (12%)



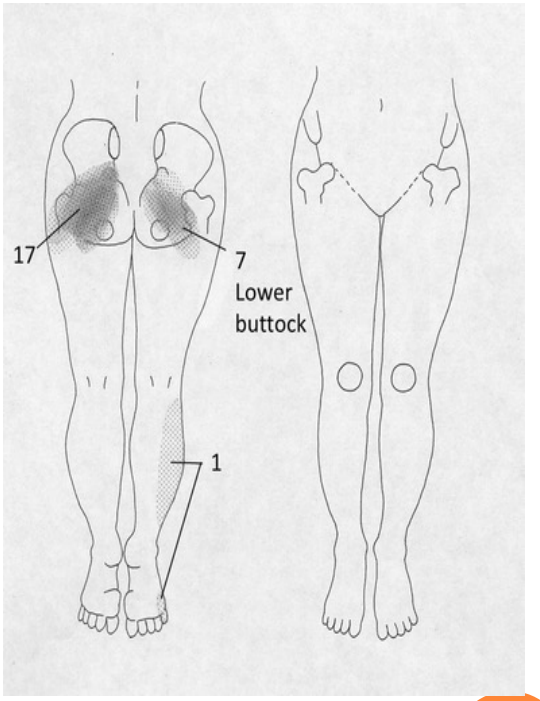
Referral Patterns Based On Extra-Articular SI Joint Pathology



Upper Joint



Middle Joint

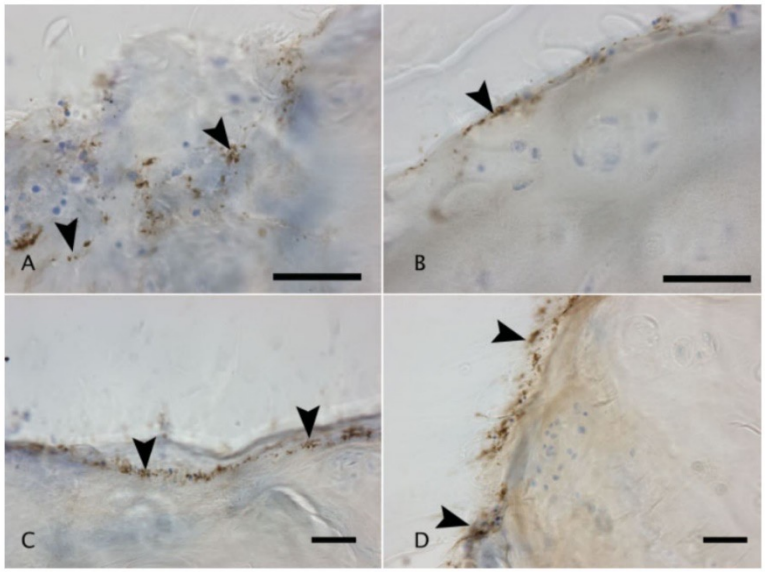


Lower Joint

Kurosawa et al. Eur Spine J 2015

Nociceptor Density in SI Joint Complex

- Mechano- and thermal sensitive and polymodal nociceptors present in SI joint capsule, ligaments, subchondral bone and cartilage
- Can be activated mechanically (strains) or biochemically (inflammatory arthritis)
- Volume of ligaments > capsule



