Dorsal root ganglion stimulation for mixed pain following multiple surgical interventions

Mentor: Kiran V. Patel, MD

Trainee: Nitish Aggarwal MD/MBA

Disclosures

- Nitish Aggarwal – No financial disclosures

DRG-S: The Basics

- Placing an electric field around the cell nuclei of the primary sensory afferent neurons
- FDA approval February 2016
- FDA Indication: CRPS & Peripheral Causalgia
- FDA labelling: T10-S2
- Thinner lead (0.9 mm)
- Contains 4 electrodes
- Paresthesia free
- Ideal for treatment of focal neuropathic pain

  (*and also diffuse…)

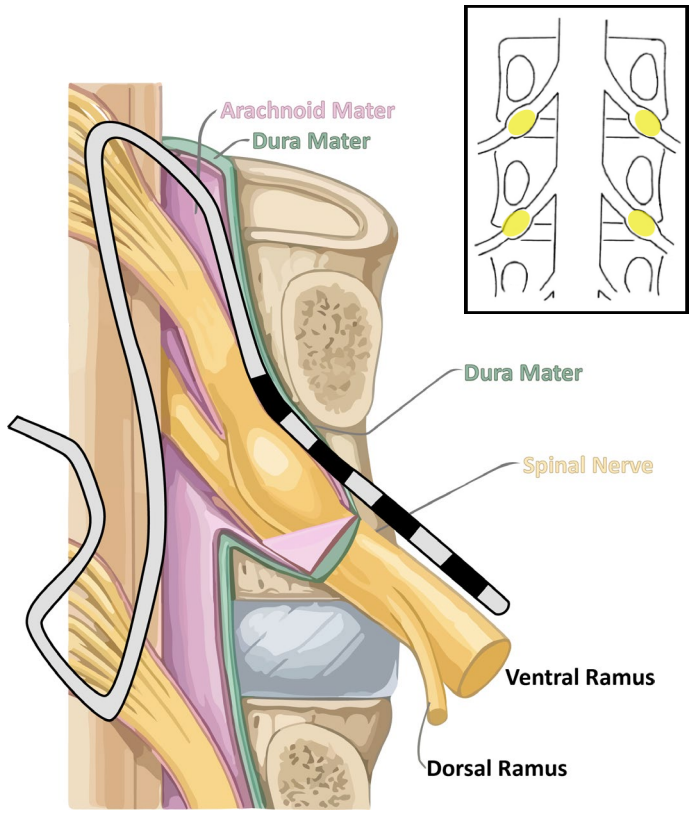
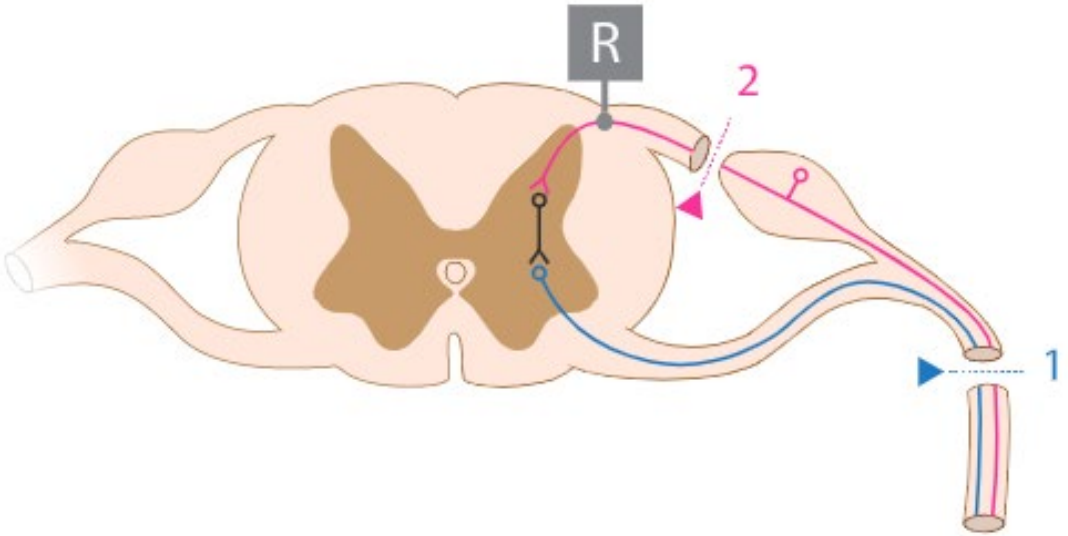
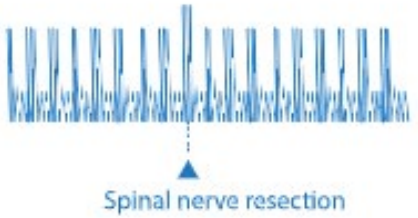


Image from: Gray's Anatomy (2005). Standring, S. (Ed.).

