Peripheral Nerve Stimulation

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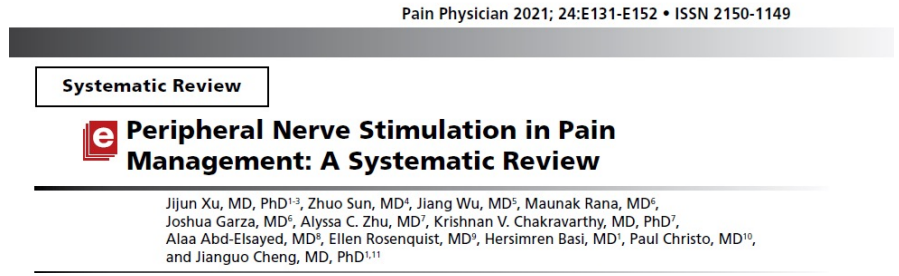
38TH ANNUAL MEETING

Disclosures

- CONSULTANT:
  - Bioventus, Nalu, SPR Therapeutics, Coloplast, Invicta, Medtronic, Abbott
- GRANT/RESEARCH SUPPORT:
  - Bioness: Protocol Title: A Prospective, Open-label, Long-term, Multi-center, Registry to Assess the Safety and Efficacy of the Bioness StimRouter Neuromodulation System in Subjects with Chronic Pain of Peripheral Nerve Origin
  - SPR: Feasibility and Effectiveness of using peripheral nerve stimulation (PNS) to treat chronic post-surgical pain (CPSP) following total knee arthroplasty

- This presentation does NOT contain off-label or investigational use of drugs or products.

- Where does PNS fit into the chronic pain algorithm?
- Basics of PNS implants
  - 3 Styles of implant examples
- Evidence for PNS

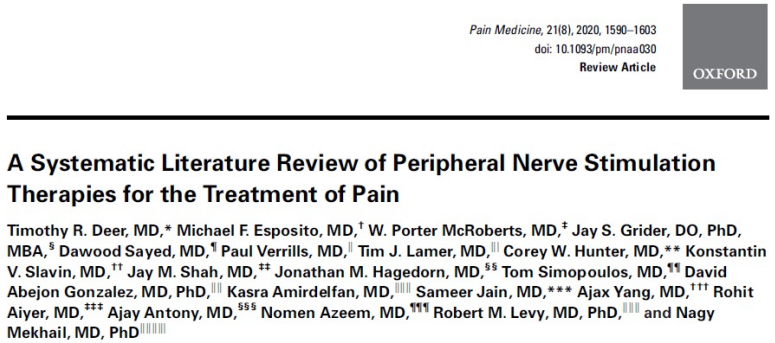


Pain Physician 2021; 24:E131-E152 • ISSN 2150-1149

Systematic Review

Peripheral Nerve Stimulation in Pain Management: A Systematic Review

Jijun Xu, MD, PhD[1-3], Zhuo Sun, MD[4], Jiang Wu, MD[5], Maunak Rana, MD[6], Joshua Garza, MD[6], Alyssa C. Zhu, MD[7], Krishnan V. Chakravarthy, MD, PhD[7], Alaa Abd-Elsayed, MD[8], Ellen Rosenquist, MD[9], Hersimren Basi, MD[1], Paul Christo, MD[10], and Jianguo Cheng, MD, PhD[1,11]



Pain Medicine, 21(8), 2020, 1590–1603
doi: 10.1093/pm/pnaa030
Review Article

OXFORD

A Systematic Literature Review of Peripheral Nerve Stimulation Therapies for the Treatment of Pain

Timothy R. Deer, MD,* Michael F. Esposito, MD,† W. Porter McRoberts, MD,‡ Jay S. Grider, DO, PhD, MBA,§ Dawood Sayed, MD,¶ Paul Verrills, MD,‖ Tim J. Lamer, MD,‖ Corey W. Hunter, MD,** Konstantin V. Slavin, MD,†† Jay M. Shah, MD,‡‡ Jonathan M. Hagedorn, MD,§§ Tom Simopoulos, MD,¶¶ David Abejon Gonzalez, MD, PhD,‖‖ Kasra Amirdelfan, MD,‖‖ Sameer Jain, MD,*** Ajax Yang, MD,††† Rohit Aiyer, MD,‡‡‡ Ajay Antony, MD,§§§ Nomen Azeem, MD,¶¶¶ Robert M. Levy, MD, PhD,‖‖ and Nagy Mekhail, MD, PhD‖‖‖

Pain Ther
https://doi.org/10.1007/s40122-021-00306-4

REVIEW

Peripheral Nerve Stimulation for Chronic Pain: A Systematic Review of Effectiveness and Safety

Standiford Helm · Nikita Shirsat · Aaron Calodney · Alaa Abd-Elsayed · David Kloth · Amol Soin · Shalini Shah · Andrea Trescot

