Voice of Interventional Pain Management

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SAVE THE DATE!
NEW YORK SOCIETY OF INTERVENTIONAL PAIN PHYSICIANS
MID YEAR PAIN SYMPOSIUM, 2016

June 4, 2016
www.NYSIPP.ORG

Disclosures
Board certifications: ABA Anesthesiology & Pain Medicine
Residency & Fellowship: NYU and Thomas Jefferson
President, NY State Society of Interventional Pain Physicians
Interventional Pain Section Editor: Pain Physician, Pain Medicine
News
Board member, Eastern Pain Association
Speaker/Consultant: Teva, Takeda, Mallinckrodt, Pernix, Iroko
Clinical research: MBB vs IA facet, SCS, ESI/TFESI
Interventional Pain Procedures: Indications, Complications and Technical Aspects

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When should I perform or refer out for interventional procedures?

Can these procedures be performed for chronic management of pain?
How many steroid injections can my patient receive per year?

- Is there a lifetime limit?

How long should my patient wait before a follow up injection?

Should my patients get three consecutive injections?
Should I request an injection specifying type, level, approach, etc.?

Sources of Neck and Back Pain
- Bones - spondylolisthesis, foraminal stenosis, DDD
- Muscles - sprain, strain, spasm
- Joints - facet syndrome, sacroiliitis
- Discs - HNP, annulus fibrosis, annular tear
- Infectious - epidural abscess, osteomyelitis, discitis
- Inflammatory - arachnoiditis, epidural processes
- Rheumatic - ankylosing spondylitis
- Cancer - primary, metastatic
- Referred - vascular, GI, pancreatic, renal etc.
- Other...

Injection Techniques for Spinal Pain
- Interlaminar epidural steroid injection
- Transforaminal epidural steroid injection
- Paravertebral nerve root injection
- Intra-articular facet joint injection
- Diagnostic Medial branch block
- Medial branch block RF neuroablation
- Caudal epidural steroid injection
- Diagnostic discogram
- Sacroiliac joint injection
- Intra-Discal Electrothermal Therapy
Encouragement, time

OTC Analgesics
Non-opioids, short term opioids

Physical therapy
Interventional pain management

Surgery
Interventional pain management

Chronic opioids
Spinal cord stimulation, pump
Neuralysis

Pain Treatment Ladder

Interventional Pain Management

Outcome Measures

- Reduce pain
- Enhance ADLs
- Reduce analgesic consumption
- Patient satisfaction
- Better sleep
- Reduce analgesic consumption
- Return to work
- Patient satisfaction
- Better sleep
- Reduce analgesic consumption
- Return to work

• Reduce pain
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Outcome Measures

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Role of Interventional Pain Management

• Diagnostic

• Prognostic

• Therapeutic

- Fluoroscopy identifies joints, foramen, discs
- Electrical stimulation identifies nerves
- Local anesthetic blocks nerves
- Similar pain provocation aids diagnosis
- Post-injection pain relief aids diagnosis

Role of Interventional Dx Testing

MRI, CT, X-Rays, Bone Scan, Myelogram, EMG, etc

Radiological tests reveal spinal pathologies, but not necessarily the source of pain. Furthermore, multiple potential pain generators usually exist in the spine.

Diagnostic nerve blocks and provocative injections can confirm the source of the pain and help with therapeutic planning.
Interventional Pain Management

Indications

• Failure of oral medications & physical therapy
• Uncontrollable severe pain (especially during PT)
• Medication aversion, intolerance or contraindications
• Unclear pain generator: diagnostic utility

Interventional Pain Management

Benefits

• 50-80% receive short to intermediate term relief
• Outpatient procedure, prompt recovery (hrs vs. weeks)
• Immediately compatible with other tx modalities
• Pain relief allows proper physical & psychosocial tx
• Pain relief provides psychological boost

Interventional Pain Management

Benefits

• Appropriate drug is delivered to the appropriate area
• Pain relief without CNS depression/sedation
• Low risk when performed by experienced physicians
• Money is saved when: patients return to work sooner, procedure obviates admissions, surgery is not needed
Interventional Pain Management
Disadvantages/Complications

- Soreness in the needle entry area, back pain
- Nonspecific reactions
  - N/V, vasovagal, decreased HR/BP
- Steroids take 2-3 days to have effect
- Post dural puncture headache
- Suppression of hypothalamic-pituitary-adrenal axis
- Transient weight gain due to fluid retention

