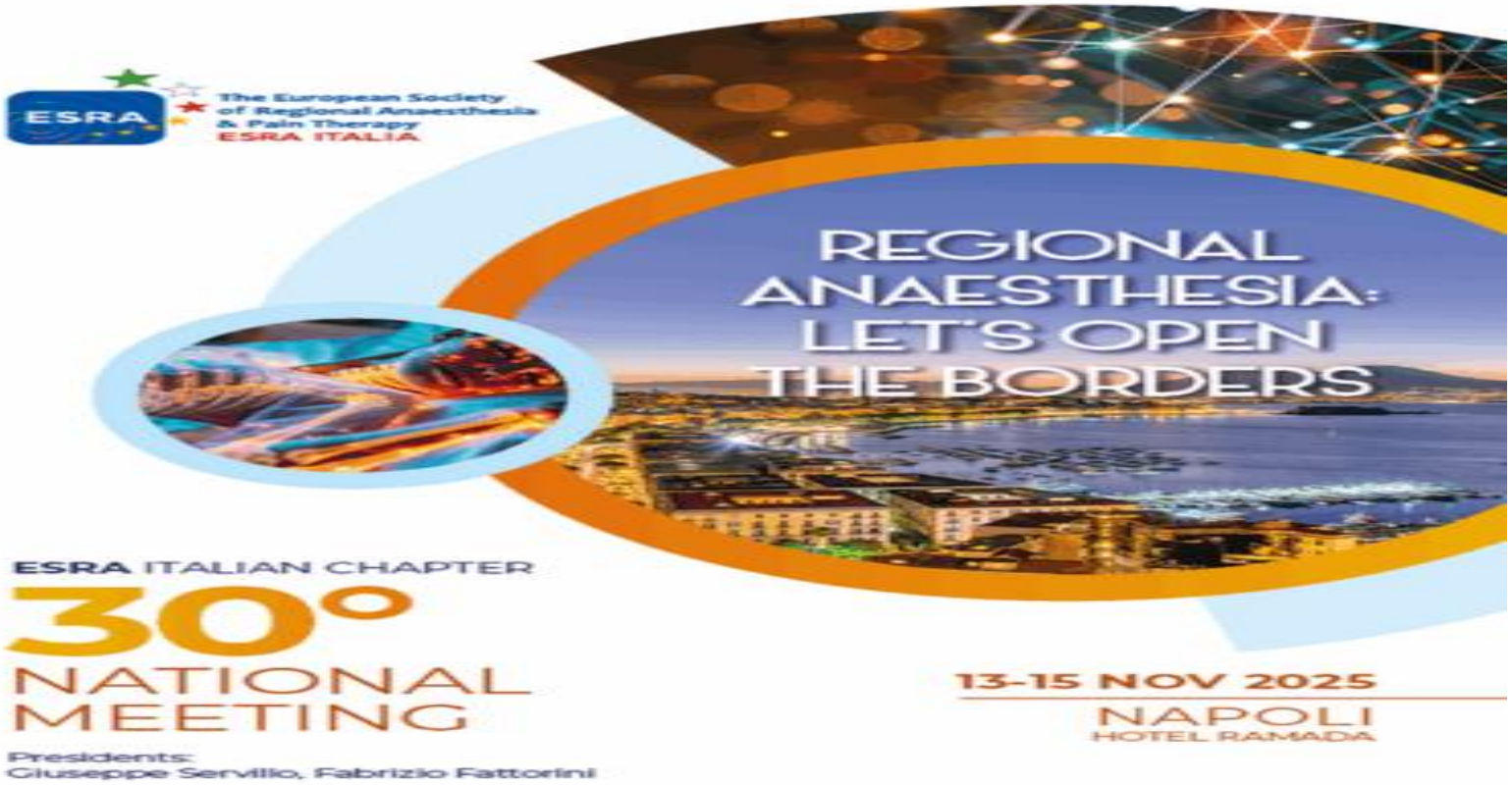



# Joints, muscles and nerves: an overview of spinal pain generators and their treatment

Dott. Pietro Vassetti
Direttore HUB - UOSD Medicina del Dolore – P.O. San Giuliano – ASL Napoli 2 Nord

# Spinal Pain: a Constellation of Pathologic Entities

**Mechanical / Non-specific**
Muscle strain, ligament sprain
Disc degeneration (DDD)
Disc herniation
Facet joint dysfunction
Spondylolysis
spondylolisthesis
Postural abnormalities