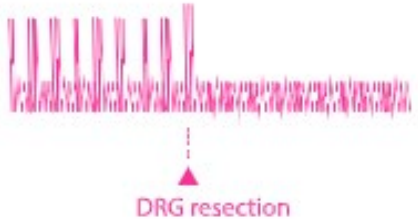
PERIPHERAL NERVE DAMAGE (CRPS) THE PATHOLOGY IS IN THE DRG!



1 Transect injured spinal nerve distal to DRG



2 Transect proximal to DRG



Deer T, Levy R, et al. Dorsal root ganglion stimulation yielded higher treatment success rate for complex regional pain syndrome and causalgia at 3 and 12 months: a randomized comparative trial. Pain. 2017;158(4):669-681.

POST-SURGICAL CAUSALGIA AND CRPS I THINK DRG THERAPY

DRG THERAPY HAS BEEN PROVEN EFFECTIVE FOR:

NEUROPATHIC PAIN AFTER SURGICAL PROCEDURES (CAUSALGIA):

- Hernia Repair Surgery
- Total Knee & Hip Replacements
- Foot & Ankle Surgery
- Pelvic Pain after Surgery
- Lower Extremity Amputations

CAUSALGIA FROM A TRAUMATIC INJURY OF THE HIP, KNEE, ANKLE, OR FOOT

CRPS I OF LOWER EXTREMITIES

CHRONIC POST SURGICAL PAIN INCIDENCE	
Hernia surgery	8.5%
Total knee replacements	15%
Total hip replacements	6%
Foot & ankle surgery	5.3%
Hysterectomy	17 – 50%
Cesarean sections	10%
Low extremity amputations	30 – 85%

850,000+
Post-surgical causalgia

VS

8,725
CRPS I
Lower Extremities

Nociceptive Pain??

- 61-year-old, schoolteacher for 40 years, with left knee pain and subsequent 25 surgeries/revisions, including Total Knee Replacement
- Pain was at anterior, medial, lateral and posterior knee joint and Exacerbated by weight bearing, walking, kneeling, squatting.
- Surgeon placed L3 DRG lead for neuropathic pain.. BUT continued to have more pain (MIXED pain)
- Added L2, L4 and S1 leads via trial and then implantation.
- DRG… ⬇ Pain ⬆ Quality of Life

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Northwell
Health

SUSTAINED PAIN RELIEF FOR CHRONIC POST-SURGICAL PAIN

A SPOTLIGHT ON KNEE PAIN

- N=14, 12 included in analysis
- Primary diagnosis causalgia (CRPS type II), secondary to either trauma or postoperative chronic pain (**knee replacement or arthroscopy**)
- Primary outcome measure: Pain reduction assessed by NRS pre- and postoperatively
- Patients were followed out to a mean of 34 months (range: 15 - 78 months, 95% CI 11.4 months)