Interventional Pain Management
Disadvantages/Complications

- Needle injury/high speed injectate injury
- LA toxicity
- Adhesive arachnoiditis, meningitis
- Nerve damage: epidural infection, hematoma
- Neural ischemia - dynamic mass effect: Local pressure exceeds neural perfusion, capillary and/or venous outflow pressures
- Arterial disruption – anterior spinal a. syndrome
  - Painless paraplegia

“The List” – 1º & 2º Epidural Steroid MOAs

1. Anti-inflammatory to nerve roots
2. Irritative of inflammatory mediators
3. LOA
4. C-fiber neurolytic
5. Prolonged Na channel blockade
6. Antispasmodic of paraspinal and myotomes (e.g., gluteal, piriformis)
7. Facet analgesia – dorsal ramus block, anti-inflammatory
8. Discal analgesia – Sinuvertebral and ramus communicans blocks
9. Decreased dural inflammation
10. Sympathetic block
11. Central desensitization
12. Peripheral desensitization
13. Radicular axial pain relief (C2-4, L2-4)
14. Relief of having just completed the injection!!
Epidural Steroids

Interlaminar vs. Transforaminal

Update to the technique...

Epidural Steroids

Pitfalls of non-visualized ESI

• 1/4 of “blind” injections are not epidural
• Spinal pathology, post-surgical backs increase the likelihood medication not reaching the nerve
• Vertebral level of the injectate is an approximation
• Laterality of the injectate is uncertain
• Injectate is given in the posterior epidural space
• Compromised tactile feel due to poor needle placement
Epidural Steroids - Outcome Data

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<tr>
<th>Reference</th>
<th>No. of Patients</th>
<th>Acute Pain (%)</th>
<th>Chronic Pain (%)</th>
<th>Post-</th>
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*Best results for acute pain.

Epidural Steroids

How can we improve the technique?

- **Goals:**
  - Confirm the correct spinal level
  - Confirm the laterality of the injectate
  - Verify epidural placement
  - Improve steroid spread & location

Interlaminar Epidural Steroid Injection

- Blind vs. fluoro
- Blind: estimated level & side
- Posterior epidural placement
- 4-10 cc volume injected
- Mostly therapeutic
- Proven safety record
Interlaminar Epidural Steroid Injection

Cervical Epidural Steroid Injection

Transformaminal Epidural Steroid Injection

- Confirmed spinal level & laterality
- Improved steroid placement
  - Better root coverage
  - Anterolateral steroid placement
- Diagnostic & therapeutic
Transforaminal Epidural Steroid Injection

Cervical Transforaminal Epidural Steroids

Lumbar Transforaminal Epidural Steroids
Transforaminal Epidural Steroids

Ligamentum Flavum Interruptions
- >50% gaps above C7-T1
- Much better continuity below T3 - 4
- LOR interlaminar technique injury to spinal cord
- Fluoroscopic guidance is SOC
- Consider lateral views in absence engagement


C5 - 6 Interlaminar Epidural Steroid
Spinal Cord Injury from Direct Needle Trauma

Spinal Cord Injury: Direct Needle Trauma
Interlaminar vs Transforaminal Cervical Epidural Injection

Should this approach be done first?

FDA, April 23, 2014

Drug Safety Communications

FDA Drug Safety Communication: FDA requires label changes to warn of rare but serious neurologic problems after epidural corticosteroid injections for pain

Safety Announcement

[4-23-2014] The U.S. Food and Drug Administration (FDA) is warning that injection of corticosteroids into the epidural space of the spine may result in rare but serious adverse events, including loss of
FDA, April 23, 2014
15 listed references do not support the conclusions
• 6 related to CTFESI
• 4 related to LTFESI
• 1 related to TESI
• 2 related to CESI
• 1 case report of cervical paravertebral injection
• 1 atlanto-axial steroid injection
• Implicated fluoroscopy & CT guided injections

FDA, April 23, 2014
• Incomplete literature review
• Vast majority of complications related to CTFESI
• Applies to all epidurals at all levels and all steroids
• Does not account for the variability in technique & injectates
Mechanisms of Nerve Injury I
Mechanical injury to SC, roots, cauda equina

- Needle trauma
  - 25 gauge needle with internalized lumen
  - 17G vs. 20G Tuohy LOR feel
- High velocity injectate trauma – jetting
- Volume sans run-off (scarring, adhesions)
- Local injectate-related pressurization
  - Interruption of CSF flow

Mechanisms of Nerve Injury II

- Epidural hematoma
  - Advanced age, unrecognized coagulopathy
  - High prevalence of anticoagulant use
  - Elderly female
- Epidural abscess
  - DM, advanced age, immunosuppressants
  - CTX, organ transplant
  - Pre-existing infection
  - Dental work

Cervical & Conus Spinal Vascularity
Mechanisms of Nerve Injury – Vascular I

ASA syndrome, artery of adamkiewicz, RA, RMA, etc.