**Degenerative**
Osteoarthritis (spondylosis)
Degenerative disc disease
Facet joint arthropathy
Spinal stenosis

**Infectious**
Discitis
Vertebral osteomyelitis
Epidural abscess
Spinal tuberculosis (Pott's disease

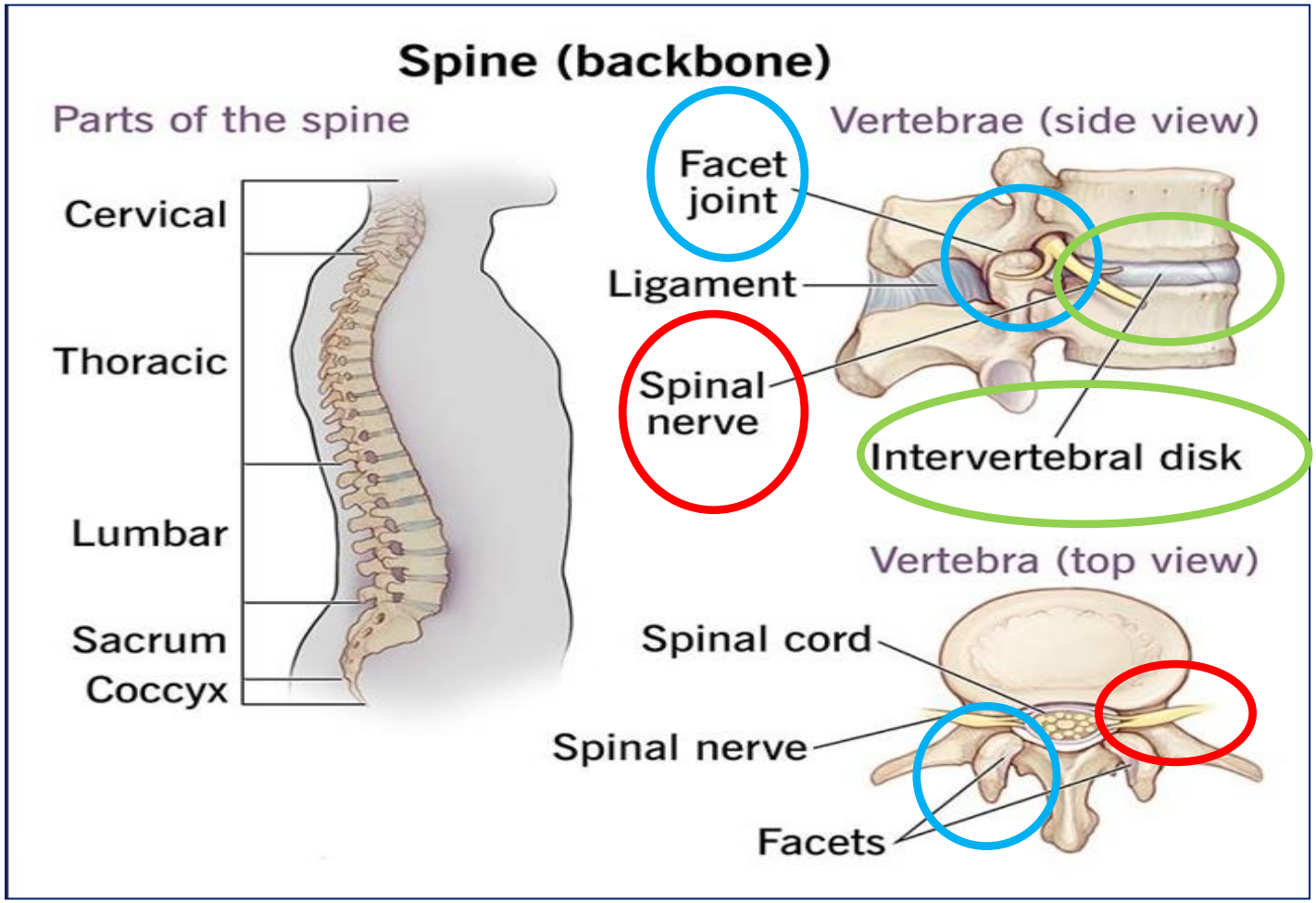
**Inflammatory / Autoimmune**
Ankylosing spondylitis
Psoriatic arthritis
Rheumatoid arthritis
DISH

**Neuropathic**
Radiculopathy
Spinal cord lesions
Failed back surgery syndrome

**Neoplastic**
Primary spinal tumors
Metastases
Multiple myeloma
Lymphoma / leukemia

An Overview of Chronic Spinal Pain Revisiting Diagnostic Categories and Exploring an Evolving Role for Neurostimulation Ashwini Sharan, MD, FACS, Jonathan Riley, MD, and Christian Hoelscher, MD SPINE Volume 42, Number 14S, pp S35–S40 2017

# Pain Generators of Spinal Pain

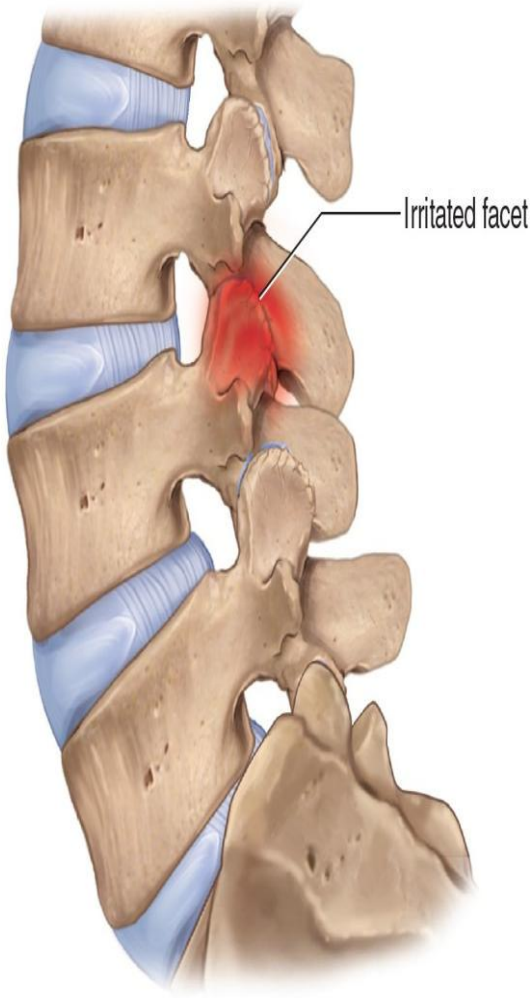


# Clinical Aspects of Facet-Joint Pain

Facetogenic pain is estimated to be the source of chronic low back pain in about **15 % to 45 %** of cases

Pain is predominantly **axial** (low back or neck) and may be worsened by extension, rotation, or prolonged standing

On physical exam: local paraspinal tenderness, pain on extension/rotation maneuvers, but no reliable pathognomonic signs.