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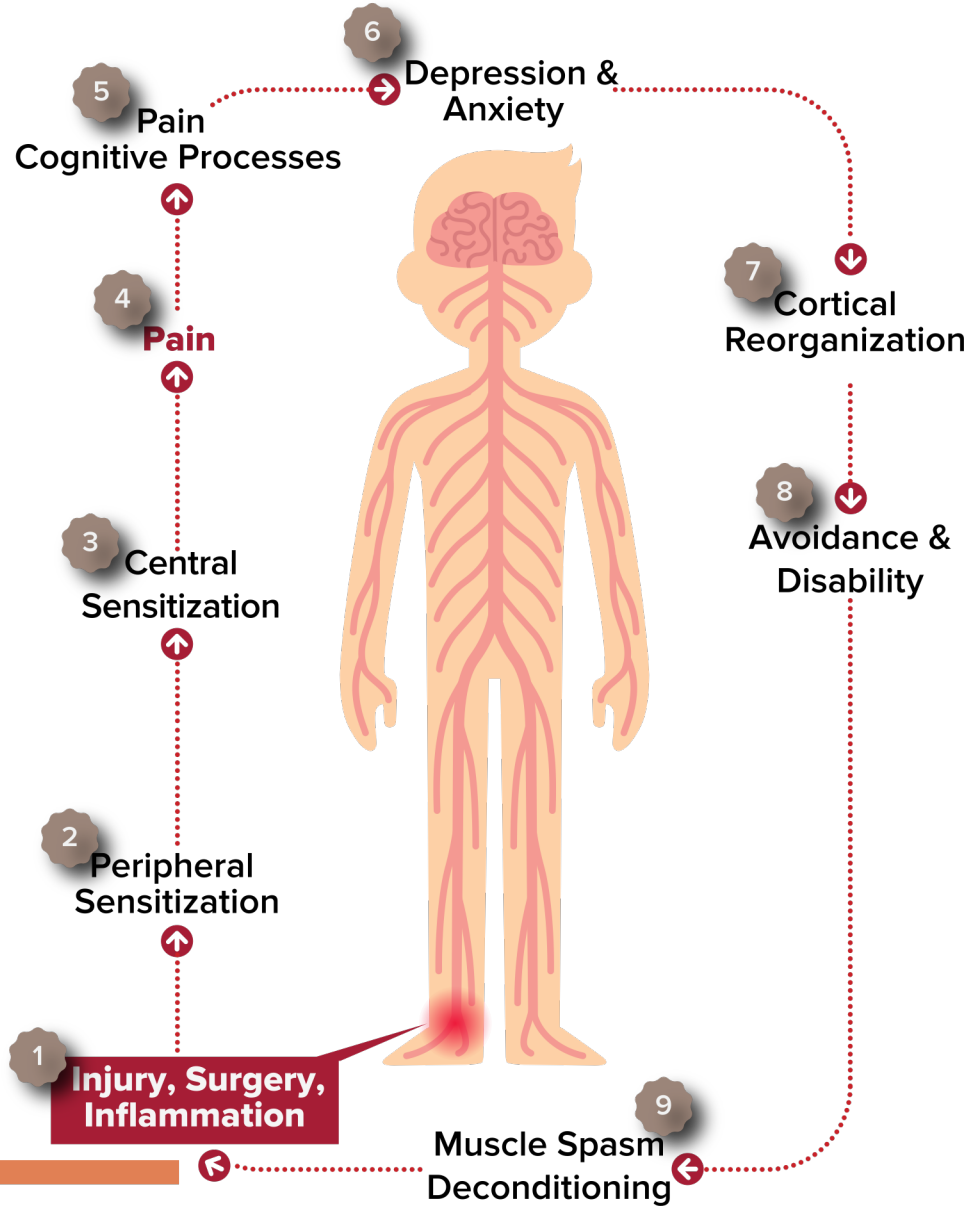
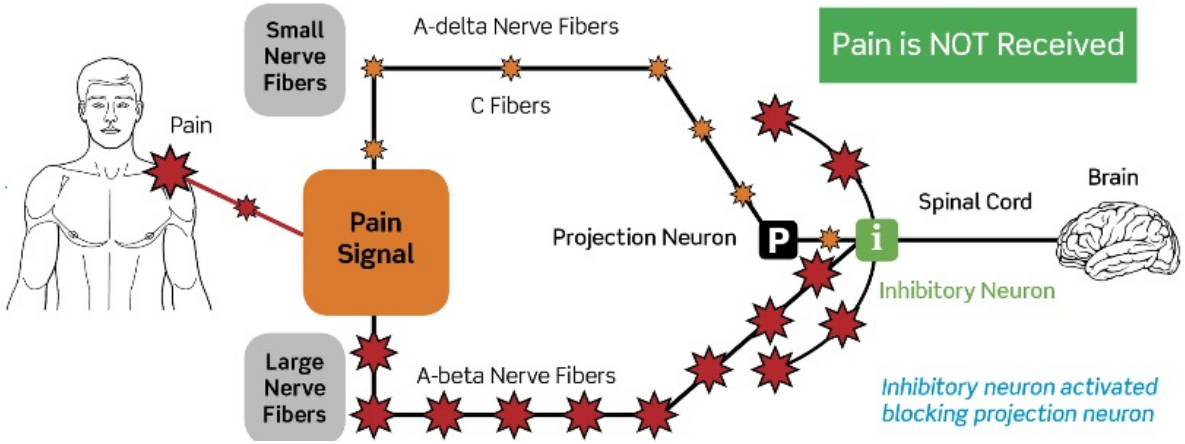


Sweet reported "pain relief until death." in 1976

Sweet WH. Control of pain by direct electrical stimulation of peripheral nerves. *Clin Neurosurg*. 1976;23:103–111.



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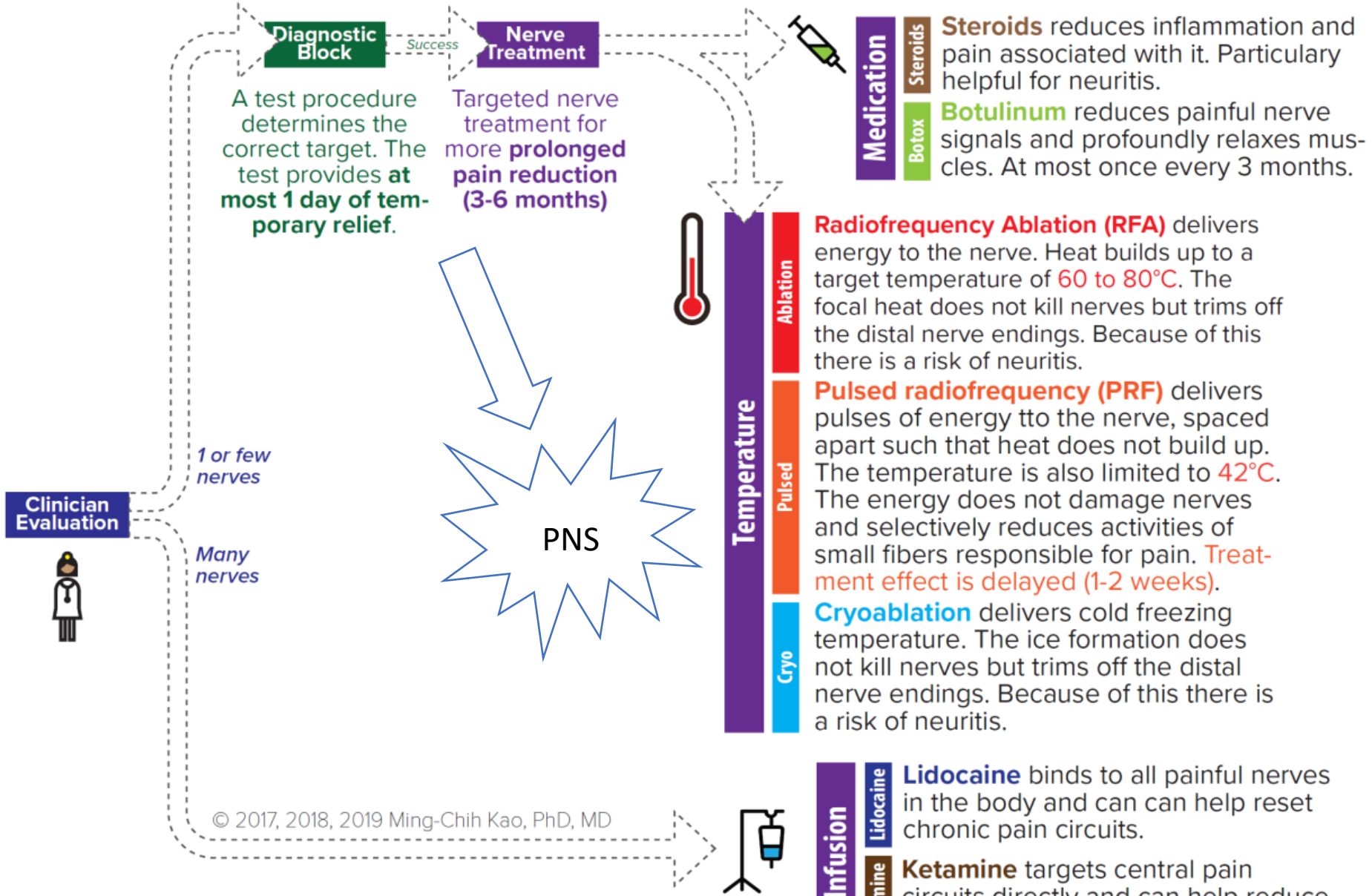
Nerve interventions for pain