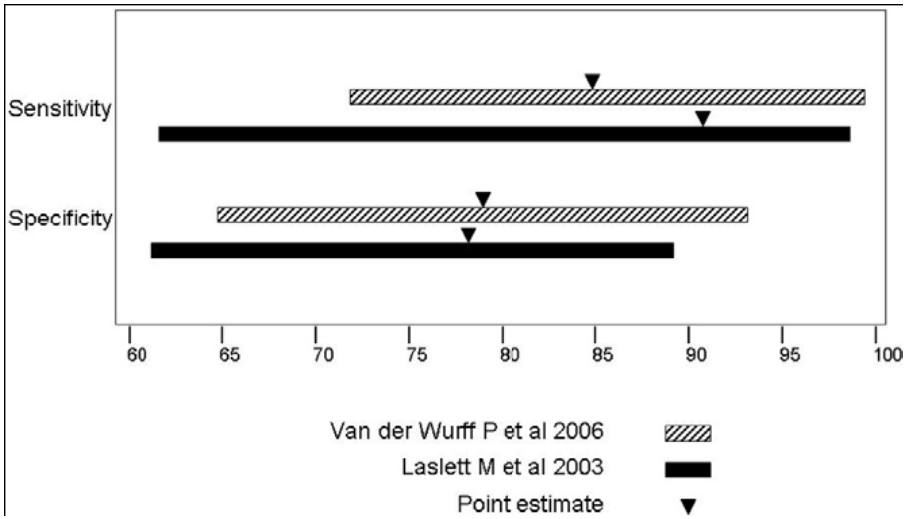
CGRP-immunoreactive nerve fibers in sacral and iliac cartilage.
Szadek et al. Clin Anat 2010

Studies Evaluating SI Joint Pain Patterns

Author	Patients	Findings Suggestive of SI Joint Pain
Fortin	10 volunteers & 16 pts with SI joint pain	Point of maximum discomfort within 10 cm caudal & 3 cm lateral to PSIS
Murakami	38 pts responders to periarticular injections	Point of maximum discomfort within 3 cm from PSIS
Schwarzer	43 pts with axial LBP	Radiation to groin
Dreyfuss	85 pts with axial LBP	None
Slipman	50 pts with axial LBP	94% had buttock, 72% lumbar, 28% lower leg and 14% groin pain
Van der Wurff	60 pts with axial LBP	None
Jung	160 pts with SI joint arthropathies	Buttock pain alone, extending into posterolateral thigh, or into groin
Laslett	56 pts with axial LBP	Non-centralizaton of pain
DePalma	127 responders to IA SI joint blocks	Lateral > midline pain
Young	102 pts with non-radicular LBP	Pain rising from sitting, non-midline pain below L5
Kurosawa	397 pts with SIJ pain, lumbar stenosis or lumbar HNP	46.5% of SIJ pts reported groin pain vs. < 10% for LSS or HNP
DePhillipo	50 pts with primarily SIJ region pain	After w/u, 90% dxed with l-spine pain, 4% hip pain & only 3% SIJ pain

Diagnosis

- Single PE tests unreliable, but battery of 3 (+) tests can be helpful
- Low-volume injections "sine qua non" for dx
- Spondyloarthropathy dxed by imaging and lab tests

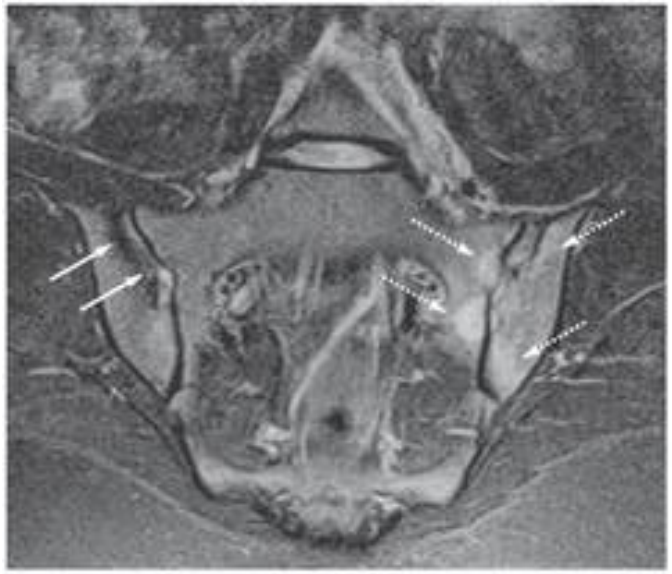


Can Physical Exam Tests Predict Response to Injections?