- Diagnostic imaging:facet hypertrophy, osteoarthritis, joint space narrowing
- The gold standard to implicate a facet joint is **diagnostic block** (medial branch block or intraarticular injection) under imaging guidance

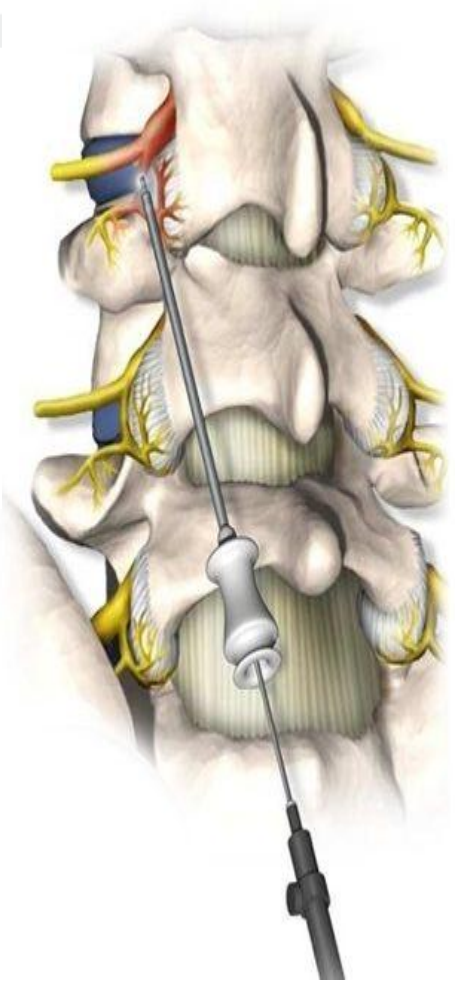
# Treatment of Facet Joint Pain: interventional options

Pain Physician 2020; 23:S1-S127• ISSN 2150-1149

Facet Joint Interventions Guidelines

## Comprehensive Evidence-Based Guidelines for Facet Joint Interventions in the Management of Chronic Spinal Pain: American Society of Interventional Pain Physicians (ASIPP) Guidelines

Laxmaiah Manchikanti, MD, Alan D. Kaye, MD, PhD, Amol Soin, MD, Sheri L. Albers, DO, Douglas Beall, MD, Richard E. Latchaw, MD, Mahendra R. Sanapati, MD, Shalini Shah, MD, Sairam Atluri, MD, Alaa Abd-Elsayed, MD, MPH, Salahadin Abdi, MD, PhD, Steve Aydin, DO, Sanjay Bakshi, MD, Mark Boswell, MD, PhD, Ricardo Buenaventura, MD, Joseph Cabaret, MD, Aaron K. Calodney, MD, Kenneth D. Candido, MD, Paul J. Christo, MD, Lynn Cintron, MD, Sudhir Diwan, MD, Christopher Gharibo, MD, Jay Grider, DO, PhD, Myank Gupta, MD, Bill Haney, MD, Michael E. Harned, MD, Standiford Helm II, MD, Jessica Jameson MD, Sunny Jha, MD, Adam M. Kaye, Pharm D, FASCP, FCPhA, Nebojsa Nick Knezevic, MD, PhD, Radomir Kosanovic, MD, Maanasa V. Manchikanti, Annu Navani, MD, Gabor Racz, MD, Vidyasagar Pampati, MSc, Ramarao Pasupuleti, MD, Cyril Philip, MD, Kartic Rajput, MD, Nalini Sehgal, MD, Gururau Sudarshan, MD, Rachana Vanaparthy, MBBS, Bradley W. Wargo, DO, and Joshua A. Hirsch, MD



- Intraarticular injections
- **Radiofrequency neurotomy of medial branch**
- Therapeutic facet joint nerve blocks

# Radiofrequency Ablation of Medial Branch

Special article

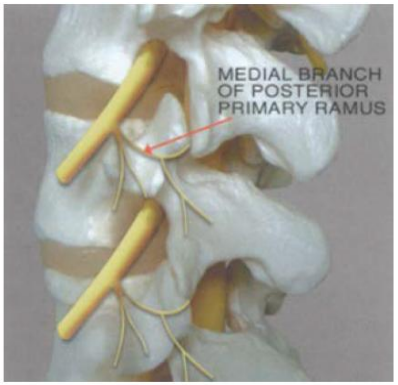
OPEN ACCESS

## Consensus practice guidelines on interventions for lumbar facet joint pain from a multispecialty, international working group

Steven P Cohen [1], Arun Bhaskar,[2] Anuj Bhatia,[3] Asokumar Buvanendran,[4] Tim Deer,[5] Shuchita Garg,[6] W Michael Hooten [7], Robert W Hurley,[8] David J Kennedy,[9] Brian C McLean,[10] Jee Youn Moon,[11] Samer Narouze,[12] Sanjog Pangarkar,[13] David Anthony Provenzano,[14] Richard Rauck,[15] B Todd Sitzman,[16] Matthew Smuck,[17] Jan van Zundert [18,19], Kevin Vorenkamp,[20] Mark S Wallace,[21] Zirong Zhao[22]

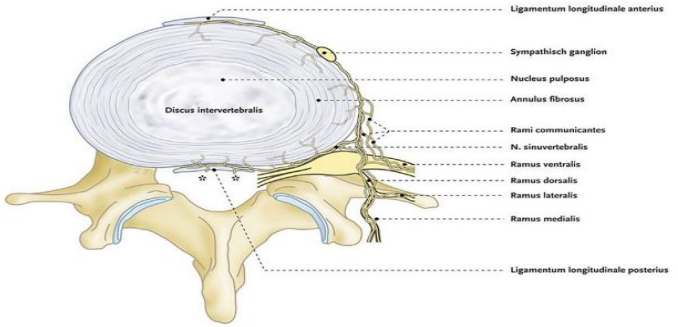
*RFA techniqueRFA technique*

| | | |
|---|---|---|
| Stimulation | Motor necessary; sensory recommended in the absence of multiple lesions | Motor strongly recommended; sensory at discretion of practitioner |
| Needle size | Large (preferably at least 18-gauge) | Large |
| Temperature | 80°C–90°C | 80°C–90°C |
| Duration | Preferably at least 2 min | At least 1.5 min |
| Multiple lesions and/ or other techniques to increase lesion size | Necessary in the absence of clear-cut stimulation benchmarks | Depends on circumstances |