LEAD LOCATION(S)	# OF PATIENTS
L3	8
L4	1
L3 and L4	3

RESULTS

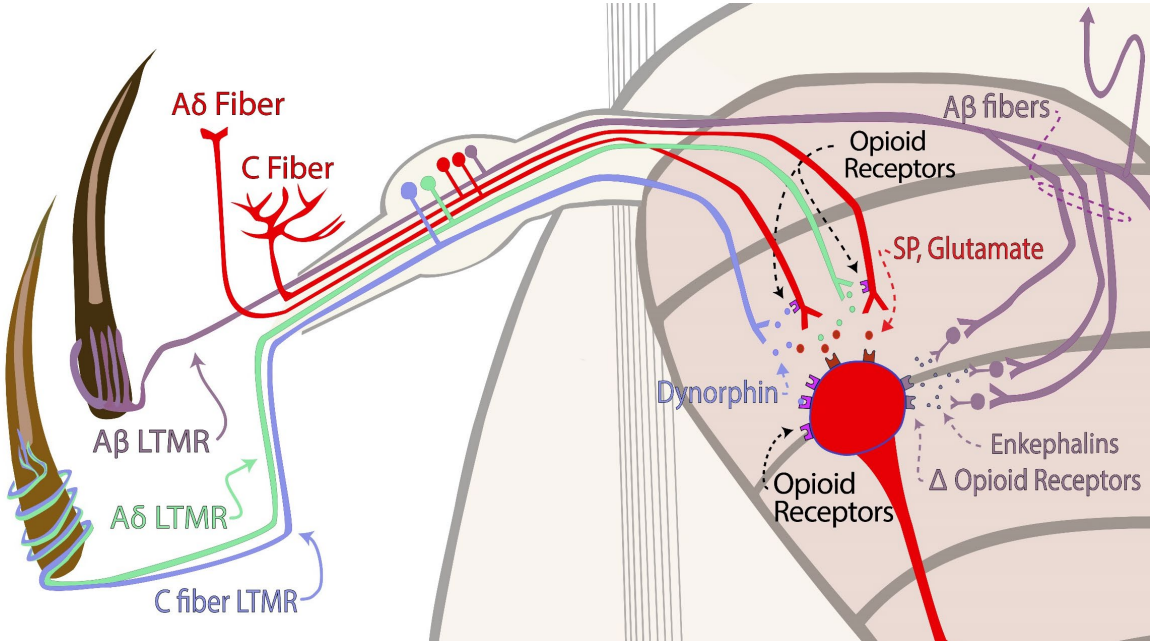
100%	Responder rate
80%	Median improvement in pain score: Average Baseline NRS: 8.5; Post-op: 2
85%	Median coverage of pain area
54%	Average reduction in daily morphine equivalent dosage*

*Observational endpoint

Dorsal Root Ganglion Stimulation for the Treatment of Chronic Neuropathic Knee Pain, Martin et al.

WHY DRG?

Modulates a variety of fibers

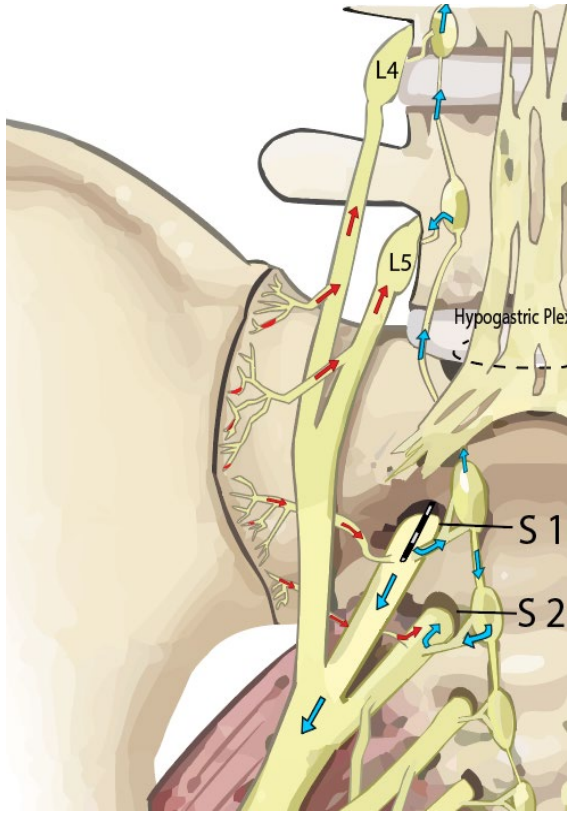


- SCS preferentially recruits A**β** fibers
- Very low frequency DRG-S can entrain all LTMR fiber types
- DRG-S can target unmyelinated C fibers, A**δ**, and A**β** fibers

- IMPLICATIONS for nociceptive and mixed component pain!
- Potential to expand indications!

Kandel ER, Schwartz JH, Jessell TM. Principles of Neural Science. In: Chap. 24: The perception of pain. 4th edn, New York: McGraw-Hill; 2000. p. 472–491.