Anatomical variation
• AVMs, AVFs, posterior spinal a. aberration

Post-op: neovascularization vs. vascular relocation
• scar neovascularization & anastomoses with native perfusion
• 25 gauge needle tip vascularly internalized vs.
• 22 gauge needle tip with intra & extra vascular placement
Mechanisms of Nerve Injury – Vascular II

- Mechanical vascular disruption to RA, MA, RMA
  - Needle transection
  - High speed injectate jetting injury
- Embolization – distal or retrograde flow & distant
  - Flawed theory
    - Assumes microarteries can be entered/exited w/o sequela
  - Does not explain the delayed development of complications
- Air - dead space air volume of the needle shaft
- Particulate steroids
- Atherosclerotic plaque
- Fresh thrombus

Mechanisms of Nerve Injury – Vascular III

- Occlusion
  - Arterial vasospasm due to advancing needle or injectate
    - Inflamed vasculature partly not protected by dura
    - Inflammation-induced arterial irritability, ID=1 mm
  - Intimal flap
  - Vascular dissection
  - Thrombus
  - Injectate pressure > perfusion pressure – arterial ischemia
  - Injectate pressure > venous pressure – backpressure ischemia
- Hypotension, vasovagal related neural injury/TIAs
- Pre-existing atherosclerotic vascular disease

Does Steroid Particulate Size Matter?

Triamcinolone

Confocal Microscopy
 Courtesy of Sen S, Mantilla C.
 Mayo Clinic
The vast majority of ESI literature is based on particulate steroids. The entire literature set that alleges improved outcomes with TF is particulate steroid based. PS vs NPS studies mostly underpowered and/or retrospective studies.
Particulate vs Nonparticulate Steroids

2 retrospective studies:
– Lee et al, 2009, n=159, D10 vs T40: NS, trend favors PS
– Shakir et al, 2013, n=441, D15 vs T40, PS=NPS

Prospective studies:
– Kim et al, 2011, n=60, D10 vs T40, trend favors PS
– Park et al, 2011, n=106, D7.5 vs T40, PS>NPS for pain and disability reduction
– Kennedy et al, 2013, n=78, D15 vs T60, PS=NPS, but ...
  17.1% needed 3 dex inj vs 2.7% (n=1) for triamcinolone

Particulate vs Nonparticulate Steroids

Think patients first!

Dexamethasone’s lesser efficacy and higher # of injections means:
– tx failure for a higher % of patients
– Offsets any theoretical advantages by higher # of infections to get desired effect
– Increasing social and work related impairment
– Higher opioid dosing & polypharmacy and related side effects and complications
– Higher # of patients getting surgery
– Not taking into account dexamethasone related complications

MPW Recommendations
Safeguards to Prevent Neurologic Complications after Epidural Steroid Injections
Consensus Opinions from a Multidisciplinary Working Group and National Organizations

James P. Rothmall, M.D., Honorio T. Borzon, M.D., Paul Drayfuss, M.D., Marc Huntong, M.D.,
Mark Wallace, M.D., Ray Baker, M.D., K. Daniel Reew, M.D., Richard W. Rosenquist, M.D.,
Charles April, M.D., Natalia S. Rossi, M.D., M.P.H., Azizulah Buvareh, M.D.,
D. Scott Kriner, M.D., Nicolas Bogul, M.D., Ph.D., D.Sc., Daryl R. Farmer, M.D., Eduardo Frakeki, M.D.,
Scott Horn, D.D., Jeffrey Stone, M.D., Kevin Vurenkamp, M.D., Gregory Lawler, M.D.,
Jeffrey Summers, M.D., David Kloch, M.D., David O’Brien, Jr., M.D., Sean Tutton, M.D.