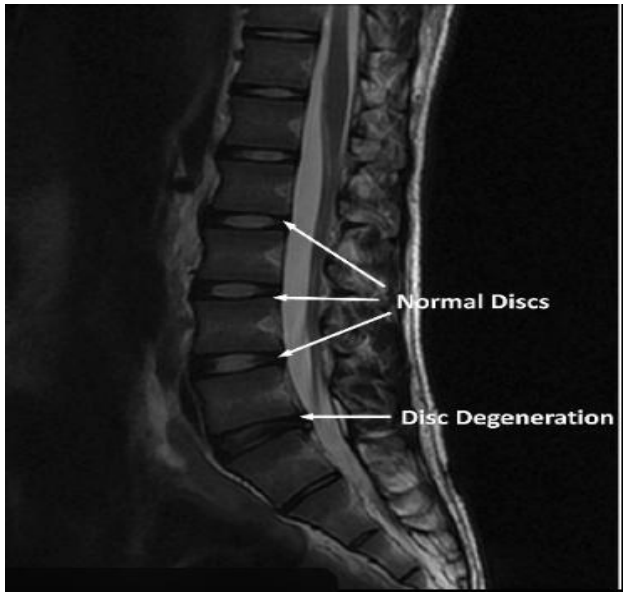

# Discogenic Pain: Clinical Features

**Discogenic Pain** results from degeneration or damage to the IVD




**Symptoms**: axial low back pain, worsened by flexion, prolonged sitting, bending, relieved by standing or extension

**Diagnosis**: MRI is the most commonly used non-invasive diagnostic tool for discogenic pain:
**Disc degeneration**: loss of signal intensity in T2 MRI
**Modic changes** (types I, II, III) in adjacent vertebral endplates
**Endplate defects, Schmorl's nodes, fissures** of annulus



# Minimally Invasive Interventional Treatments

EVIDENCE-BASED REVIEW OPEN ACCESS
Update of Evidence-Based Interventional Pain Medicine According to Clinical Diagnoses

## 14. Discogenic Low Back Pain

Wouter K. M. van Os[1] | Ricardo Alvarez-Jimenez[1] | Steven P. Cohen[2,3] | Milan P. Stojanovic[4,5,6] | Ricardo Ruiz-Lopez[7] | Jan Van Zundert[8,9] | Jan Willem Kallewaard[1,10]

**TABLE 2** | Evidence of interventional pain management of CDLBP.

| Technique | Level of evidence | Best available evidence + effect (size)[a] | Recommendation |
|---|---|---|---|
| Biacuplasty | Moderate | 3 RCTs [237, 243, 245]: reduced pain (1.6, 1.8 and 2.6) and ODI scores (8 and 12) at 6 months. The effects in the intervention cohorts sustained at 12 months (not sham-controlled) [242, 244] | Can be performed for refractory cases in selected centers |
| Spinal cord stimulation | Moderate | No RCTs<br>Prospective cohort [284]: positive outcome in 9/10 patients, reduced pain scores (4.8), but no improvement in disability at 12 months.<br>Prospective cohort [285]: positive outcome in 15/17 patients, reduced pain scores (2.9) and ODI (15.4), but no improved patient satisfaction or quality of life at 12 months | Could be considered only in severe cases when all other treatments have failed |
| IDET | Low | RCT [231]: sham-controlled trial negative at 6 months<br>RCT [230]: sham-controlled trial reduced pain (1.3) and ODI scores (7) after 6 months with a number needed to treat of 5<br>2 single-arm MA [232, 233]: reduced pain scores (2.9–3.4) and ODI (5.2–7.0) at 6–34 months | Can be considered for refractory cases with debilitating pain, but ideally in a study setting |
| DRG stimulation (L2) | Very low | No RCTs<br>Prospective cohort [292]: 68.3% of patients had significant pain reduction, reduced ODI (21.99) and increased EQ-5D index (0.23) at 12 months | Should not be considered as standard treatment but may be considered as rescue therapy for refractory cases or as part of a clinical study |

# Minimally Invasive Interventional Treatments

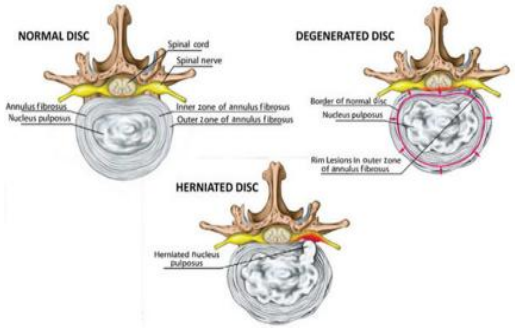
| | | | |
|---|---|---|---|
| Intradiscal corticosteroid injection | Low | 2 RCTs [120, 121]: negative at 2 weeks and 12 months<br>RCT [122]: reduced pain scores and ODI at 3 and 6 months<br>RCT [123]: reduced pain scores (1.5 points), but not functional outcomes at 1 month, negative at 12 months<br>RCT [124] (control group: lidocaine): reduced pain scores (2.8 points) at 1 month, but not at 3 or 6 months | Should not be used outside of a study setting |
| Intradiscal methylene blue injection | Low | RCT [130]: negative at 6 months<br>RCT [131]: reduced pain and ODI scores (approx. 4.5 and 33, respectively) at 6, 12 and 24 months<br>1 single-arm MA [135]: reduced pain and ODI scores (3.6 and 25, respectively, at 3 months, 3.0 and 23 at 6 months, 3.2 and 30 at 12 months) | Should not be used outside of a study setting |
| PIRFT | Low | RCT [250]: negative at 8 weeks | Should not be used outside of a study setting |
| Mesenchymal stem cells injection | Very low | RCT [192]: negative at 3, 6 and 12 months<br>RCT [191]: improvement in VAS and ODI until 36 months<br>Single-arm MA [186]: reduced pain scores (3.7) and ODI (26) at 12 months | Should not be used outside of a study setting |
| Platelet rich plasma injection | Very low | RCT [198]: negative at 2 months<br>RCT [152]: reduced "best pain scores" (0.7), but no improved functional outcomes at 2 months<br>4 single-arm MA [184–186, 188]: reduced pain scores (approx. 4) | Should not be used outside of a study setting |
| Cytokine antagonists | Very low | 2 RCTs [216, 217]: negative at 1–2 months | Should not be used outside of a study setting |

