Role of Radiofrequency in SI Joint Pain

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Pain Generators in LBP

- Intervertebral disc  40%
- Facet Joint  15 - 40%
- Sacroiliac Joint  15%
- Vertebral body : rare
- Neural Tissue : rare
- Muscles & Connective Tissue : acute phase only, chronic : rare
SIJ Anatomy

- **Largest true synovial joint, 75% or more maybe fibrous capsule**
- **Strong fibrous capsule**
- **Adult surface area of 17.5 cm², volume 0.5 – 2 ml**
- **Morphology variable between sides & individuals**
- **Flat in young age; coarse ridges and depressions develop with age**
- **The synovial cleft narrows with age, 1-2 mm < 70 and 0-1 mm >70 years of age**
- **Complete intra-articular ankylosis is relatively rare**
SIJ Anatomy and Function

Function: Transfer of weight, strength, stability to spine, pelvis

SI Joint Human Innervation

- **Free nerve endings** (pain and thermal sense) exist in the SIJ capsule and posterior ligaments. Solonon; Acta Orthop Scand 1957;27:1-127, Vilensky; Spine;27:1202-1207, 2002

- **Pressure and position sense** exists. Solonon; Acta Orthop Scand 1957;27:1-127


- **Dorsal dissections** on 10 specimens bilaterally found that S1 and S2 lateral branches primarily innervate the SIJ and associated ligaments posteriorly, occasional contributions from S3 but not S4. Willard. Third World Congress on Low Back and Pelvic Pain. Vienna, Austria, November, 1998
SIJ Dorsal Innervation

- Great variability in anatomical locations
- Variable number of lateral branches between sides and individuals
- Variability in anatomical landmarks and take-offs from neural foramina
- Lateral branches within 10 mm of dorsal SIJ ligaments
- LBN can be on the sacral plate or several mms from its surface (Willard 1998, Yin 2003)

Not an easy joint to treat !!!
Nerve Supply of SI Joint
Lateral br ns leave at 2-6 o’clock (right); 10 to 6 o’clock (left) for S1
Maximal SIJ pain is below L5 but can refer into the entire lower extremity with 94% having buttock, 48% with thigh pain and 28% with lower leg pain (*)

- Provocation Tests
- Diagnostic Blocks

(*) Fortin, Spine 1994; 19: 1475-1482
Diagnosis of SIJ Pain (4)

IA Diagnostic Injections

- A positive response is provided by complete or near complete relief of pain following IA injection (*index or main pain concept*)

- Obtain AP, lateral, ipsi and contralateral obliques to note flow outside of the joint (*especially ventral capsular tears*)

- Ventral capsular defects occur in 20% of asymptomatic individuals (Dreyfuss 2000) and in 16-42% of those with CLBP (Schwarzer 1995, Fortin 1999)

- Dual SIJ blocks remain the only means of establishing a diagnosis of IA SIJ pain

- Volume of injectate 1.1 – 1.5 ml
Contralateral Oblique SIJ Arthrogram
Ventral capsular tear
SI Joint Pain Treatments

- **Non-Invasive:** Education, PT, Medication
- **Steroid Injections:** “Moderate short term”
- **Denervation:**
  - Phenol and Prolotherapy (Ward)
  - DRG via Burr Holes (Finch P)
  - Lateral Branch RF denervation (Yin W)
  - Bipolar lateral branch RF denervation (Burnham R)
  - Bipolar Ligamentous RF denervation (Gevargez A)
  - Bipolar SI Joint RF denervation (Ferrante F)
  - Bipolar SI Joint RF Denervation (Cosman & Gonzalez)
  - SI Joint Pulsed RF (Vallejo, Benyamin)
  - Single Long Strip Lesion, Simplicity (Vilims B)
  - Cold RF
RADIOFREQUENCY
Tip Vs Shaft

- Heat
- Electromagnetic field

lesions produced by RF in rat sciatic nerve at 6-8 weeks

• Wallerian degeneration in all nerve fibres
• Physical disruption of basal laminae
• Focal disruption of perineurium at lesion site
• Degranulation of mast cells (increase may indicate regeneration)
• Recruitment of exogenous macrophages
• Local muscle necrosis
• Delayed axonal regeneration
• Prolonged changes in micro-vascular bed—vascular stasis with extravasation of erythrocytes (resembling ischaemic changes of re-perfusion injury)
“Standard” RF-Perpendicular Approach