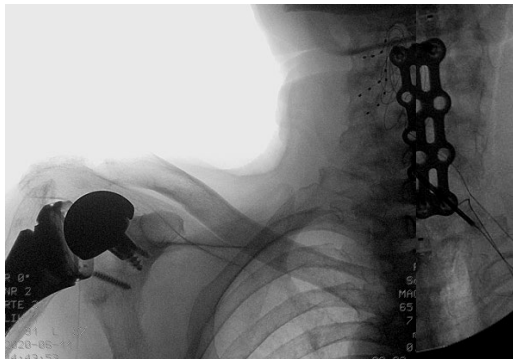
Joint Pain/Mixed Pain/Nociceptive Pain



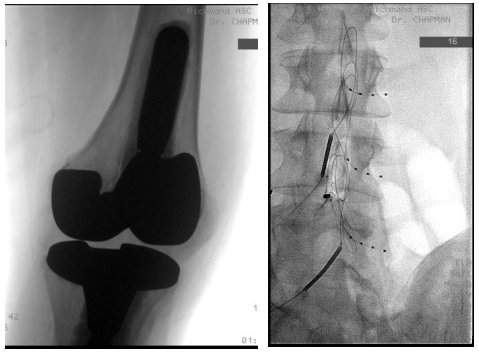
Study	Number of participants	Study Type	Follow up	Outcome Measures	Results: Efficacy for Pain Intensity	Results: Adverse Events
Morgala et al (2018)	51 implanted (27 knee pain)	PR	1yr: 40, 2 years: 3 years: 25	VAS, PDI, PCS BPI, BDI	3 years VAS 8 to 4. PDI 45 to 23. PCS 34 to 21. BPI 73 to 30. BDI 36 to 21	27.5% complication rate (14/51). 2 infections. 1 lead fx. 3 req. extra leads
van Bussel et al. (2018)	1 Knee pain	CR	16 d trial. 3 time points	Pt preference SCS vs DRGS, VAS, GPE Scale	Baseline VAS: 68	No SAEs occurred
Hunter et al (2019)	Accurate subgroup 14 pt (12 knee, 2 hip)	RCT subanaylsis	12 months	VAS	Knee: NRS decreased 71.7% Hip NRS decreased 68.6%	Not separately identified
Martin et al (2020)	14 consecutive knee (7 post op, 7 trauma)	PR	mean of 34 months (15-78 mo) L3 only : 8 L4 only:8 L3+L4 : 3	VAS	VAS Median 8.5 > 2.0 Median % improved 80% Responder rate 100% Mean ME 45-20	2 pts explanted: 1 for migration x2, 1 for infection then reimplanted. 1 pt failed tria;
Kretzschmar et al. (2020)	23 patients (10 knee)	CS	36 months	VAS, MCS, PCS, QLIP	Improvement Vas 73% MCS 25% PCS 18% QLIP 102%	5 electrode dislocations, 2 explants
Chapman et al. (pending)	14 pt LBP and SI joint pain	CS	18 months	NRS, SF-36, EQ-5, ODI		

Hunter CW et al. DRG FOCUS: A Multicenter Study Evaluating Dorsal Root Ganglion Stimulation and Predictors for Trial Success. Neuromodulation. 2019 Jan;22(1):61-79. doi: 10.1111/ner.12796.
Morgalla Mhet al. Dorsal root ganglion stimulation (DRGS) for the treatment of chronic neuropathic pain: A single center study with long-term prospective results in 62 cases. Pain Physician 2018;21:E377–87.
Kretzschmar M, Reining M, Schwarz MA. Three-Year Outcomes After Dorsal Root Ganglion Stimulation in the Treatment of Neuropathic Pain After Peripheral Nerve Injury of Upper and Lower Extremities. Neuromodulation. 2020 Jun 23. doi: 10.1111/ner.13222. Epub ahead of print. PMID: 32573868.
Martin et al.. Dorsal Root Ganglion Stimulation for the Treatment of Chronic Neuropathic Knee Pain. World Neurosurg. 2020 Nov;143:e303-e308. doi: 10.1016/j.wneu.2020.07.102. Epub 2020 Jul 22. PMID: 32711140.

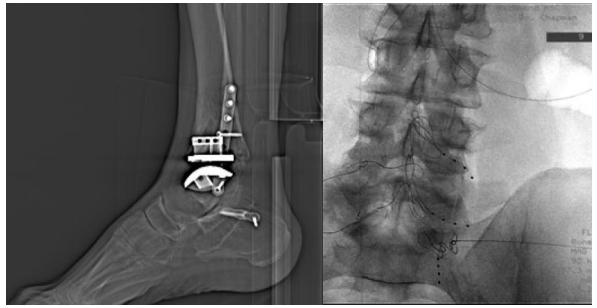
Nociceptive Pain



- A 67 y/o male with left shoulder pain s/p failed shoulder replacement x2 . DN4 1/10.
- ROM all planes <5°
- Leads were placed on the left C4-C6 DRGs.
- He had 70% pain relief and significantly improved ROM, QOL, and mood.
- Forward flexion 65, Abduction 70, able to wipe self and reach wallet.