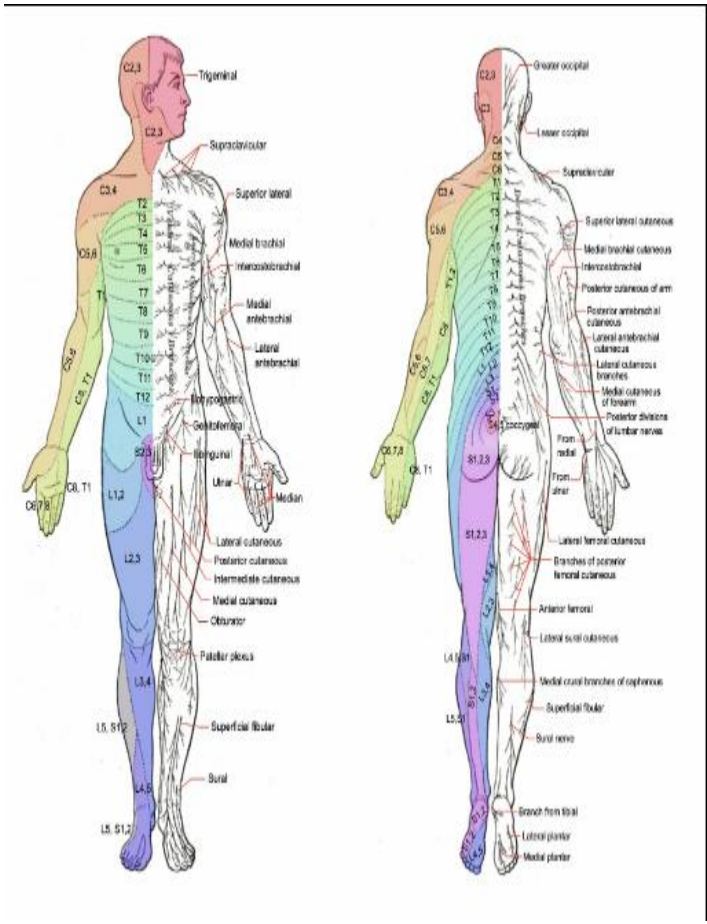
# Neuropathic spinal pain: radiculopathies

Radicular pain is pain radiating along a spinal nerve root distribution, associated with sensory loss or paresthesias and often due to compression, inflammation or irritation of the root.

**Common causes**: intervertebral disc herniation, foraminal stenosis, degenerative spine disease (osteophytes, spondylosis), vertebral stenosis, infection (Herpes-zoster)

**Diagnosis:** clinical examination (distribution of pain, positive and negative symptoms), MRI, EMG



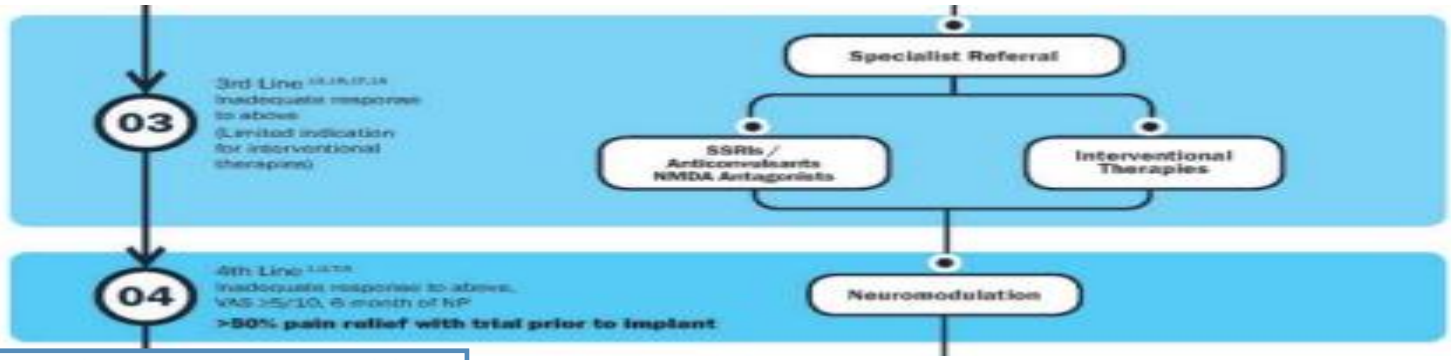
# Neuropathic spinal pain: interventional management

Review Article OXFORD

REVIEW ARTICLES

## A Comprehensive Algorithm for Management of Neuropathic Pain

Daniel Bates, MD,* B. Carsten Schultheis, MD, PhD,† Michael C. Hanes, MD,‡ Suneil M. Jolly, MD,§,¶ Krishnan V. Chakravarthy, MD, PhD,‖,⁂ Timothy R. Deer, MD,** Robert M. Levy, MD, PhD,†† and Corey W. Hunter, MD‡‡




Epidural Injection. The recommendations around the use of epidural injections in neuropathic pain are mixed. The American Pain Society (APS) reported that there was fair evidence and provided a weak recommendation for the use of epidural steroid injection in persistent

Pulsed Radiofrequency. Pulsed radiofrequency is a nondestructive radiofrequency technique that passes an electrical field across the nerve, likely resulting in changes in synaptic transmission, in a neuromodulatory-type effect [90]. The APS and ASIPP provide no recommenda

Adhesiolysis. Adhesiolysis for FBSS and radicular pain is performed based on the premise that epidural adhesions are partly responsible for generation of pain. Injection of hyaluronidase, normal or hypertonic saline, and steroids is performed via a catheter in the epidural

# Pulsed radiofrequency of DRG

> Pain Med. 2020 Dec 25;21(12):3320-3343. doi: 10.1093/pm/pnaa141.