- Safe due to precise targeting, since tip use get some heat effect but not as much as when using shaft of needle (hence ?? less risk of neuritis)
- get maximum electromagnetic field effect
Sacroiliac Joint RF points

1. L4/L5  RF den
2. L5/S1  RF den
3. S2 & S3 RF den

Left Doral Branch of L5

Sensory / Motor Parameters

- Frequency: 50Hz
- Voltage: up to 0.5V
- Pulse width: 2ms

- Frequency: 2Hz
- Voltage: 2 x sensory voltage but at least 1V
- Pulse width: 2ms
Failure of Conventional RF

- Variable anatomy
- Variable innervation
- Difficult diagnosis
- Effectiveness of RF treatment in SIJ pain still not conclusively proven yet
- No large collaborative studies
- No universal RF generator and hardware

- The evidence for accuracy of provocative maneuvers in diagnosis of sacroiliac joint pain is limited
- The evidence for therapeutic intra-articular sacroiliac joint injections is limited
- The evidence for “traditional” radiofrequency neurotomy in managing chronic sacroiliac joint pain is limited
Randomized Placebo-controlled Study Evaluating Lateral Branch Radiofrequency Denervation for Sacroiliac Joint Pain

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Background: Sacroiliac joint pain is a challenging condition accounting for approximately 20% of cases of chronic low back pain. Currently, there are no effective long-term treatment options for sacroiliac joint pain.

Methods: A randomized placebo-controlled study was conducted in 28 patients with injection-diagnosed sacroiliac joint pain. Fourteen patients received L4–L5 primary dorsal rami and S1–S3 lateral branch radiofrequency denervation using cooling-probe technology after a local anesthetic block, and 14 patients received the local anesthetic block followed by placebo denervation. Patients who did not respond to placebo injections crossed over and were treated with radiofrequency denervation using conventional technology.

Results: One, 3, and 6 months after the procedure, 11 (79%), 9 (64%), and 8 (57%) radiofrequency-treated patients experienced pain relief of 50% or greater and significant functional improvement. In contrast, only 2 patients (14%) in the placebo group experienced significant improvement at their 1-month follow-up, and none experienced benefit 3 months after the procedure. In the crossover group (n = 11), 7 (64%), 6 (55%), and 4 (36%) experienced improvement 1, 3, and 6 months after the procedure. One year after treatment, only 2 patients (14%) in the treatment group continued to demonstrate persistent pain relief.

Conclusions: These results provide preliminary evidence that L4 and L5 primary dorsal rami and S1–S3 lateral branch radiofrequency denervation may provide intermediate-term pain relief and functional benefit in selected patients with suspected sacroiliac joint pain. Larger studies are needed to confirm these results and to determine the optimal candidates and treatment parameters for this poorly understood disorder.

Sacroiliac joint pain is a challenging condition estimated to account for between 15% and 20% of chronic axial low back pain cases.†,‡ Currently, there is no reliably effective treatment for sacroiliac pain. In randomized studies evaluating periarticular and intraarticular corticosteroid injections in patients suspected of having sacroiliac joint pain, the results are divided as to whether or not they afford any long-term benefit.‖ Studies evaluating conservative therapies are flawed by the lack of adequate control subjects and inappropriate diagnostic
Sacral Joint Interventions: A Systematic Review

Hans C. Hansen, MD1, Anne Marie McKenzie-Brown, MD2, Steven P. Cohen, MD3
John R. Swicogood, MD4, James D. Colson, MD5 and Laxmiah Manchikan1, MD2

Background: The sacral joint is a diarthrodial synovial joint with abundant innervation and capability of being a source of low back pain and referred pain in the lower extremity. There are no definitive historical, physical, or radiological features to provide definite diagnosis of sacral joint pain, although many authors have advocated provocative maneuvers to suggest sacral joint as a pain generator. An accurate diagnosis is made by controlled sacral joint diagnostic blocks. The sacral joint has been shown to be a source of pain in 10% to 27% of suspected cases with chronic low back pain utilizing controlled comparative local anesthetic blocks. Intrarticular injections, and radiofrequency neurotomy have been described as therapeutic measures. This systematic review was performed to assess diagnostic testing (non-invasive versus interventional diagnostic techniques) and to evaluate the clinical usefulness of interventional techniques in the management of chronic sacral joint pain.