June 24, 2014
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RE: FDA Safe Use Initiative of Epidural Steroid Evaluation with Assignment of Responsibility to Multistate Pain Workgroup (MPSW)
Dear Drs. Hamborg and Lennartson:

On behalf of the American Society of Interventional Pain Physicians (ASIPP), we have recently corresponded with you in reference to major concerns about the FDA safe use initiative for epidural injections.

We request that the FDA withdraws the present warning and replace it with an evidence-based warning emphasizing the off-label use of interventional epidural steroids can cause severe, but serious neurologic problems when performed without appropriate precautions.

The primary outcome measure was a 50% improvement in pain and function. Outcome assessments included numeric rating scale (NRS), Neck Disability Index (NDI), opioid intake, employment, and changes in weight.

Results: Significant pain relief and functional improvement (> 50%) was present at the end of 2 years in 72% of patients receiving local anesthetic only and 70% receiving local anesthetic with steroids. In the successful group of patients, however, defined as consistent relief with 2 or more injections at least 3 weeks apart. Significant improvement was observed in 79% in the local anesthetic alone group and 70% in the local anesthetic with steroids group. The results reported at the one-year follow-up were sustained at the 2-year follow-up.

Conclusions: Cervical intervertebral epidural injections with or without steroids may provide significant improvement in pain and function in patients with chronic discogenic or axial pain that is function-limiting and not related to facet joint pain.
LACK OF EFFECT OF INTRAARTICULAR CORTICOSTEROIDS FOR CHRONIC PAIN IN THE CERVICAL ZYGOPHYSIS JOINTS

Leslie Barnes, B.Med, Susan M. Lebo, B.MeD, Barbara J. Walker, B.Sc., and Nicholas Brown, Ph.D.

Abstract: Background. Chronic pain in the cervical zygapophysial joints is a common problem after a whiplash injury. Treatment with intraarticular injections of corticosteroid preparations has been advocated, but the value of this approach has not been established. We compared the efficacy of a depot injection of a corticosteroid preparation with the efficacy of an injection of a local anesthetic agent in patients with painful cervical zygapophysial joints.

Methods: Sixteen men and 25 women with pain in one or more cervical zygapophysial joints after automobile accidents (mean age, 43 years; median duration of pain, 36 months) were randomly assigned to receive 0.5 ml intraarticular injection of either betamethasone (0.5 percent) or betamethasone (0.7 mg) under double-blind conditions. The patients were followed by means of regular telephone contact and office visits until they reported a return to a level of pain equivalent to 50 percent of the preinjection level. The time from treatment to a 50 percent return of pain was compared in the two groups with the use of a survival analysis.

Results. Less than half the patients reported relief of pain for more than one week, and less than one in five patients reported relief for more than one month, irrespective of the treatment received. The median time to a return of 50 percent of the preinjection level of pain was 3 days in the 21 patients in the corticosteroid group and 3.5 days in the 25 patients in the local-anesthetic group (P = 0.42).

The Food and Drug Administration’s Recent Action on April 23, 2014 Failed to Appropriately Address Safety Concerns about Epidural Steroid Use

To the Editor:

As patient safety advocates, we are thankful for the oversight of the US Food and Drug Administration (FDA) in our health care system. Unfortunately, it is our belief that recent actions of the FDA were incorrect and but instead has used isolated case reports, which do not amount to a critical appraisal of evidence either for efficacy of these techniques, or for potential complications. The scientific-minded must ask if it is accurate.
Dexamethasone Experience & Toxicity

Controversial in peripheral nerve blocks for acute pain
Perineural dexamethasone has been found to be no more effective than IV dexamethasone

Muller, et al, 2014, Experimental Neurology: Dexamethasone enhances necrosis-like neuronal death in ischemic rat hippocampus


CONCLUSIONS

... Conversely, systemic dexamethasone has been investigated extensively and boasts a well-established safety and adverse effect profile. With this in mind, recent trials reporting equivalence between systemic and perineural routes should cause us to reevaluate our approach in researching this agent. We propose that future studies on adjuvant dexamethasone include not only a local anesthetic control but also a systemic control arm. Only after we establish the comparative effect of systemic dexamethasone on nerve block characteristics can we make decisions that maximize the benefits and minimize the risks, known and unknown, to our patients. Appropriate follow-up regarding short- and long-term complications is also strongly encouraged for future studies. The preliminary focus of adjuvant dexamethasone research has been on prolongation of block duration; however, the greater question of benefit to clinically meaningful outcomes such as quality of recovery, patient satisfaction, and return to function time awaits further study. Adjuvant dexamethasone is the latest in a long line of new ideas in anesthesia; its fate as innovation, farce, or folly is yet to be determined.
Dexamethasone Decreases Blood Flow in Normal Nerves and Dorsal Root Ganglia