## Efficacy and Safety of Pulsed Radiofrequency as a Method of Dorsal Root Ganglia Stimulation in Patients with Neuropathic Pain: A Systematic Review

Ivana Vuka [1], Tihana Marciuš [1], Svjetlana Došenović [2], Lejla Ferhatović Hamzić [3], Katarina Vučić [4], Damir Sapunar [1 5], Livia Puljak [5]

Pulsed radiofrequency (PRF) is a nonablative pain treatment that uses radiofrequency current in short high-voltage bursts, resulting in interruption of nociceptive afferent pathways

Clinical data are encouraging but limited by small sample sizes and variability in methods. High-quality, large RCTs are needed

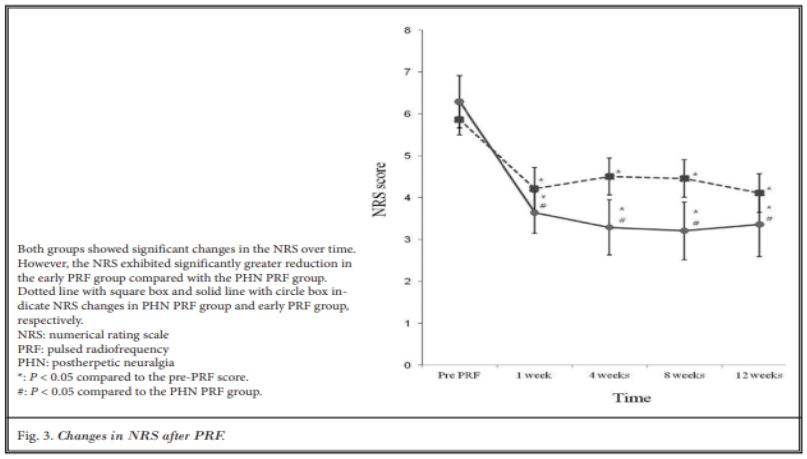
# Pulsed radiofrequency of DRG in PHN

Pain Physician 2017; 20:E411-E418• ISSN 2150-1149

Retrospective Study

## Pulsed Radiofrequency to the Dorsal Root Ganglion in Acute Herpes Zoster and Postherpetic Neuralgia

KooHyun Kim, MD, DaeHyun Jo, MD, and EungDon Kim, MD




Both groups showed significant changes in the NRS over time. However, the NRS exhibited significantly greater reduction in the early PRF group compared with the PHN PRF group. Dotted line with square box and solid line with circle box indicate NRS changes in PHN PRF group and early PRF group, respectively.
NRS: numerical rating scale
PRF: pulsed radiofrequency
PHN: postherpetic neuralgia
*: $P < 0.05$ compared to the pre-PRF score.
#: $P < 0.05$ compared to the PHN PRF group.

Fig. 3. *Changes in NRS after PRF.*

Table 3. *Success rates of PRF.*

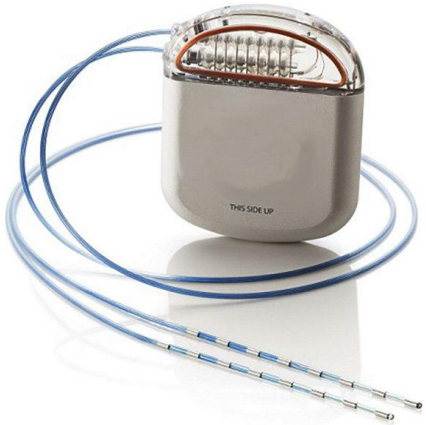
| | Early PRF group (n = 29) | PHN PRF group (n = 29) | *P*-value |
|---|---|---|---|
| Success of PRF, n (%) | 24 (82.7) | 5 (17.2) | < 0.0001# |

PRF: pulsed radiofrequency. PHN: postherpetic neuralgia. #: $P < 0.0001$

# Spinal cord stimulation: indications and complications

brain sciences

MDPI




*Review*

## Spinal Cord Stimulation for Neuropathic Pain: Current Trends and Future Applications

**Ivano Dones * and Vincenzo Levi**

**Table 1.** Common SCS indications and contraindications.

| SCS Common Neuropathic Indications | SCS Main Contraindications |
|---|---|
| Failed back surgery syndrome | |
| Complex regional pain syndrome (I and II) | Infection |
| Radicular and nerve root pain | Coagulopathy |
| Postherpetic neuralgia | Spinal stenosis |
| Pain due to peripheral nerve injury | Psychiatric disorders |
| Intercostal neuralgia | Substance abuse |
| Phantom pain | |

SCS: spinal cord stimulation.

**Table 2.** SCS surgical complications.

| SCS Common Complications |
|---|
| More frequent |
| Hardware-related (lead migration, breakage, connection failure, malfunctioning, pain at the IPG) |
| Haematoma and seroma at IPG site |
| Rare |
| Spinal epidural haematoma |
| CSF leak |
| Neurological deficit |

IPG: internal pulse generator; CSF: cerebrospinal fluid.