Author	Design	Sensitivity	Specificity	# of Provocation Tests
Van Der Wurff 2006	Prospective	85%	79%	3 of 5
Stanford & Burnham 2010	Prospective	82%	57%	3 of 6
Laslett 2005	Blinded prospective	94%	78%	3 of 6
Young 2003	Prospective	Phi coefficient 0.6, effect size 0.36. 100% sensitivity for pain rising from sitting		3 of 6
Broadhurst & Bond 1998	Double-blind study	77%-87%	100%	Patricks's, posterior shear & resisted abduction tests
Szadek 2009	Systematic review	85%	76%	3 of 5
Liliang 2011	Prospective	P=0.02 to distinguish from < 4 tests	Not reported	4 of 6
Schneider 2020	Prospective	Highest for Patrick's and sacral thrust (.77)	Distraction (.83) and compression (.78) highest	Gaenslen's test had lowest P-value (.18) for predicting response to injection. No combination of tests predicted injection response.
Mekhail 2021	Prospective	94%	17%	2 (Patricks & Mekhail/ Gaenslen's) of 3, with 81% PPV, 44% NPV
Cohen 2022	Prospective	Patrick's 59%, Gaenslen's 71%, both 53%	Patrick's 26%, Gaenslen's 21%, both 37%	Patrick's PPV & NPV: 43%, 38%. Gaenslen's PPV & NPV: 47%, 41%. Both: 41%, 38%

Imaging and Diagnosis

Imaging Modality	Accuracy
CT Scan	Good for already established bone changes. Does not detect inflammation. 58% sensitive and 69% specific in identifying symptomatic joint.
MRI	Treatment of choice for radiological abnormalities (i.e. SpA). STIR and contrast-enhanced superior. 85% sensitive for active sacroiliitis.
Bone Scans	Low sensitivity, high specificity (> 90%), indicating poor screening test for injections
X-rays	Very low sensitivity, high specificity