@DrMingKao



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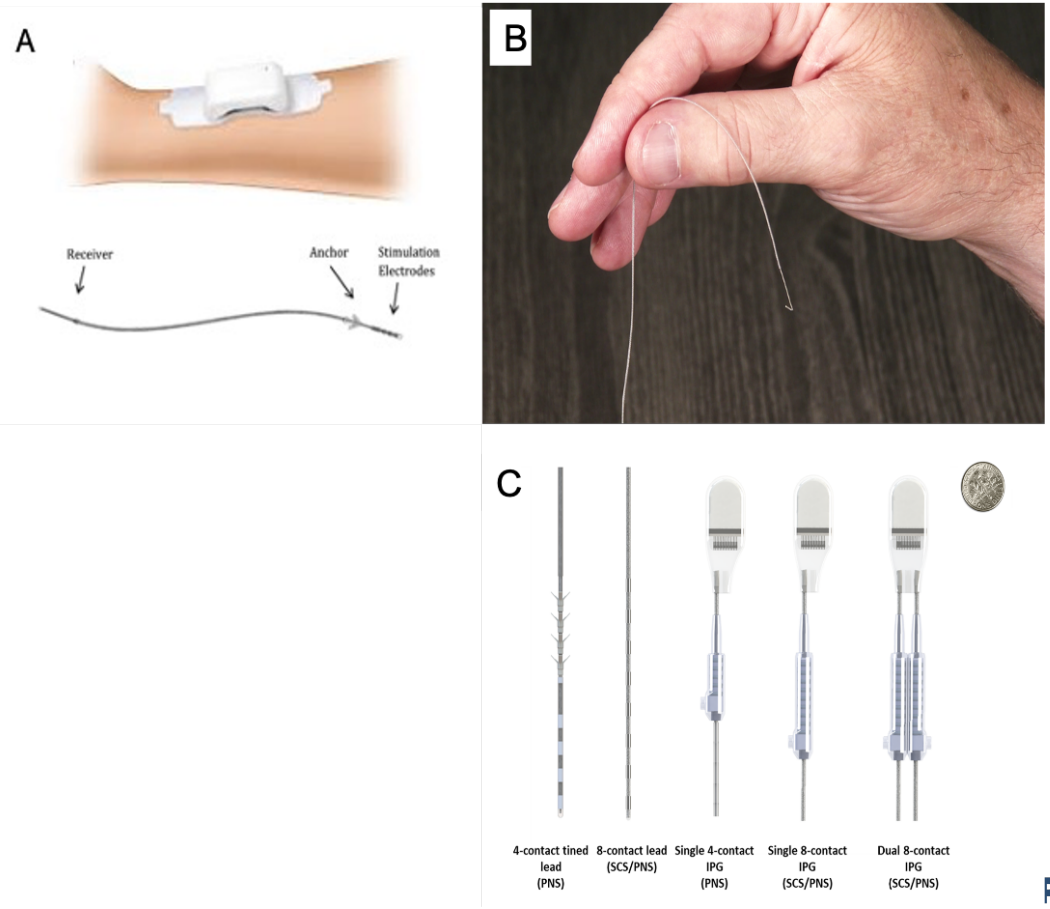
Patient and Device Selection: General Considerations

- Single peripheral nerve?
- Can patient reach the area?
- MRI considerations?
- Consider the natural trajectory of the pain condition
    - Acute pain that is expected to get better with time: ***post-surgical pain, total shoulder, adhesive capsulitis***
    - Acute pain that has a high risk of progressing to chronic pain: ***amputation***
    - Chronic or cancer pain: CRPS, mononeuropathy, post-surgical neuropathy



Appropriateness for Peripheral Nerve Stimulation

Diagnostic Blocks: Are They Necessary?

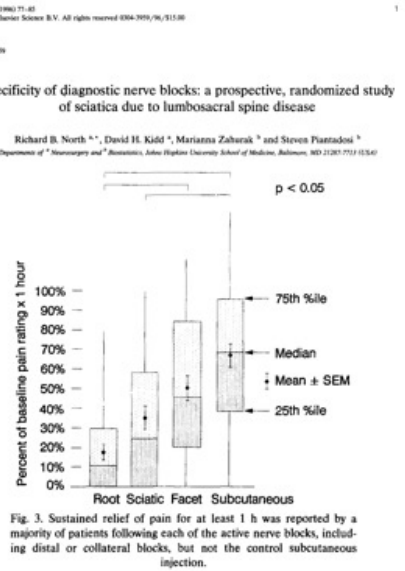


Fig. 3. Sustained relief of pain for at least 1 h was reported by a majority of patients following each of the active nerve blocks, including distal or collateral blocks, but not the control subcutaneous injection.

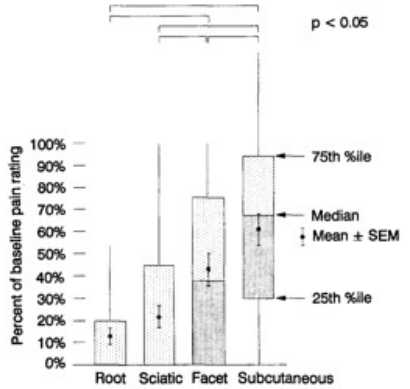


Fig. 2. The fraction of patients reporting at least 50% relief of pain was significantly greater for all 3 'active' nerve blocks than for the control subcutaneous injection (chi square, $P < 0.05$). The results for each of the 4 blocks are displayed here as quartile plots (showing median results and frequency distributions) with superimposed means + SEM of sustained 1-h ratings, as fractions of the baseline pain rating. Most patients reported sustained relief by at least 90% after the root blocks, and by at least 75% after the sciatic nerve blocks – distal or collateral to their known spinal pathology.