# Spinal Cord Stimulation:

Hindawi
Neural Plasticity
Volume 2021, Article ID 5607898, 9 pages
https://doi.org/10.1155/2021/5607898

*Review Article*

## Spinal Cord Stimulation and Treatment of Peripheral or Central Neuropathic Pain: Mechanisms and Clinical Application

Liting Sun,[1,2] Changgeng Peng,[1,2] Elbert Joosten,[3] Chi Wai Cheung,[4] Fei Tan,[5] Wencheng Jiang,[5] and Xiafeng Shen[1]

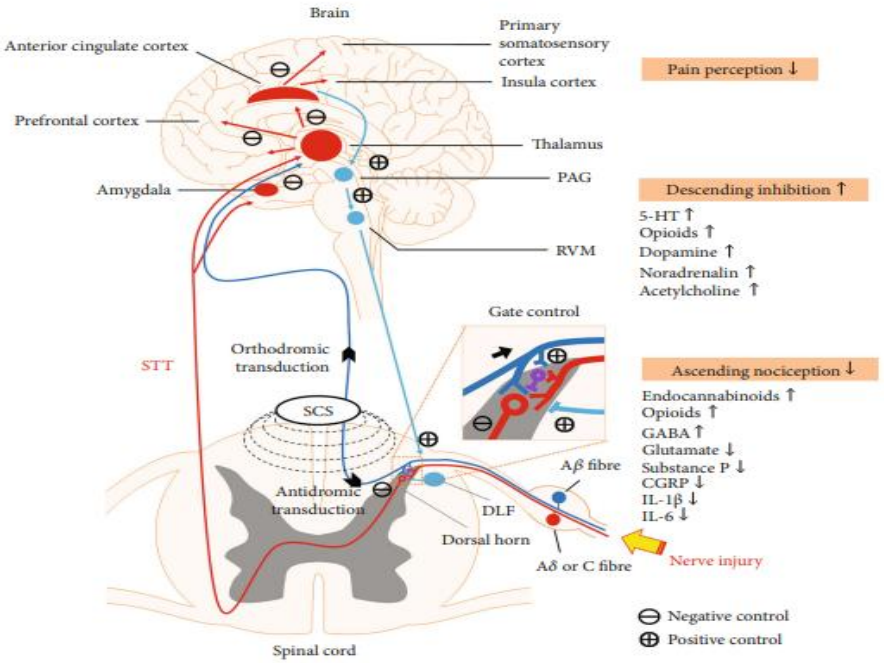
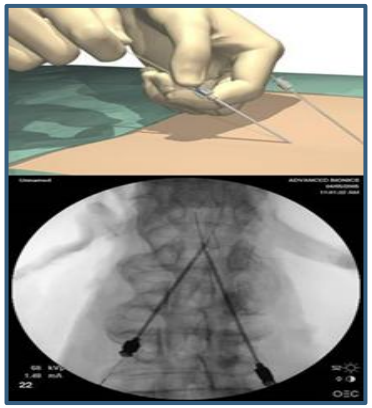
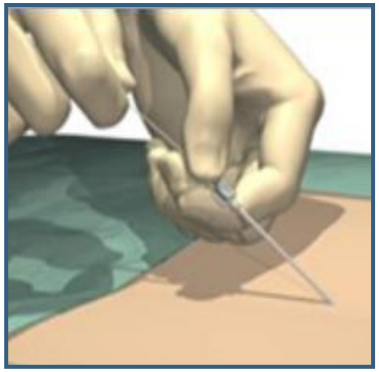
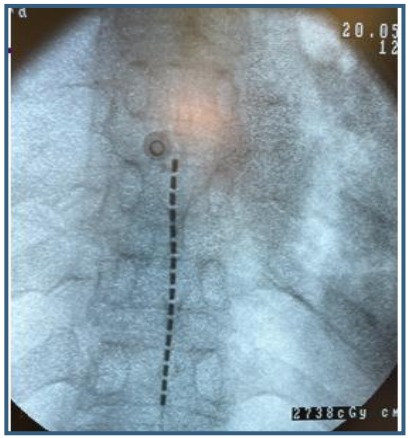


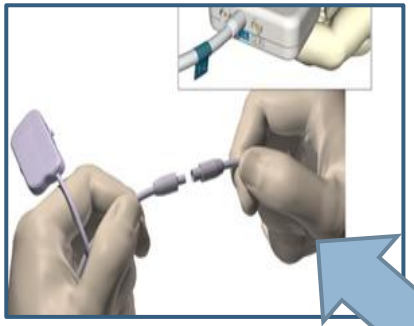

FIGURE 1: Schematic drawing shows the effects of spinal cord stimulation on nociceptive processing including segmental spinal inhibition, activation of descending inhibitory system, and cortical modulation. SCS: spinal cord stimulation; STT: spinothalamic tract; PAG: periaqueductal gray; RVM: ventrolateral medulla; DLF: dorsolateral funiculus.