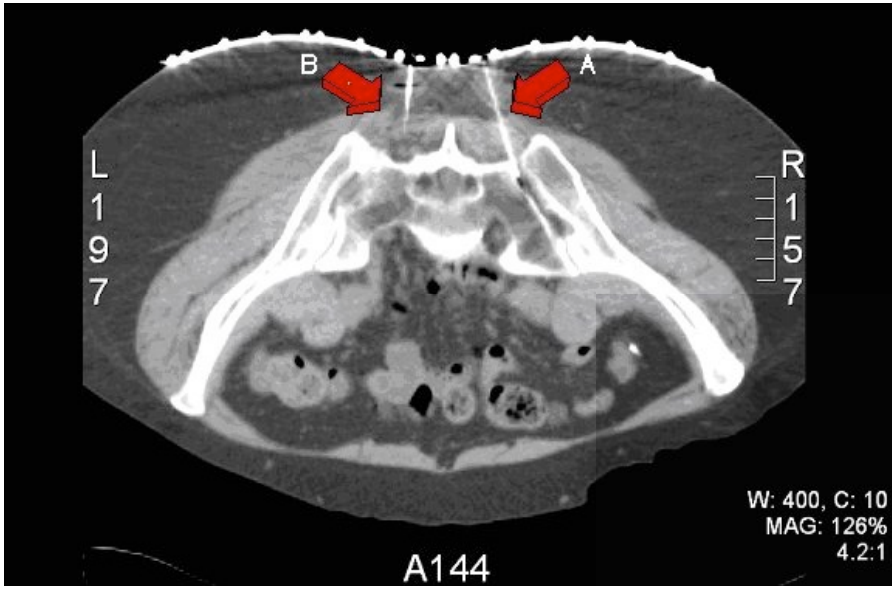
Axial MRI STIR image through SI joint

Randomized Trials SI Joint Injections

Study	Patients	Design	Interventions	Results
Kim 2010	48 pts with injection-confirmed SIJ pain	Randomized comparative-effectiveness	Prolo: IA 1-3 inj 2.5 mL 25% dextr vs. IA steroid & LA	59% of prolo vs. 10% of IA steroid group had $\geq$ 50% relief at 15 mo.
Singla 2017	40 pts with imaging pathology & (+) PE tests	Randomized C-E	IA PRP vs. IA steroid + LA	Steroid = PRP @ 4 wks, PRP > steroid @ 3 mo.
Cohen 2019	125 pts with (+) PE tests	Randomized, DB C-E	Landmark (EA) vs. fluoroscopy-guided (IA) steroid + LA	Both groups had comparable benefit @ 1 mo, FG/ IA > LG/ EA @ 3 mo
Fischer 2003	89 children w/ spA	Randomized controlled	Responders to NSAID rec'd NSAID. NR rec'd IA steroid & NSAID	Both groups had excellent long-term (20 mo) outcomes, no difference
Visser 2013	51 pts with SIJ-related leg pain	Randomized, single-blind	PT, manual therapy, fluoroscopy-guided IA steroid + LA	Success rates @ 12 wk 20% for PT, 72% for MT & 50% for injections
Luukkainen 1999	20 pts with sero (-) spA & (+) PE tests	DB, PC	Unilateral periarticular inj with steroid + LA or saline + LA	Steroid > saline @ 2 mo
Luukkainen 2002	24 pts w/o spA & (+) PE tests	DB, PC	Unilateral periarticular inj with steroid + LA or saline + LA	Steroid > saline @ 1 mo
Maugars 1996	10 pts, 13 joints with spA &	DB, PC	IA injections with steroid + LA or saline	5/6 steroid vs. 1/7 saline had (+) outcome @ 1-mo. 12/14 had (+) outcome @ 1-mo, 7/12 @ 6 mos.
Lee 2010	39 pts with injection-confirmed SIJ pain	Randomized C-E	Periarticular injections of steroid + LA or botulinum toxin	Both groups had comparable improvement @ 1-mo. At 3-mo, BTX > steroid

Overall Problems with SI Joint Injection Studies

- Pts not "pre-selected" based on response to diagnostic blocks
- All small with short-term outcomes
- No RTW data
- Not proven to enhance functional capacity or reduce medication intake