**Conclusion**

The current study demonstrates that application of dexamethasone to the sciatic nerve and DRG decreases blood flow in these tissues at 30 minutes and 4 hours after acute application. Although the measured deficit in blood flow was modest in normal animals relative to the threshold for ischemic injury, it is possible that dexamethasone in combination with vasoactive agents, such as lidocaine and epinephrine, would have a pathophysiologic role in nerve damage after therapeutic application.

**Key Points**

- Dexamethasone causes reduced blood flow in normal nerve.
- Dexamethasone causes reduced blood flow in normal dorsal root ganglia.
- The reduced blood flow is at the threshold for ischemic injury.

Adjuvant Dexamethasone for Bupivacaine Sciatic and Ankle Blocks

**Results From 2 Randomized Placebo-Controlled Trials**

Michael J. Predicci, MD, FANZCA, MD,* Tony K. Daniels-Clough, MD, FANZCA,* and Richard White, PhD†

**Background and Objectives**: Dexamethasone is an excellent anti-inflammatory agent, yet little is known about its ability to modulate local tissue blood flow. The present study investigated the effect of dexamethasone on blood flow in the sciatic nerve and ankle block territories. We hypothesized that dexamethasone would reduce blood flow in sciatic nerve and ankle block territories.

**Methods**: One hundred and forty-three patients scheduled for total knee replacement surgery were enrolled. Patients were randomized to receive either saline (n=72) or dexamethasone (n=71). The primary outcome was change in local tissue blood flow as measured by laser Doppler imaging. Secondary outcomes included sensory and motor block scores, and pain scores.

**Results**: Compared to placebo, dexamethasone significantly reduced local tissue blood flow in the sciatic nerve territory (mean change: -20.9%; P=0.001) and ankle block territory (mean change: -19.6%; P=0.002). Sensory block scores were significantly lower in the dexamethasone group compared to the placebo group at 30 minutes and 4 hours after injection, indicating a trend towards reduced pain.

**Conclusion**: Dexamethasone significantly reduces local tissue blood flow in the sciatic nerve and ankle block territories. This finding highlights the potential for dexamethasone to decrease the risk of ischemic nerve injury when used as an adjuvant for sciatic and ankle blocks. Further research is needed to determine the clinical implications of these findings.

**Original Article**

Neurotoxicity of Adjuvants Used in Perineural Anesthesia and Analgesia in Comparison With Ropivacaine

Brian S. Williams, MD, MBA,* Karen A. Hough, MD, CYT, KLAAT,* Scott Y. V. Tsui, MPH,* James W. Brown, MD, FANZCA,* Michael S. Gold, PhD,* and U. P. Goelz, PhD†

**Discussion**

In these experiments, we first confirmed that a concentration of R administered clinically (2.5 mg/mL) is neurotoxic to isolated neurones. High concentrations of clinically available local anesthetic agents, C, B, and M, were significantly more toxic than R. Next, we found that high concentration single-adjuvant combinations with R (specifically R + C, R + B, and R + M) significantly increased R-induced cell death with only 3-hr exposure. In the absence of R, retention of clinical concentrations of the combination of C + B + D + M has no detectable influence on neurone cell death after 24-hr exposure, however, even a low concentration of M in combination with R resulted in a significant increase in neurotoxicity (10%) that was associated with R alone. This effect of R + M was not influenced by the addition of C + B + D. Finally, increasing the concentration of C from 0.5% to 1.5% in the combination of clinical concentrations of R + C at 10% resulted in a further increase in neurotoxicity. These observations reinforce the need for additional preclinical testing before clinical use of a new anaesthetic.
Location of Critical Vessels

Highest vascular presence in the “Safe Triangle”

Is Dr. Kambin’s Triangle safe?