Objective: To evaluate and update the available evidence regarding diagnostic and therapeutic sacral joint interventions in the management of sacral joint pain.

Study Designs: A systematic review using the criteria as outlined by the Agency for Healthcare Research and Quality (AHRQ), Cochrane Review Group Criteria for therapeutic interventions and AHRQ, and Quality Assessment for Diagnostic Accuracy Studies (QUADAS) for diagnostic studies.

Methods: The databases of EMBASE and MEDLINE (1966 to December 2006), and Cochrane Reviews were searched. The searches included systematic reviews, narrative reviews, prospective and retrospective studies, and cross-references from articles reviewed. The search strategy included sacroiliac joint pain and dysfunction, sacral joint injections, interventions, and radiofrequency.

Results: The results of this systematic evaluation revealed that for diagnostic purposes, there is moderate evidence showing the accuracy of comparative, controlled local anesthetic blocks. Prevalence of sacral joint pain is estimated to range between 10% and 27% using a double block paradigm. The false-positive rate of single, uncontrolled, sacral joint injections is around 20%. The evidence for provocative testing to diagnose sacral joint pain is limited.

For therapeutic purposes, intrarticular sacral joint injections with steroid and radiofrequency neurotomony were evaluated. Based on this review, there is limited evidence for short-term and long-term relief with intrarticular sacral joint infections and radiofrequency thermoneurotomy.

Conclusions: The evidence for the specificity and validity of diagnostic sacral joint injections is moderate. The evidence for accuracy of provocative maneuvers in diagnosis of sacral joint pain is limited. The evidence for therapeutic intrarticular sacral joint injections is limited. The evidence for radiofrequency neurotomy in managing chronic sacral joint pain is limited.

Keywords: Low back pain, sacral joint pain, axial pain, spinal pain, diagnostic block, sacral joint injection, thermal radiofrequency, and pulsed radiofrequency.
The results of this systematic evaluation are similar to one previous systematic review (1) and reports assessing the value and validity of sacroiliac joint injections (2,6,85). The literature on diagnostic and therapeutic interventions of the sacroiliac joint continues to be scarce. The literature on diagnostic sacroiliac joint injections and non-invasive diagnostic techniques is superior to the literature on therapeutic interventions. Due to the lack of significant literature, the level of evidence was low for therapeutic interventions. Consequently, it is imperative that previous studies are replicated and high quality evidence produced.

For therapeutic purposes, intraarticular sacroiliac joint injections with steroid and radiofrequency neurotomy were evaluated. Based on this review, there is limited evidence for short-term and long-term relief with intraarticular sacroiliac joint injections and radiofrequency neuroablation.

Conclusions: The evidence for the specificity and validity of diagnostic sacroiliac joint injections is moderate. The evidence for accuracy of provocative maneuvers in diagnosis of sacroiliac joint pain is limited. The evidence for therapeutic intraarticular sacroiliac joint injections is limited. The evidence for radiofrequency neurotomy in managing chronic sacroiliac joint pain is limited.

Keywords: Low back pain, sacroiliac joint pain, axial pain, spinal pain, diagnostic block, sacroiliac joint injection, thermal radiofrequency, and pulsed radiofrequency.