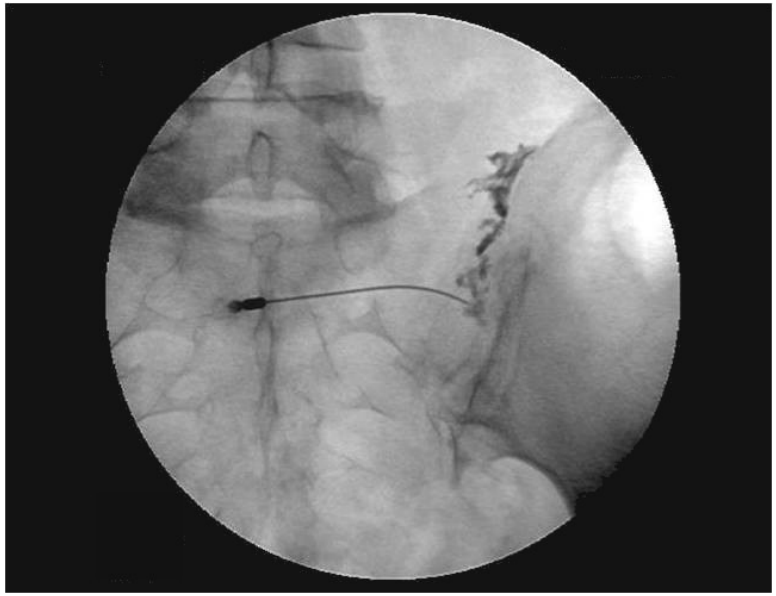


Intra- vs. Extra-Articular Injections

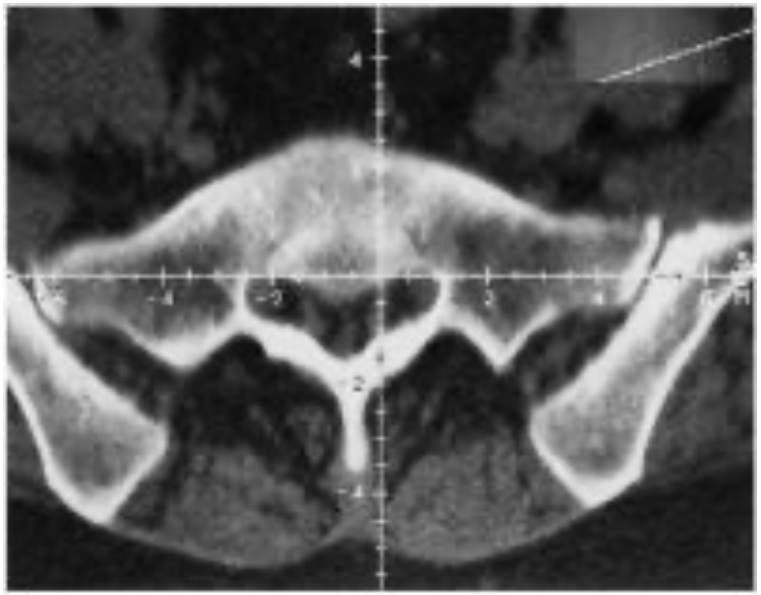
- Intra-articular
  - Arthritis
  - Spondyloarthropathy
  - Infection
  - Trauma
- Likely to be older, have bilateral pain, radiological evidence of degeneration, other concomitant pain sources

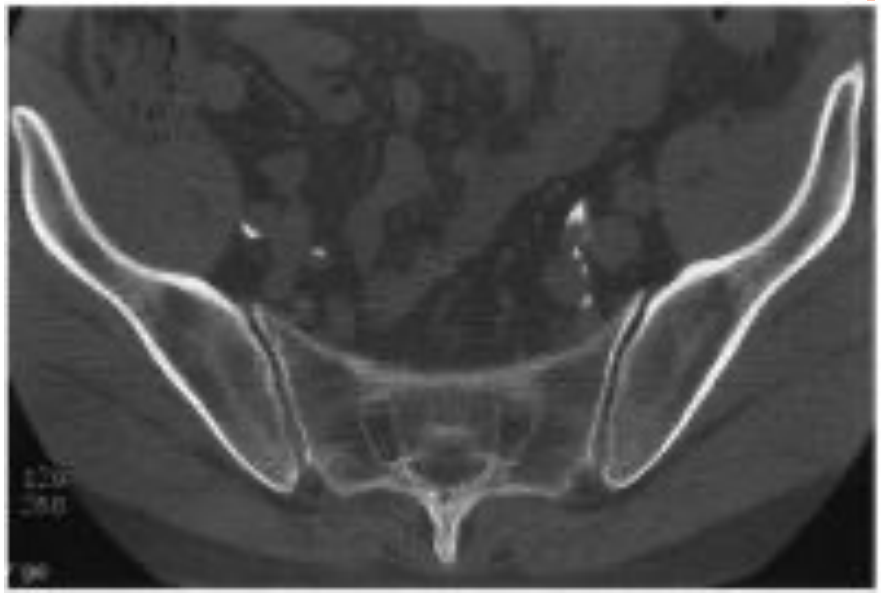
- Extra-articular
  - Trauma/ Fractures
  - Ligamentous injury
  - Myofascial pain
  - Enthesopathy
  - Pregnancy
- Younger, prominent tenderness, unilateral pain, less radiological findings, athletic/ inciting event

Intra vs. Extra-Articular Injections?