# Spinal cord stimulation: implantation

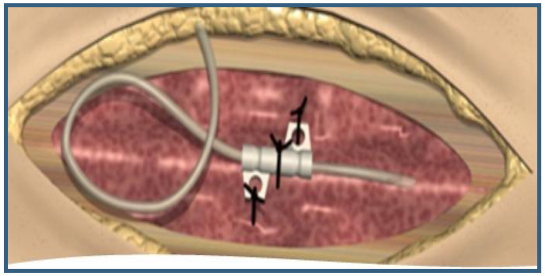












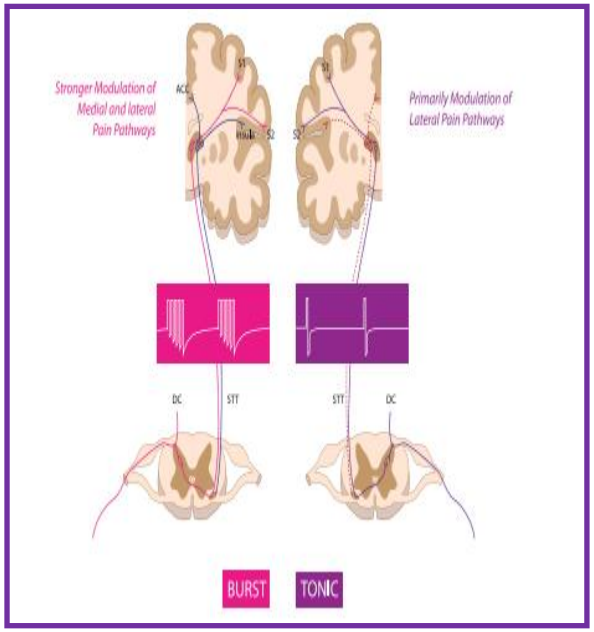
# Spinal cord stimulation: waveform

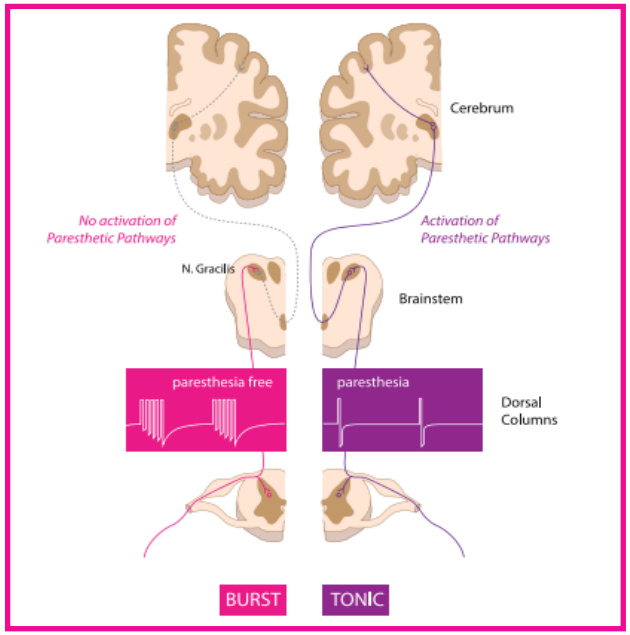
*Pain Medicine*, 20, 2019, S13–S22
doi: 10.1093/pm/pnz073
**Review Article**

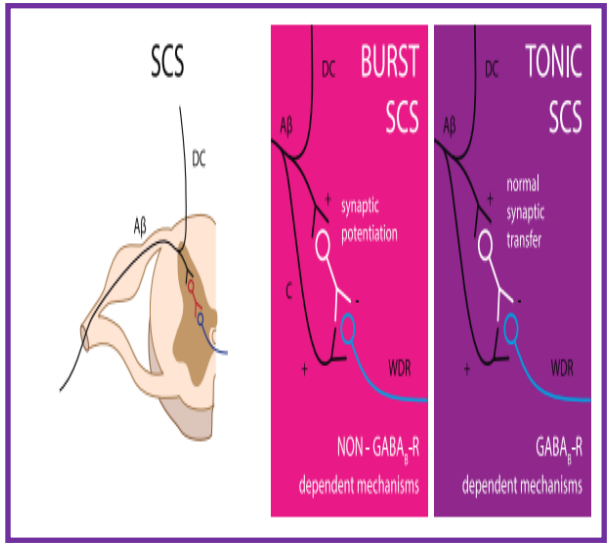
OXFORD

## Mechanism of Action in Burst Spinal Cord Stimulation: Review and Recent Advances

Krishnan Chakravarthy, MD, PhD,* Michael A. Fishman, MD,† Xander Zuidema, MD, PharmD,‡ Corey W. Hunter, MD,§ and Robert Levy, MD, PhD¶



# Spinal cord stimulation: waveform

Pain Physician 2020; 23:451-460 • ISSN 1533-3159

Systematic Review

## Comparison of Spinal Cord Stimulation Waveforms for Treating Chronic Low Back Pain: Systematic Review and Meta-Analysis

Jay Karri, MD[1], Vwaire Orhurhu, MD[2], Sayed Wahezi, MD[3], Tuan Tang, MD[4], Timothy Deer, MD[5], and Alaa Abd-Elsayed, MD[6]

Spine

SPINE Volume 47, Number 7, pp 548–556


CLINICAL CASE SERIES

OPEN

## Passive Recharge Burst Spinal Cord Stimulation Provides Sustainable Improvements in Pain and Psychosocial Function: 2-year Results From the TRIUMPH Study

Timothy R. Deer, MD,[a] Steven M. Falowski, MD,[b] Gregory A. Moore, MD,[c] J. Kelby Hutcheson, MD,[d] Isaac Peña, MD,[e] Kenneth Candido, MD,[f] Eric G. Cornidez, MD,[g] von und zu Fraunberg, MD,[h] Bram Blomme, PhD,[i] and Robyn A. Capobianco, PhD[i]



Published in final edited form as:

*Pain Pract*. 2018 November ; 18(8): 1048–1067. doi:10.1111/papr.12692.

## Spinal Cord Stimulation: Clinical Efficacy and Potential Mechanisms

**AD Sdrulla**[1], **Y Guan**[2,3], and **SN Raja**[2]

[1]Department of Anesthesiology and Perioperative Medicine, Oregon Health & Science University, Portland, Oregon, U.S.A.

[2]Department of Anesthesiology and Critical Care Medicine, School of Medicine, Johns Hopkins University, Baltimore, Maryland, U.S.A.

[3]Department of Neurological Surgery, School of Medicine, Johns Hopkins University, Baltimore, Maryland, U.S.A.

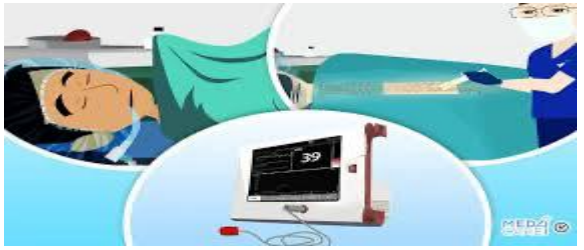
COMPLEX CONDITION

# SPINAL PAIN

PROGRESSIVE AND MULTIMEDIA APPROACH

# QUALITY OF LIFE

CONSERVATIVE STRATEGY



INTERVENTIONAL TECHNIQUES

# Grazie per l'attenzione