- Diagnosis may have decreased treatment success in the past
- Ultrasound
- MRI neurogram
- EMG/NCV
- If we can block it then we can stim it

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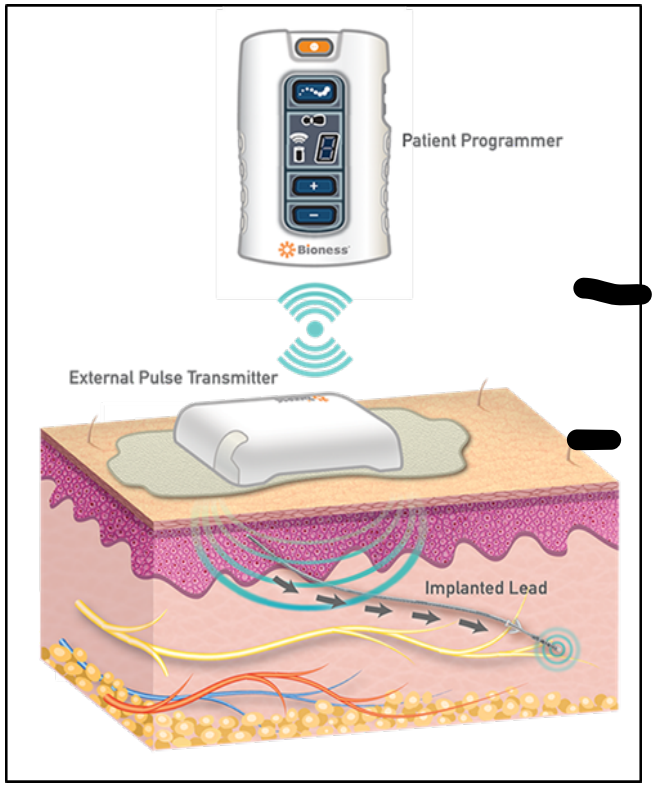
Neuromodulation System



- **Patented Electric Field Conduction (EFC)** allows the StimRouter system to deliver energy consistently to stimulate the most anatomically challenging nerve targets.

“Electric Field Conduction (EFC)”

- Method of energy delivery to power implanted receiver.
- Overcomes “attenuation” or decay of energy delivery through the skin with RF used by other PNS companies.

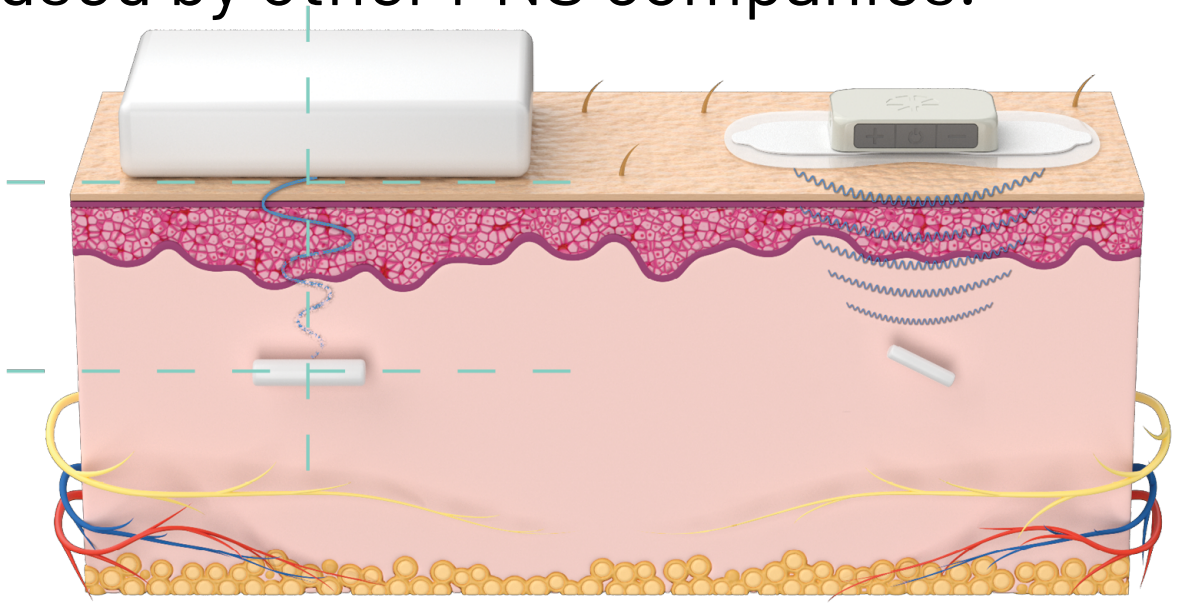
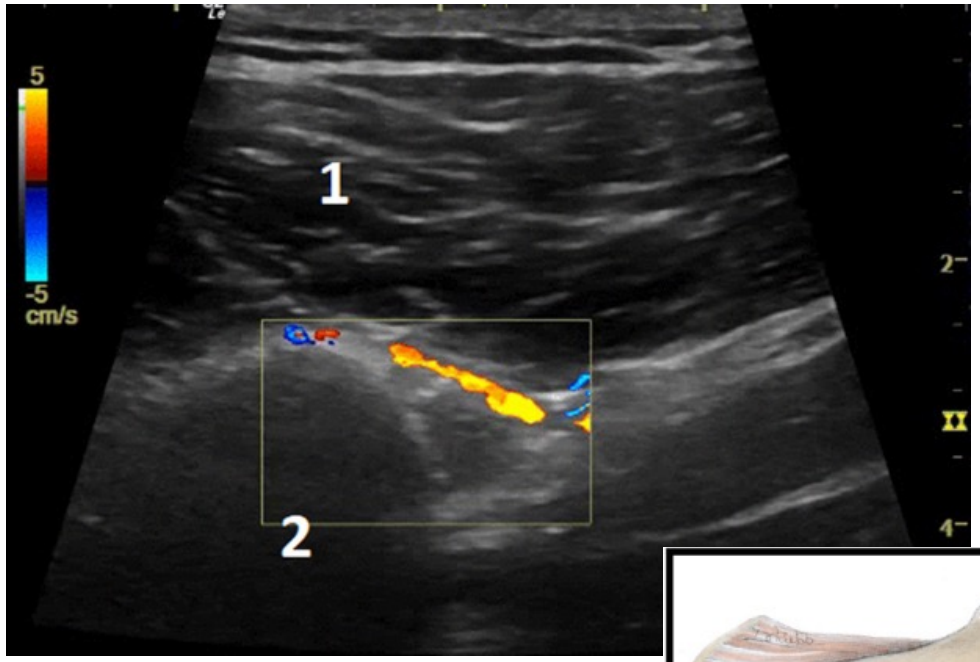
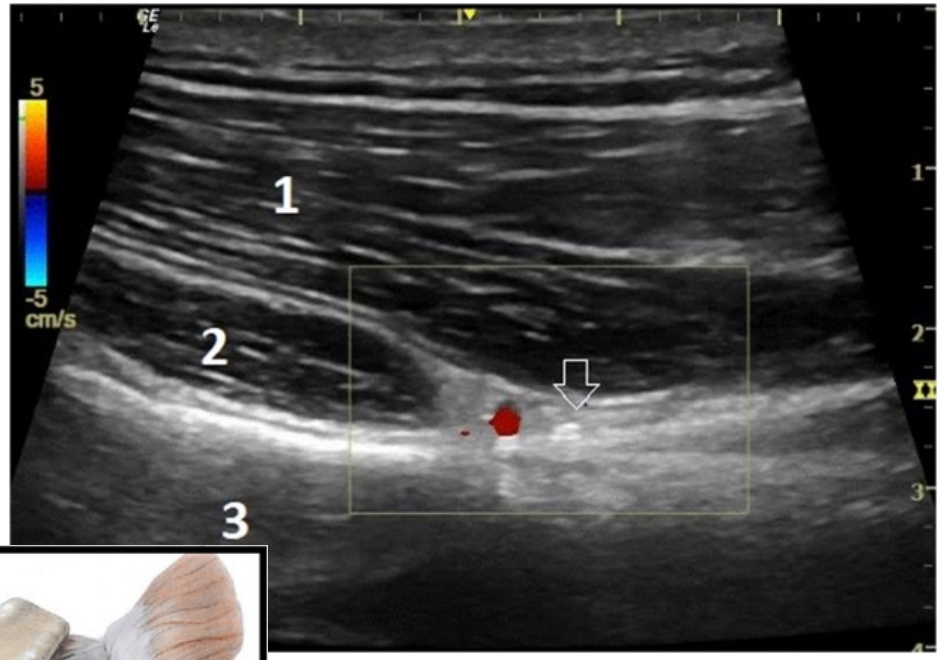