Pain Physician 2007; 10:165-184
“The meta-analysis demonstrated that RFA is an effective treatment for SI joint pain at 3 months and 6 months. This study is limited by the available literature and lack of randomized controlled trials. Further standardization of RFA lesion techniques needs to be established, coupled with prospective randomized controlled trials”
### Table 6. Description of studies evaluating radiofrequency neurotomy of sacroiliac joint

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Intervention(s)</th>
<th>Outcome(s)</th>
<th>Conclusion(s)</th>
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</thead>
<tbody>
<tr>
<td>Burnham and Yasui (131)</td>
<td>9 patients with SIJ pain.</td>
<td>Patients were treated with a series of RF strip lesions performed adjacent to</td>
<td>Assessments in pain intensity and frequency, analgesic intake, disability, satisfaction with treatment, and procedure complications evaluated at 1, 3, 6, 9, and 12 months after the procedure. Results showed significant reductions of back and leg pain intensity and severity; and analgesic intake. Overall, 8 of 9 subjects were satisfied with the procedure.</td>
<td>Positive short-term and long-term relief</td>
</tr>
<tr>
<td>Prospective, cohort study</td>
<td></td>
<td>the lateral dorsal foraminal aperture plus conventional monopolar lesioning at the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vallejo et al (132)</td>
<td>22 patients failed to respond to repeated sacroiliac</td>
<td>Pulsed radiofrequency denervation of the medial branch of L4, posterior primary</td>
<td>VAS score and quality of life assessments. 16 patients or 73% experienced good or excellent pain relief and quality of life improvement. Duration of pain relief was 6 to 9 weeks in 4 patients, 10 to 16 weeks in 5 patients, and 17 to 32 weeks in 7 patients.</td>
<td>Positive short-term and negative long-term relief</td>
</tr>
<tr>
<td>Prospective case series.</td>
<td>joint injection and medical therapy after the</td>
<td>rami of L5, and lateral branches S1 and S2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHRQ score: 5/8.</td>
<td>diagnosis of sacroiliac joint pain was confirmed</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ferrante et al (126)</td>
<td>33 patients with sacroiliac syndrome.</td>
<td>All patients underwent diagnostic SI joint injections with local anesthetic before</td>
<td>The criteria for successful RF denervation were at least a 50% decrease in VAS for a period of at least 6 months; 36.4% of patients (12 of 33) met these criteria. The average duration of pain relief was 12.0 +/- 1.2 months in responders versus 0.9 +/- 0.2 months in non-responders (P &lt; 0.0001).</td>
<td>Negative short-term and long-term relief</td>
</tr>
<tr>
<td>AHRQ score: 4/8.</td>
<td></td>
<td>denervation. 50 sacroiliac joint radiofrequency denervations were performed in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yin et al (129)</td>
<td>14 patients met inclusion criteria for this</td>
<td>Sensory stimulation-guided sacral lateral branch radiofrequency neurotomy after</td>
<td>64% of patients experienced a successful outcome, with 36% experiencing complete relief. 14% of patients did not achieve any improvement.</td>
<td>Positive short-term and long-term relief</td>
</tr>
<tr>
<td>AHRQ score: 4/8.</td>
<td>retrospective study.</td>
<td>dual analgesic sacroiliac joint deep intersosseous ligament analgesic testing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cohen and Abdi (128)</td>
<td>9 patients who experienced &gt;50% pain relief</td>
<td>Nerve blocks of the L4-5 primary dorsal rami and S1-3 lateral branches innervating</td>
<td>8 of 9 patients (89%) obtained &gt;/=50% pain relief from this procedure that persisted at their 9-month follow-up.</td>
<td>Positive short-term and long-term relief</td>
</tr>
<tr>
<td>AHRQ score: 4/8.</td>
<td>underwent RF lesioning of the nerves.</td>
<td>the affected joint.</td>
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</table>
13. Sacroiliac Joint Pain

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Table 2. Evidence of Interventional Pain Management for SIJ Pain

<table>
<thead>
<tr>
<th>Technique</th>
<th>Assessment</th>
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<tbody>
<tr>
<td>Therapeutic intra-articular injections with corticosteroids and local anesthetic</td>
<td>1 B+</td>
</tr>
<tr>
<td>Radiofrequency (RF) treatment of rami dorsales and laterales</td>
<td>2 C+</td>
</tr>
<tr>
<td>Pulsed RF treatment of rami dorsales and rami laterales</td>
<td>2 C+</td>
</tr>
<tr>
<td>Cooled RF treatment of the rami laterales</td>
<td>2 B+</td>
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</tbody>
</table>