Vascular injury is described even in absence of steroid use (McMillan, 2003)

Kambin’s Triangle

Retired neurosurgeon

Approach is used by surgeons and interventionalists for percutaneous discectomy
Mechanisms of Nerve Injury – Chemical I
- Seen with high # of steroid injections
- Package inserts warn of combination toxicities
  - Ropivacaine and dexamethasone
  - Myelographic contrast and anything else
- Preservative related:
  - Steroid
  - Contrast
  - Local anesthetic
  - Saline

Mechanisms of Nerve Injury – Chemical II
- High concentration local anesthetic
  - 5% lidocaine
- Myelographic contrast toxicity
- Steroid toxicity
- Autoimmune
- Meningitis
- Infection (higher discitis incidence w Kambin TF)

Combination of Mechanisms of Injury are probably at play
Directed Catheters/Blunt Needles

- Little data to date
- Vascular placement still occurs
- Prolonged procedure
- Blunt needles have poor directionality
- Catheter navigation in a degenerated area is challenging
- Safety advantage likely overstated

Interlaminar vs Transforaminal ESI

- No prospective, randomized comparative data
- PRCT in subacute HNP randomized to IL v TF (pts with degenerative changes excluded)
- N=42
- ILESI: 80 mg DM + 2 cc 0.25% bupivacaine
- TFESI: 40 mg DM + 1 cc 0.25% bupivacaine
Interlaminar vs Transforaminal ESI

- Outcome markers: NRS, % pain reduction, Oswestry, walking tolerance, PT tolerance, opioid consumption, # ESI to 75% effect
- FU in 2 weeks
- Oswestry: IL: 37.5 to 19, TF: 38.3 to 16.8
- NRS**: IL: 7 to 3.9, TF: 6.4 to 1.7
- Walking: IL: 8.1 to 10.6, TF: 8.9 to 11.8
- Opioids: IL: 4.3 to 1.1, TF: 3.3 to 1.1

Axial Low Back Pain

*Intra-Articular Facet Injections*

*Medial Branch Nerve Block*

*Discogram*

Lumbar Facet Arthropathy

- Clinical Presentation
  - May mimic low back pain with radiculopathy in the form of referred pain
  - It can cause frank radiculopathy with proximal nerve root compression due to swelling of the capsule
Lumbar Facet Arthropathy
Intra-Articular Facet Injection

- Intra-articular local anesthetic and steroid
- Can be performed as a series
- Mostly therapeutic
- Concordant provocation may be unreliable
- Local anesthetic leakage can block nerve roots limiting diagnostic ability
- Injection of an arthritic, subluxed joint can be impossible
- Possible role in surgical planning

Lumbar Facet Arthropathy
Intra-Articular Facet Injection

L5-S1 Intra-Articular Facet Injection
Lumbar Facet Arthropathy
Medial Branch Block

- A diagnostic nerve block
- Non-provocative and less painful
- Multiple levels are performed
- Placebo vs. short-acting vs. long-acting local anesthetics
- Expected duration of pain relief can lead to more lasting therapy, namely radiofrequency facet denervation
Lumbar Facet Arthropathy
Lumbar Medial Branch Radiofrequency Thermocoagulation

- Indicated when facet joints contribute >50% to the patient’s pain
- Predictable lesioning of medial branch innervations of the facet joint
- Outpatient procedure
- 50-82% of candidate patients achieve “good” to “excellent” pain reduction
- Effects can last months to over a year
- Low morbidity

Thermal RF Lesioning

- 80 degrees Celsius for 90 seconds

- Safety Elements:
  - stimulation confirms target nerve
  - continuous monitoring

- Well circumscribed, quantified lesion
- Longer duration of relief than steroid injections
- Post injection neuritis common
RF Medial Branch Neuroablation Outcome Data

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<th>Author</th>
<th>Year</th>
<th>Temperature (°C)</th>
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<tr>
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Implantable SCS Pain Therapies
Patient Selection Criteria

• Pain dx and area favorable to response.
• Conservative therapies have failed.\(^1\)
• Psychological clearance has been obtained.\(^1\)
• A trial has been successful.\(^1\)
• Patient comprehends & accepts their role in tx.


Spinal Cord Stimulation

Advantages of Spinal Cord Stimulation

• Effective for chronic, intractable pain\(^1\)
• Effective alternative to back re-operation\(^3\)
• Reversible and nondestructive\(^4\)
• Reduction or elimination of narcotic medications\(^1,2\)
• Improved function & ADL\(^1,2\)
• Cost effective\(^6\)

Disadvantages of Spinal Cord Stimulation

- Lead migration: undesired stimulation, loss of stimulation
  - Loss of pain relief
- Threshold rise
- Hardware problems
- Pain at pocket site
- Allergy to system components
- Now MRI compatible
- Infection, bleeding, nerve damage