Illustration of RF vs. EFC

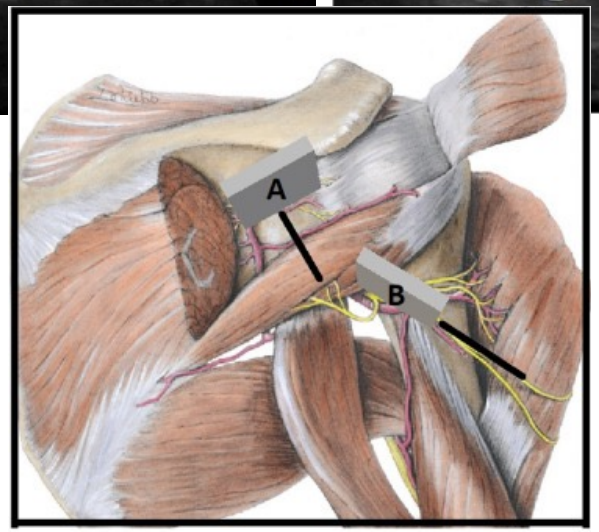
Axillary Nerve



Sonoanatomy of the quadrangular space. Color, posterior circumflex artery (long axis); 1, deltoid muscle; 2, humerus (short axis).



Distal AN sonoanatomy. Arrow, the AN (short axis); red, posterior circumflex artery (short axis); 1, deltoid muscle; 2, teres minor muscle; 3, humerus.



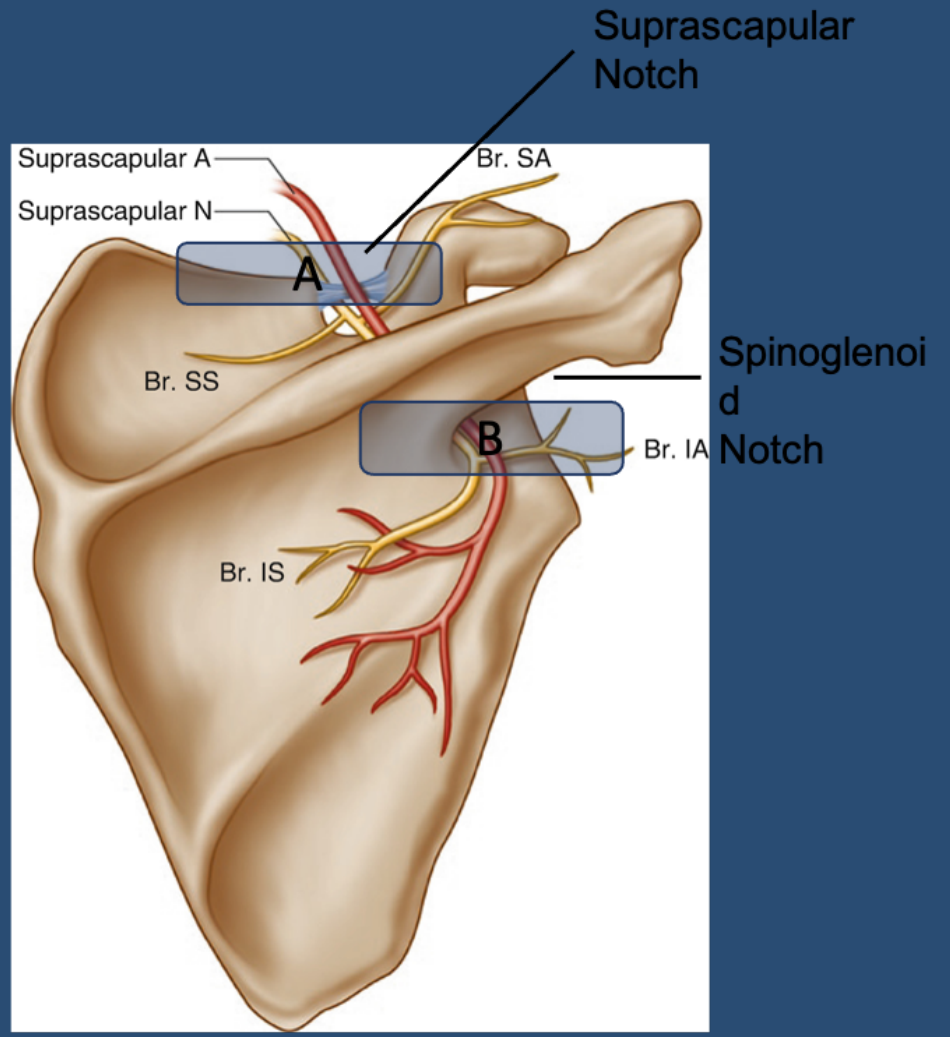
Gofeld M, Agur A. Peripheral Nerve Stimulation for Chronic Shoulder Pain: A Proof of Concept Anatomy Study. Neuromodulation. 2018;21(3):284-289.