Intra- or Extra-Articular Pathology



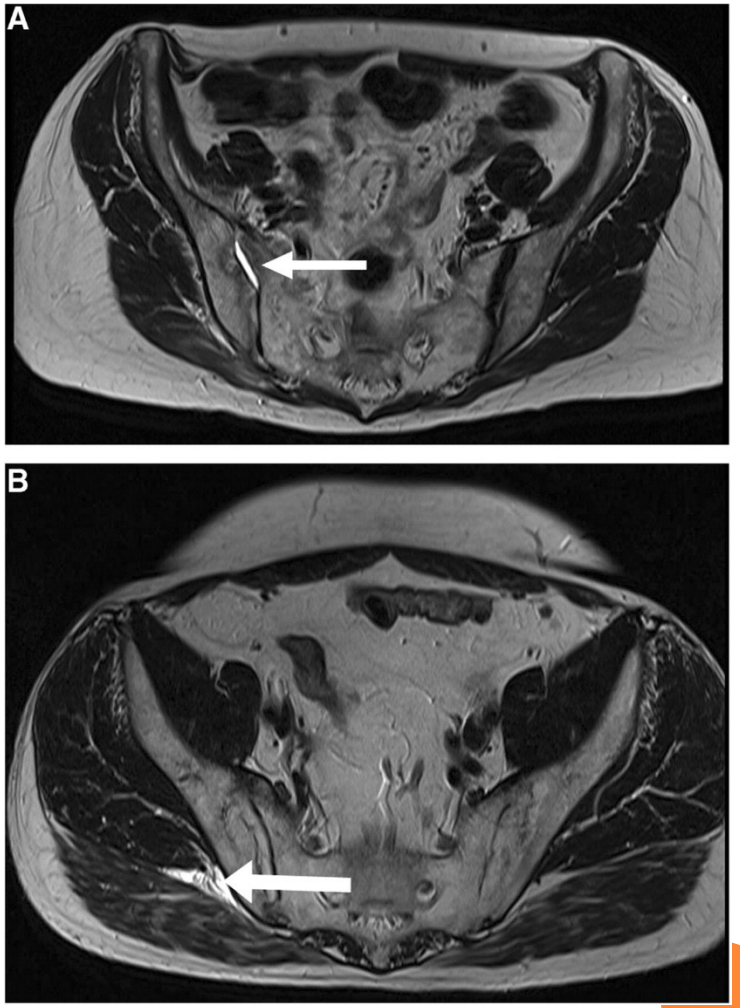


Which is Best?

- Borowsky & Fagen Arch Phys Med Rehabil 2008
- Retrospective study in 120 individuals comparing intra- (n=40) vs. intra- & extra-articular (n=80) LA & steroid injections
- Significant improvements in pain and in both groups, but combined group > intra-articular through 3 mos
- Murakami et al. J Orthop Sci 2007
- Prospective study comparing IA vs. EA lidocaine injections in 50 pts with clinically dxed SI joint pain
- 5" after injection, all EA injections provided significant relief vs. 36% of IA injections
- All 16 EA injections performed later in "failed" IA pts resulted in significant relief

Comparison of Intra vs. Extra-articular INjections

- Hartung et al. Performed US-guided SIJ injections in 20 pts with active sacroiliitis followed by MRI
  - 8 injections peri-articular, 12 intra-articular
  - No differences in treatment outcomes
    - IA, PA Baseline: 6.8, 7.0
    - IA, PA 1d post-injection: 4.3, 4.1
    - 28d post-injection: 3.5, 4.5