RF refers to standard monopolar RF
Table 1. Summary of Evidence Scores and Implications for Recommendation

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 A+</td>
<td>Effectiveness demonstrated in various RCTs of good quality. The benefits clearly outweigh risk and burdens</td>
</tr>
<tr>
<td>1 B+</td>
<td>One RCT or more RCTs with methodologic weaknesses, demonstrate effectiveness. The benefits clearly outweigh risk and burdens</td>
</tr>
<tr>
<td>2 B+</td>
<td>One or more RCTs with methodologic weaknesses, demonstrate effectiveness. Benefits closely balanced with risk and burdens</td>
</tr>
<tr>
<td>2 B±</td>
<td>Multiple RCTs, with methodologic weaknesses, yield contradictory results better or worse than the control treatment. Benefits closely balanced with risk and burdens, or uncertainty in the estimates of benefits, risk and burdens.</td>
</tr>
<tr>
<td>2 C+</td>
<td>Effectiveness only demonstrated in observational studies. Given that there is no conclusive evidence of the effect, benefits closely balanced with risk and burdens</td>
</tr>
<tr>
<td>0</td>
<td>There is no literature or there are case reports available, but these are insufficient to suggest effectiveness and/or safety. These treatments should only be applied in relation to studies.</td>
</tr>
<tr>
<td>2 C−</td>
<td>Observational studies indicate no or too short-lived effectiveness. Given that there is no positive clinical effect, risk and burdens outweigh the benefit</td>
</tr>
<tr>
<td>2 B−</td>
<td>One or more RCTs with methodologic weaknesses, or large observational studies that do not indicate any superiority to the control treatment. Given that there is no positive clinical effect, risk and burdens outweigh the benefit</td>
</tr>
<tr>
<td>2 A−</td>
<td>RCT of a good quality which does not exhibit any clinical effect. Given that there is no positive clinical effect, risk and burdens outweigh the benefit</td>
</tr>
</tbody>
</table>

RCT, randomized controlled trial.
SI Joint Pulsed RF

- Prospective study: 22 pts
- >75% relief from 1-8 hrs after a single IA SIJ injection
- Pulsed RF (perpendicular approach) performed at L4 mb, L5 DR and sensory stimulation used for (<0.4mV) lateral branch RF at S1 and S2
- 2 pulsed lesions (second rotated 180 degrees) at 45V for 120 S at 39-42 degrees C.

Vallejo Pain Medicine 7, 2006:429-434
16/22 pts (73%) had >50% drop in VAS: % with >90% relief not reported

Mean pre-Tx VAS 7.57 and 6 months post mean VAS 2.67 (65% mean decrease)

Mean duration of relief was 20 weeks only (4.6 months) (range 6-32 weeks)
SI Joint Pulsed RF

- 72.7% reported either Good (>50% reduction in VAS) or Excellent” (>80% reduction in VAS) pain relief following PRFD.

- Duration of pain relief variable:
  - 4/22 reported 6–9 weeks
  - 5/22 reported 10–16 weeks
  - 7/22 reported 17–32 weeks relief

Vallejo Pain Medicine 7, 2006:429-434
Chronic sacroiliac joint pain: fusion versus denervation as treatment options

Ashman B. et al (Evidence-Based Spine-Care Journal) 2010 Dec;1(3):35-44.

“We identified eleven articles (six fusion, five denervation) meeting our inclusion criteria. The majority of patients report satisfaction after both treatments. Both treatments reported mean improvements in pain and functional outcome. Rates of complications were higher among fusion studies (13.7%) compared to denervation studies (7.3%). Only fusion studies reported infections (5.3%). No infections were reported among denervation patients. The evidence for all findings were very low to low (※) therefore, the relative efficacy or safety of one treatment over another cannot be established.”
Strongly Recommended Reading!!
INTERVENTIONAL PAIN
HANDS-ON CADAVER WORKSHOP AND SYMPOSIUM
MALTA
16/17 MARCH 2013

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IN CONJUNCTION WITH COMEDICAL B.V, THE NETHERLANDS