Axillary Nerve

Photo: Scott Pritzlaff, MD

Suprascapular Nerve

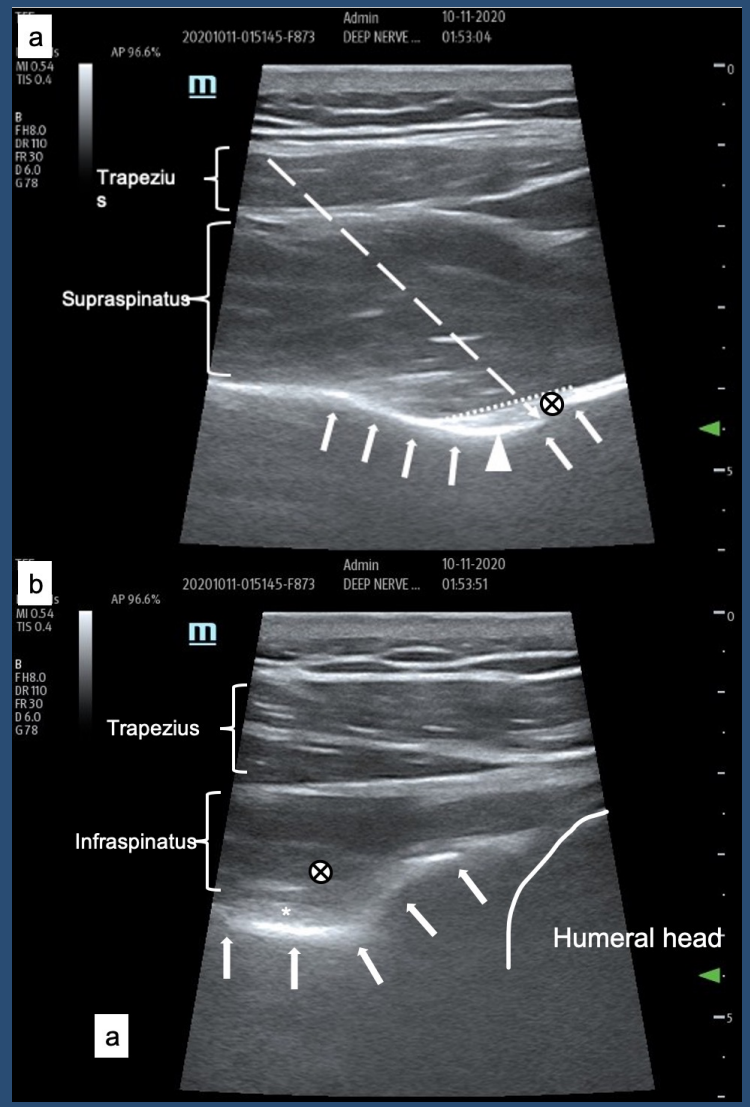
- Approximate scanning position and lead placement technique for stimulation of the suprascapular nerve.
- Position A demonstrates position for placement perpendicular to the nerve at the suprascapular notch.
- Position B demonstrates placement parallel to the nerve at the spinoglenoid notch.



Suprascapular Nerve

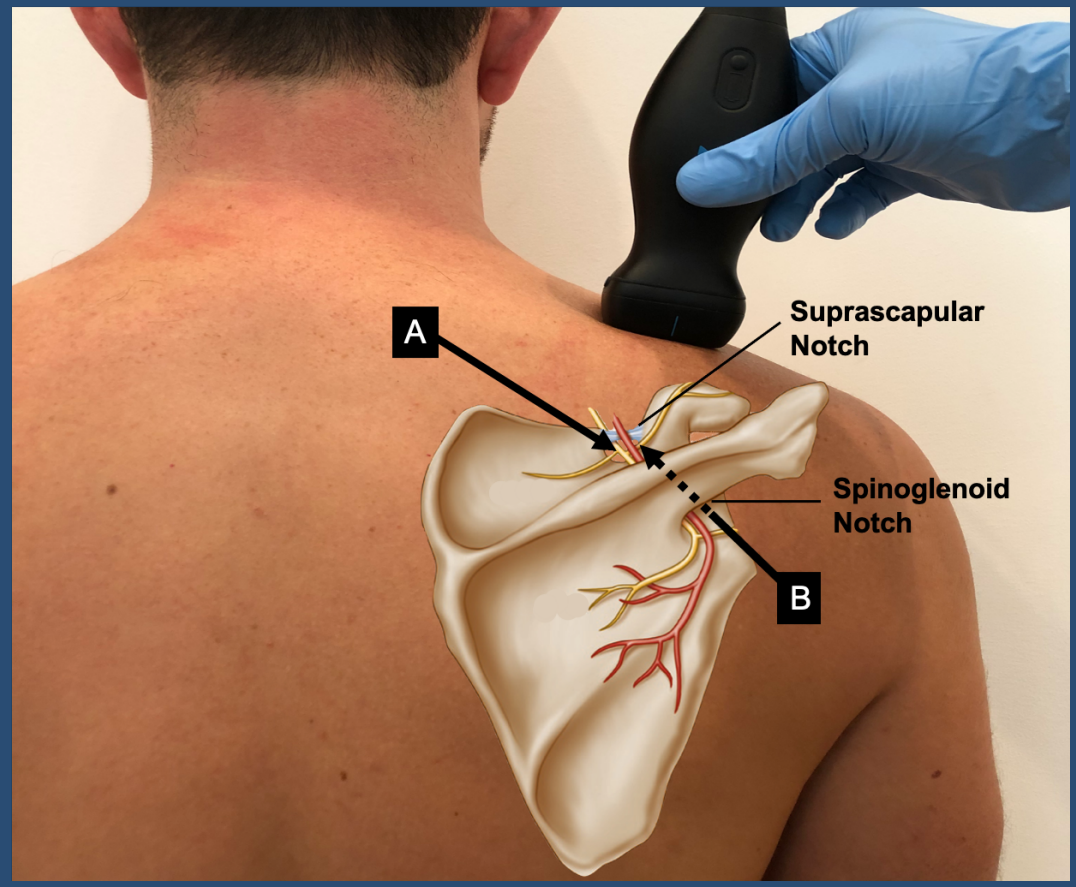
A) Ultrasound image of the suprascapular nerve (arrowhead) at the suprascapular notch (outlined with bold arrows). The suprascapular nerve lies deep to the transverse scapular ligament (dotted line). Dashed arrow indicates the approximate trajectory of the lead introducer. Final lead position deep to the ligament is similar whether the lead is inserted perpendicular to the nerve (arrowhead on dashed arrow) or inserted parallel to the nerve (circle with X) at the spinoglenoid notch as seen in X.3b and then advanced superiorly under the scapular spine.