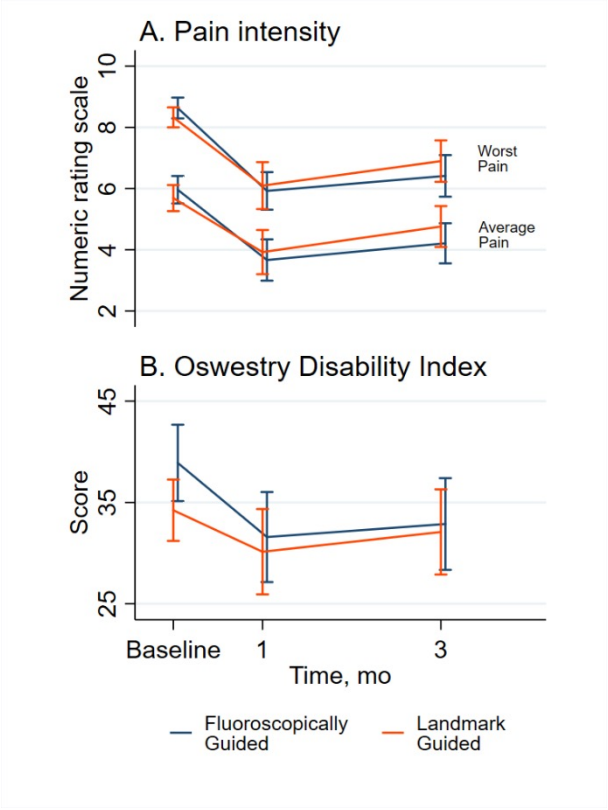
Hartung W et al. Rheumatology 2010

Fluoroscopically-Guided vs. Landmark-Guided SIJ Injections

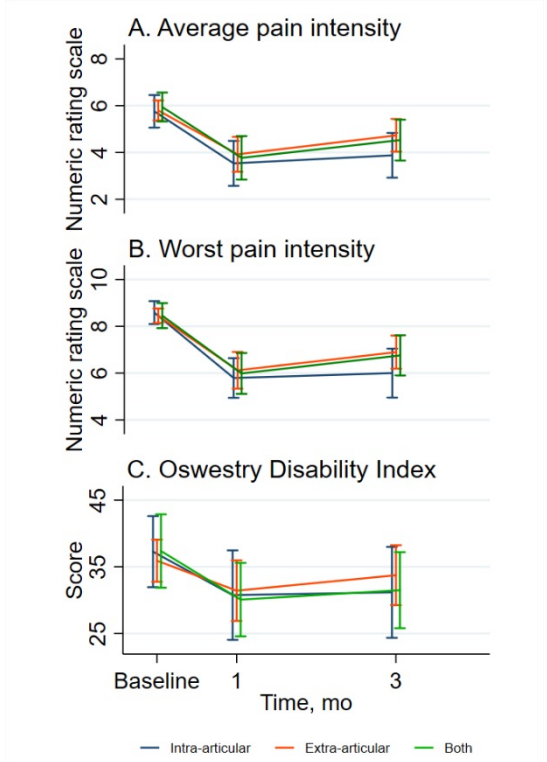
- Cohen et al. 2018
  - DB, RCT in 125 patients (35% active duty) randomized to fluoroscopically-guided SIJ or landmark-guided injections
  - 8% of landmark-guided injections IA
    - 6 injections into piriformis m & 3 into sacral foramen
  - Prevalence (i.e. + block)
    - 61% for image-guided vs. 62% for landmark-guided
    - 69% for IA + EA, 62% for IA, 57% for EA injection
- No difference in 1-month outcomes
- At 3-months, fluoroscopy-guided > landmark-guided group for avg. & worst pain but not secondary outcomes
- Stratified by location, no differences between IA and EA injections at 1-month, but IA > EA for worst pain score @ 3 months

Fluoroscopically-Guided vs. Landmark-Guided SIJ Injections

Effectiveness Based on Technique (Imaging vs. Landmark



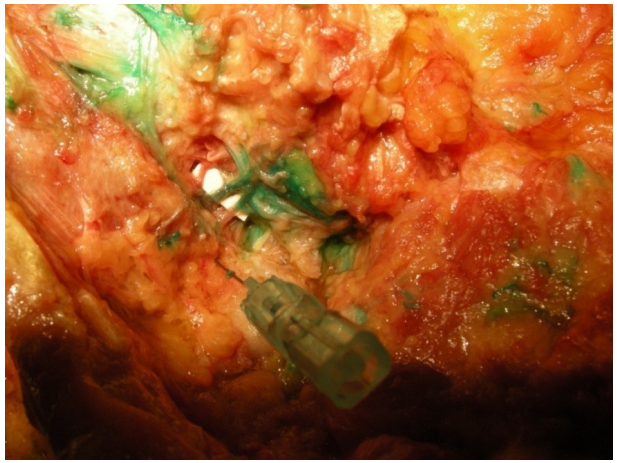
Effectiveness Based on Injection Location (Intra- vs. Extra-Articular)



Should LBB Be Used to Screen Patients?