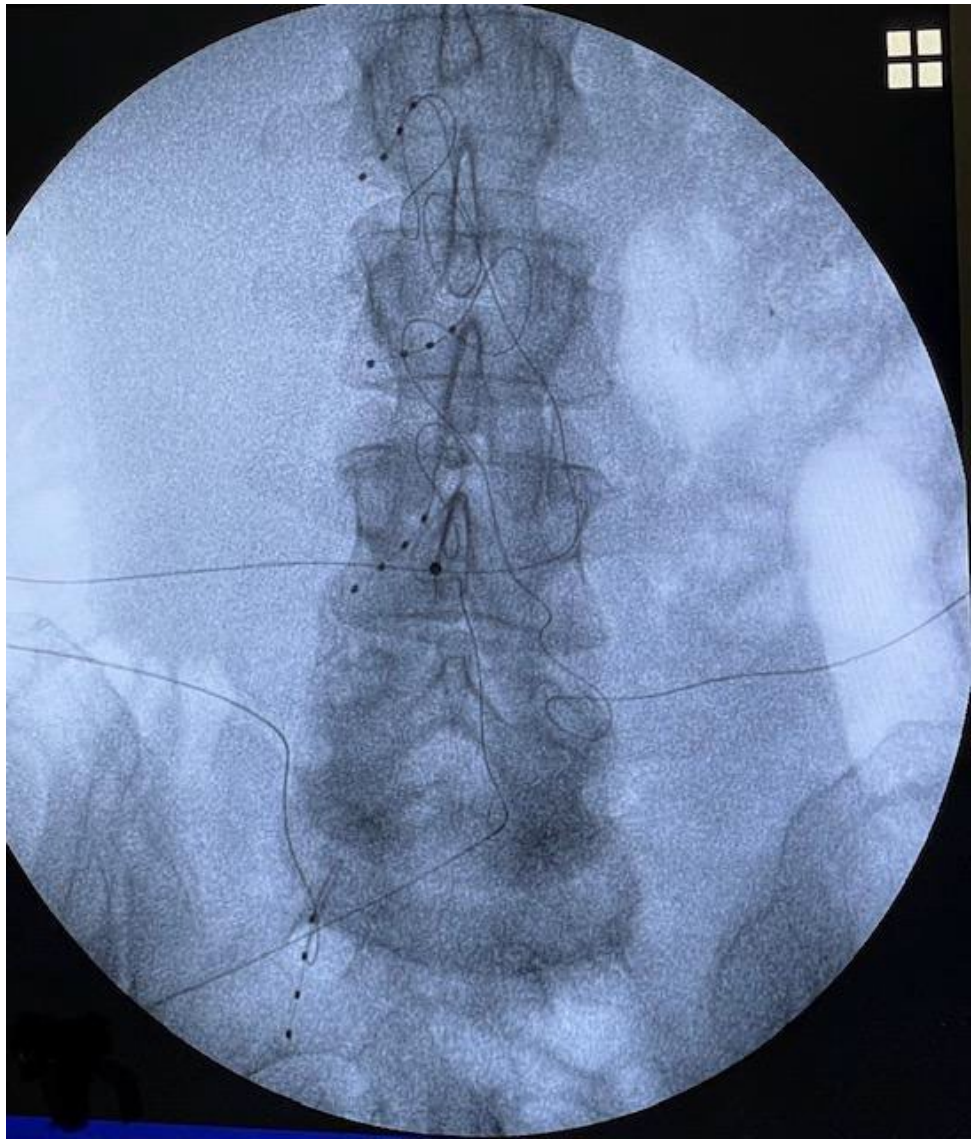


- **A 45 y/o male with right knee pain after 26 surgeries on the right knee including 3 total knee replacements. Surgeon agreed to AKA as next step. DN4 1/10.**
- **Leads were placed on the right L2, L3, L4, and S1 DRGs.**
- **He had 100% knee pain relief and greatly improved mood and functioning.**



- 58 y/o male s/p 5 ankle surgeries including ankle replacement and revision surgery with facet arthropathy secondary to gait disturbance . DN4 2/10
- Leads were placed on the right T12, L4, L5, and S1 DRGs.
- He had 100% ankle and 75% low back pain relief with decreased opioid use and improved function, QoL, and mood.

DRG for Nociceptive and Neuropathic Knee Pain



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