B) Ultrasound image of the suprascapular nerve (*) at the spinoglenoid notch (bold arrows). Approximate lead placement parallel to the nerve, out of plane approach with lead viewed in cross-section (circle with X) as it is advanced superiorly under the scapular spine. The final lead position is represented with the “circle with X” in figure X.3a.



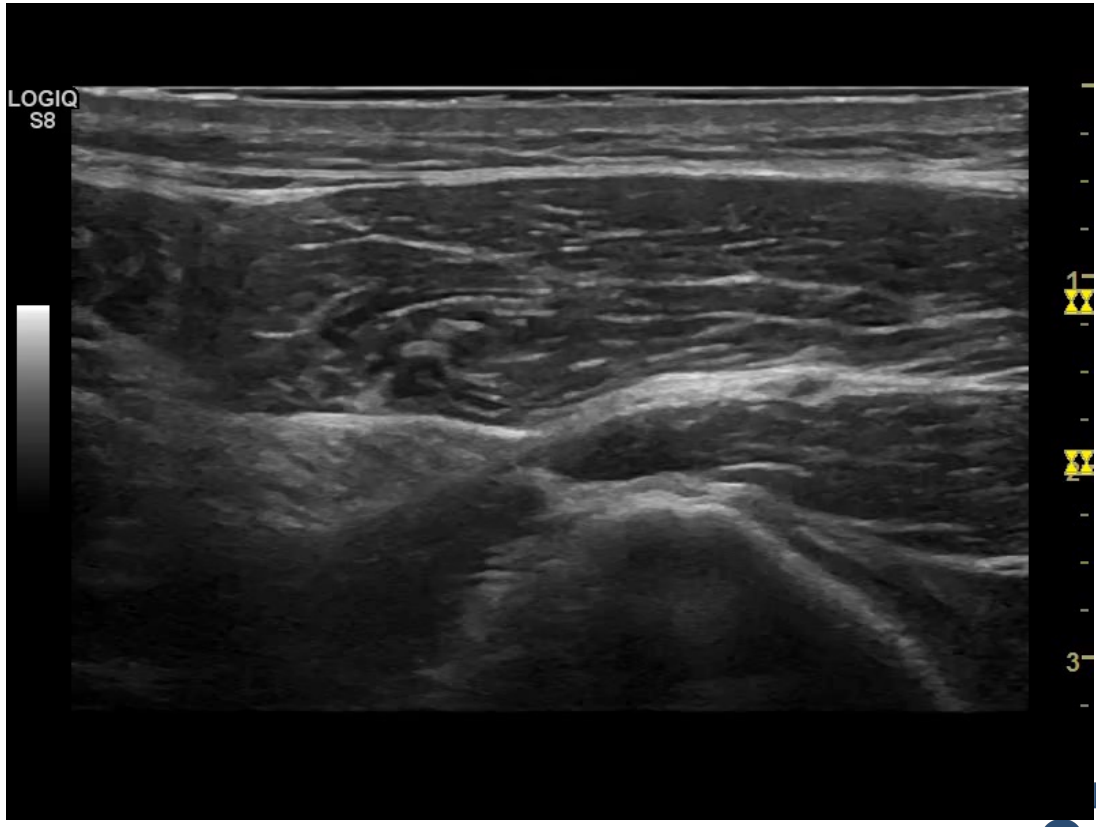
Suprascapular Nerve

- Lead insertion trajectories perpendicular to the nerve at the suprascapular notch (A) and parallel to the nerve at the spinoglenoid notch (B).
- Dotted line indicates the portion of the lead which is deep to the scapular spine.