- No evidence for LBB to provide long-term relief
- 3 of 3 RCTs that used LBB screening reported superiority of RFA to sham RFA (Patel 2012, Juch 2017) or conventional mgmt (Cohen et al. in preparation)
  - 2 (Cohen 2008, Mehta 2018) of 3 (van Tilburg 2016) that reported SIJ blocks w/o LBB reported superiority of RFA over sham RFA
- Single site LBB block less than half of the sensory input
- Injecting LA at 2 different depths blocks > 90% of nerves
- LBB are effective in preventing pain from ligamentous probing in 70% of people, but 86% still feel discomfort from capsular probing

Single site injections adjacent to foramen anesthetize 40% of LBB



Dreyfuss et al. Pain Med 2008, 2009

Interventional Pain Outcomes Stratified by Diagnostic Block "Cutoff" Threshold

- Diagnostic block cutoff (sensitivity, specificity) depends on relative risks and costs of blocks vs. definitive procedure
- SI joint injections & RFA have similar risks, higher cost ratio than z-joint blocks & RFA
- No reliable alternatives for those who fail to obtain long-term relief from SI joint injections but can't receive RFA
  - Opioids, surgery have high risks & limited utility

Author	# of Pts	Procedure	Comparison	Results
Cohen et al. 2007	92	Cervical facet RF	> 50% vs. > 80%	56% success rate in > 50% group vs. 58% in > 80% group
Erdek et al. 2010	50	Celiac plexus neurolysis	> 50% vs. > 80%	56% success rate in > 50% group vs. 54% in > 80% group
Cohen et al. 2007	262	Lumbar facet RF	> 50% vs. > 80%	52% success rate in > 50% group vs. 56% in > 80% group
Stojanovic et al. 2010	77	Lumbar facet RF	> 50% vs. > 80%	47% success rates in both groups
Williams et al. 2011	244	Spinal cord Stimulation	< 50% vs. > 50% vs. > 75%	18% in < 50% vs. 90% in > 50% vs. 71% in > 75% groups
Cohen et al. 2009	77	SI joint RF	> 50% vs. > 80%	51% success rate in > 50% group vs. 49% in > 80% group
Huang et al. 2012	101	Pulsed RF of occipital nerves	< 50% vs. > 50% vs. > 80%	50% in < 50% vs. 48% in > 50% vs. 58% in > 75% groups
McGreevy 2013	32	Superior hypogastric neurolysis	% pain relief	Mean pain relief of 75% for (+) outcomes vs. 82% for (-) outcomes
Holt & Seghal 2016	50	Lumbar & cervical facet RF	Both blocks $\geq$ 80% vs. 1 of 2 blocks $\geq$ 80%	53.1% for concordant relief vs. 44.4% for discordant (P=NS)
Derby et al. 2012	51	Lumbar RF	> 50% vs. > 80%, both 1 & 2 blocks	56% success in > 50% group vs. 84% in > 80% group
Burnham et al. 2020	92	Cervical facet RF	80-99% vs. 100%	Identical 54% success rates
Shin et al. 2006	28	Cervical facet RF	25% vs. 50% vs. 75% vs. 80% vs. 100%	No correlation between dx block pain relief & RF outcomes
Chen et al. 2021	265	Genicular RF	< 50% vs. 50-79% vs. > 80%	<5% for <50%, 29.3% for 50-79%, 69% for >80%
Cohen et al. 2022	346	Lumbar facet (n=101), SIJ injections (n=66)	> 50% vs. > 80%	39.5% for 50-79%, 65.45 for >80% for facet; 50-79% superior to >80% for SIJ

Outcome Predictors for SI Joint RF Denervation

- Cohen et al. 'Reg Anesth Pain Med' 2008 (n=77)
- LBB, # SI injections, % pain relief with block, etiology, pain referral pattern, worker's compensation, nerves targeted, PE signs, & prior surgery not associated with outcome
- Weak association between positive outcome and cooled-probe technology, short duration of symptoms, age < 65, no opioid use, and pre-procedure pain score
- Conclusions: Selection criteria for SI joint denervation should be inclusive

Take-Home Points

- SI joint pain is heterogeneous in terms of referral patterns and structural etiologies
- A battery of PE tests, pain referral patterns and historical factors can identify pts for blocks
- IA and EA have comparable overall prevalence
  - Although lateral branch RFA targets the nerve supply to ligaments, most studies have not employed EA blocks
  - Studies with prognostic LBB report better outcomes than those without
- Higher pain relief cutoffs than 50% may improve outcomes, but will result in many pts who may benefit not receiving treatment