Clinical Outcomes Update in SCS

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Border

Pain

Institut

Disclosures

None

Objectives

1. Be able to identify latest clinical outcomes, per most common disease process treated with SCS.
2. Formulate new RCT multicenter studies, to improve SCS outcomes

Historically

57 years later +-

From Norman Shealy

To ECAP and HF, DTM, CL

Yet we are far from understanding or unleashing the full potential of this modality

Outcomes Measured in SCS 50 years later 2018

- Mekhail Et Al

Reported pain reduction or variation in pain intensity,

- Level of functional ability,
- Overall quality of life,
- Psychological effects,
- Use of pain-relief medications,
- Patient satisfaction with SCS treatment, and
- Healthcare expenses and resource utilization.

Clinical Indications

1. Postlaminectomy Syndrome, commonly referred to as Failed Back Surgery Syndrome
2. Complex Regional Pain Syndrome
3. Neuropathic Pain Involving the Peripheral Nervous System
4. Peripheral Vascular Disease

Table 1. Proposed mechanisms of action and waveforms

Waveforms/Stimulation setting	Proposed Mechanism of Action	Parameters
Tonic/low frequency Continuous paresthesia-based stimulation	Dorsal column stimulation WDR inhibition Increase GABAergic neuron and glutamate reduction [3,4,11,23–26]	2–1200 Hz 2–8 mA 100–500 μs
High-Frequency (HF10) Continuous paresthesia free stimulation	Direct DH inhibition, WDR neuron inhibition, and small fiber recruitment paresthesia free [23–25,27–32]	10,000 Hz 1–5 mA 30 μs
Burst DR (Five 1 mV spikes at 500 Hz cycled by 40Hz) Noncontinuous Burst DR (Paresthesia free, passive recharge)	modulation of lateral and medial pain pathways, anterior cingulate cortex, facilitation of antinociceptive descending pathways [23–25,33–38]	200Hz 0.25–1.6 mA 1000 μs
Differential targeted multiplex (DTM) Three therapy options with four synchronous signals and six different amplitudes	Affects neural-glial interaction, modulates gene expression in immune/inflammatory processes characteristic of neuropathic chronic pain modulating ion channels and synaptic signalling [23–25,39,40]	20–1200 Hz Variable mA 500 μs max
Pulsed stimulation pattern (PSP) layered pattern waveform Pulsed stimulation	Narrow pulses stimulation includes modulation of low threshold fiber, DH, dorsal root, glial cells. High-rate train (onset/offset) increases fiber recruitment, whereas long train (charge delivery) modulates high-threshold fibers, dorsal column, lateral and medial pathways, and low-rate train (onset/offset) accommodation, medial and lateral pathway [41]	2–1500 Hz Up to 10.2 mA 12–1000 μs
Evoked compound action potential (ECAP) closed loop Closed loop stimulation	ECAP closed loop stimulation measures the DH/DC response to stimulation via ECAP and automatically adjusts stimulation within the therapeutic window to maintain ECAP consistency. ECAP activation of DC with antidromic and orthodromic inhibitory effects [42–46]	Variable based on ECAP

DC, dorsal column; DH, dorsal horn.

Cost-Effectiveness

Deer Et Al, 2025 in The Journal of Pain Research.

Compared SCS to CMM.

Identifying that within 2.7 years it proves its continued cost effectiveness, with an achievement of treatments targets at around 9 months.

ADLs, Opioid use, utilization of other medical modalities, was much less in the DISTINCT SCS group vs CMM

Study limitations: Insurance coverage changes, revisions or failure of the device, some uncertainty in the estimates, not all therapies and their costs were captured

Dorsal Root Ganglion for the Treatment of Pain

Deer Et Al, 2020 systematic review of literature.

Found a level II (moderate) evidence for DRG effectiveness in treating either neuropathic pain or CRPS.

Strict methods

Showed 88% patients had 30% or more improvement in pain

75% 50% or more. ACCURATE study = Deer

Postural difference in stimulation, DRG showed superiority,

AEs: 27.4% lead fractures, lead migration, infections, need for additional lead placement, relocation of IPG site and explantation.

What now

Dr. Prithvi Raj

Our last conversation

RCTMC across all companies and all types of stimulation

Bibliography

1. Deer T, Heros R, Scarfos K, EtAl; A Cost Effectiveness Analysis of Spinal Cord Stimulation versus Conventional Medical Management for the Treatment of Low Back Pain Using Data from DISTINCT RCT and Medical Claims from a U.S. Commercial Payer Database; Journal Of Pain Research, 2025: 18, 2823-2838.
2. Chakravarthy K, Malayil R, Kirketeig T, Deer T; Burst Spinal Cord Stimulation: A Systematic Review and Pooled Analysis of Real-World Evidence and Outcomes Data; Pain Medicine, 20, 2019, S47-S57.
3. Mekhail N, Visnjevac O, Axzer G, Et Al; Spinal Cord Stimulation 50 Years Later: Clinical Outcomes of SCS based on randomized Trials-A Systematic Review; Regional Anesthesia and Pain Medicine, 43, #4, 05/2018. 391-406.
4. Duarte R, Nevitt S, Maden M, Et Al: Spinal cord stimulation for the management of painful diabetic neuropathy: a systematic review and meta-analysis of individual patient and aregate data; Pain Nov 2021/162; 2635-2643.
5. Schmidt G; The Use of Spinal Cord Stimulation/ Neuromodulation in the Management of Chronic Pain; Journal of the American Academy of Orthopedic Surgeons;; May 1, 2019, No 9; pg e401-e407.
6. Sivanesan E, Maher D, Srinivasa R, Et Al; Supraspinal Mechanisms of Spinal Cord Stimulation for Modulation of Pain, Five decades of Research and Prospects for the Future; Anesthesiology 2019; 130;651-61
7. Malinowski M, Chopra P, Tieppo V, Et Al; A Narrative Review and Future Considerations of Spinal Cord Stimulation, Dordsal Root Granglion Dstimulation and Peripheral Nerve Stimulation; Pain Medicine,34,6, December 2021, 774-80.
8. Karri J Et Al; Comparison of Spinal Cord Stimulation Waveforms for Treating Chronis Low Back Pain: Systematic Review and Meta-Analysis; Pain Physician 2020; 23:451-460.
9. Yue J, Et Al; Surgical Treatment of refractory low back pain using implanted BurstDR SCS in a cohort of patient's without option for corrective surgery: Findings and Results from DISTINCT study, a prospective randomized multi-center-controlled trial; NASSJ 19(2024) 1-10.
10. Deer T, Hunter C, Mehta P, Et Al; A Systematic Review of Dorsal Ganglion Neurostimulation for the Treatment of Pain; Pain Medicine, 21 (8), 2020, 1581-89.