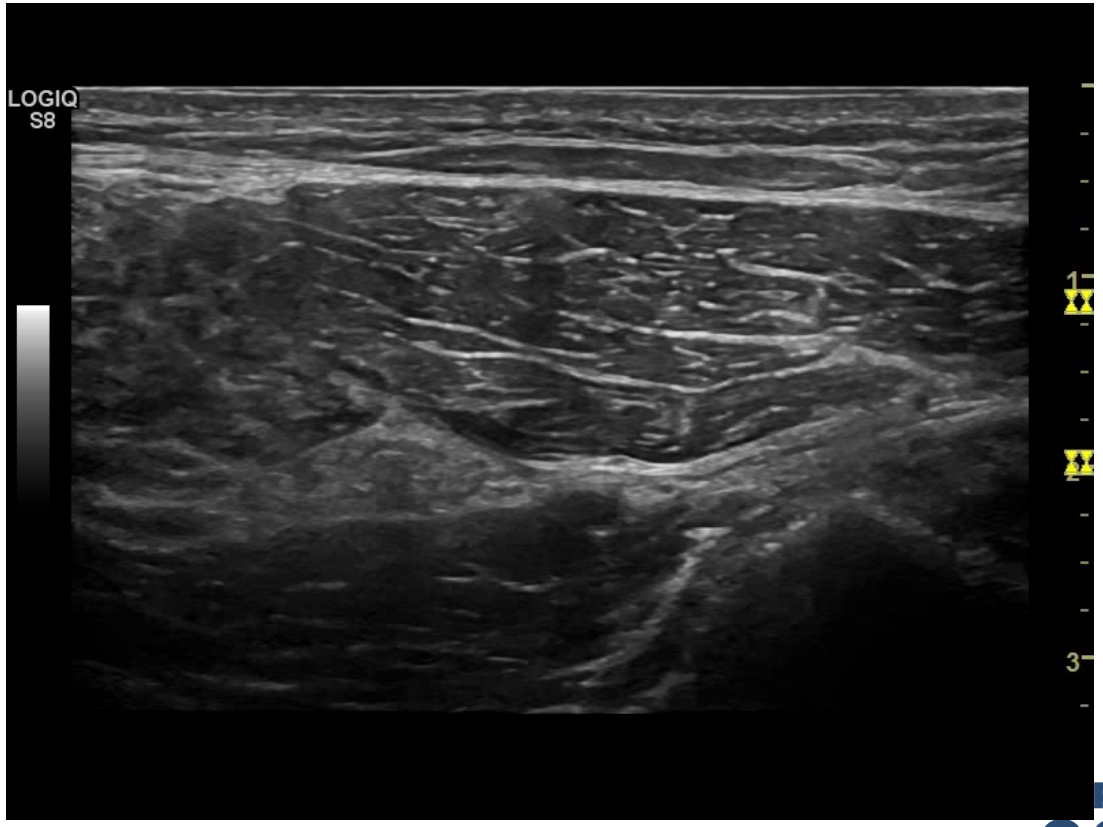


Sciatic Nerve Implant

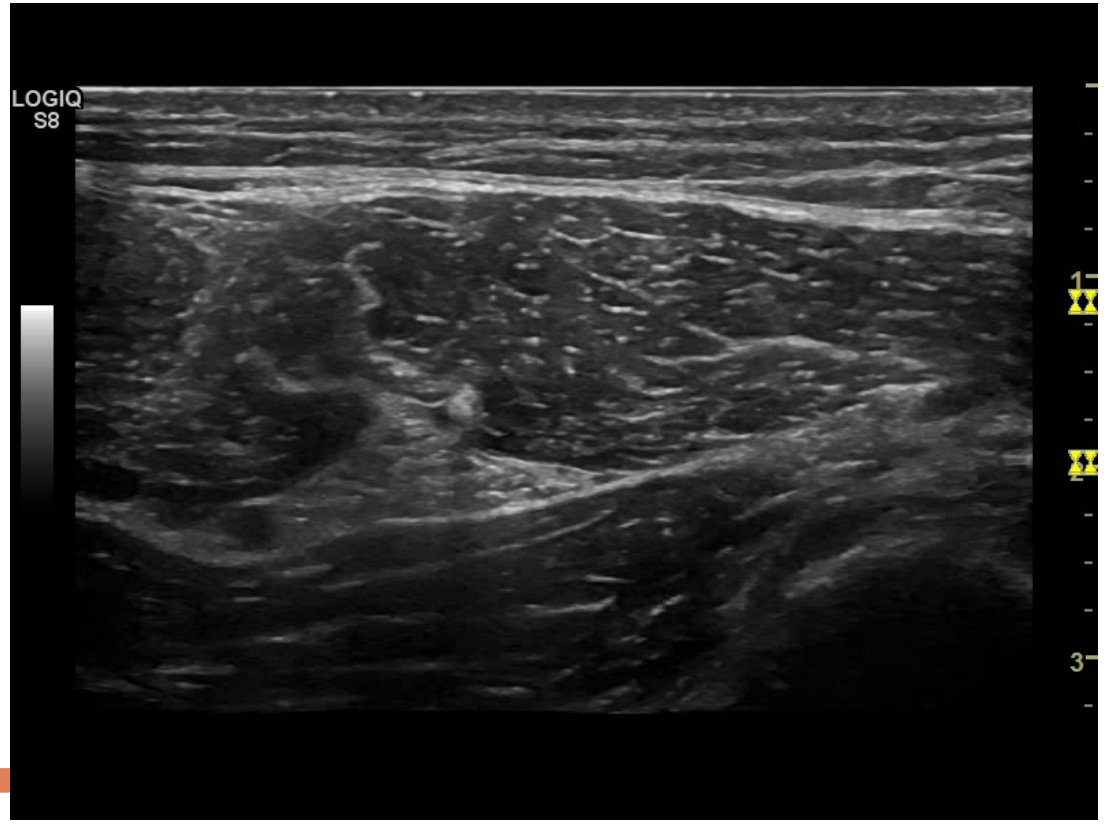
- 48 yoM S/p traumatic BLE amputation with R residual limb pain > phantom pain
- Common peroneal neuroma at fibular head and at tibial insertion from previous nerve decompression surgery

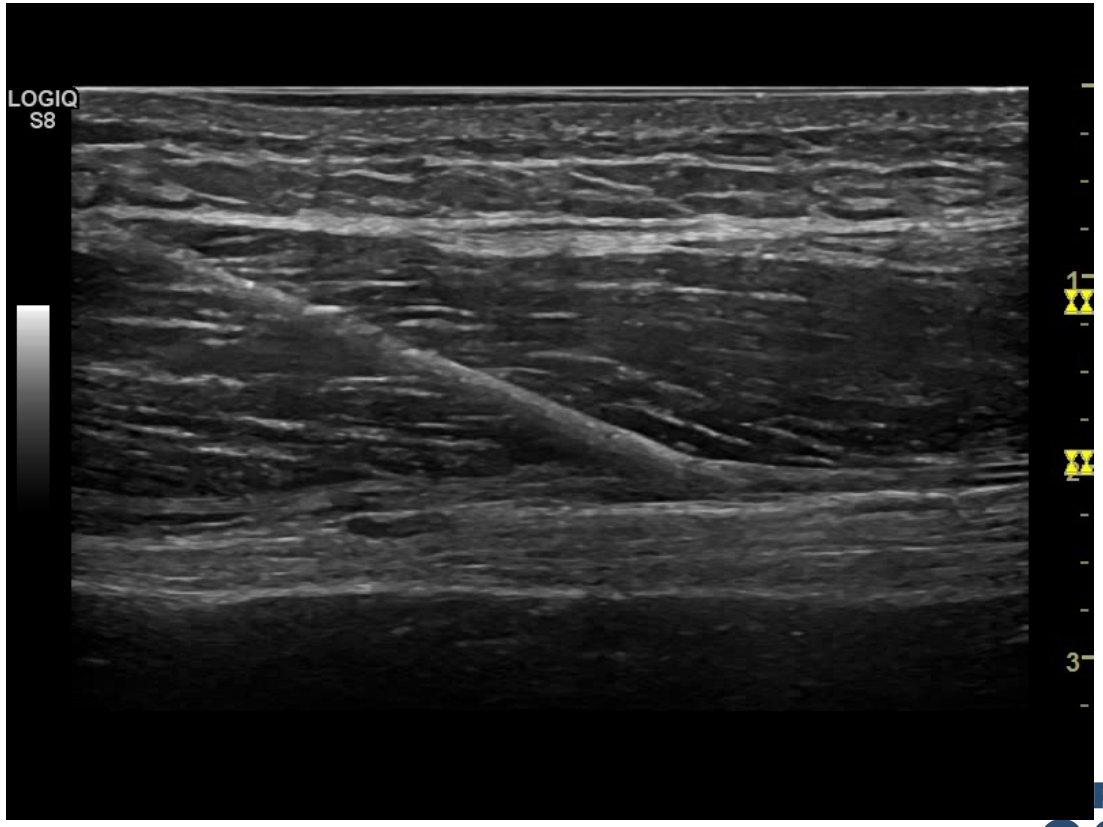


Sciatic Nerve OOP View of Needle

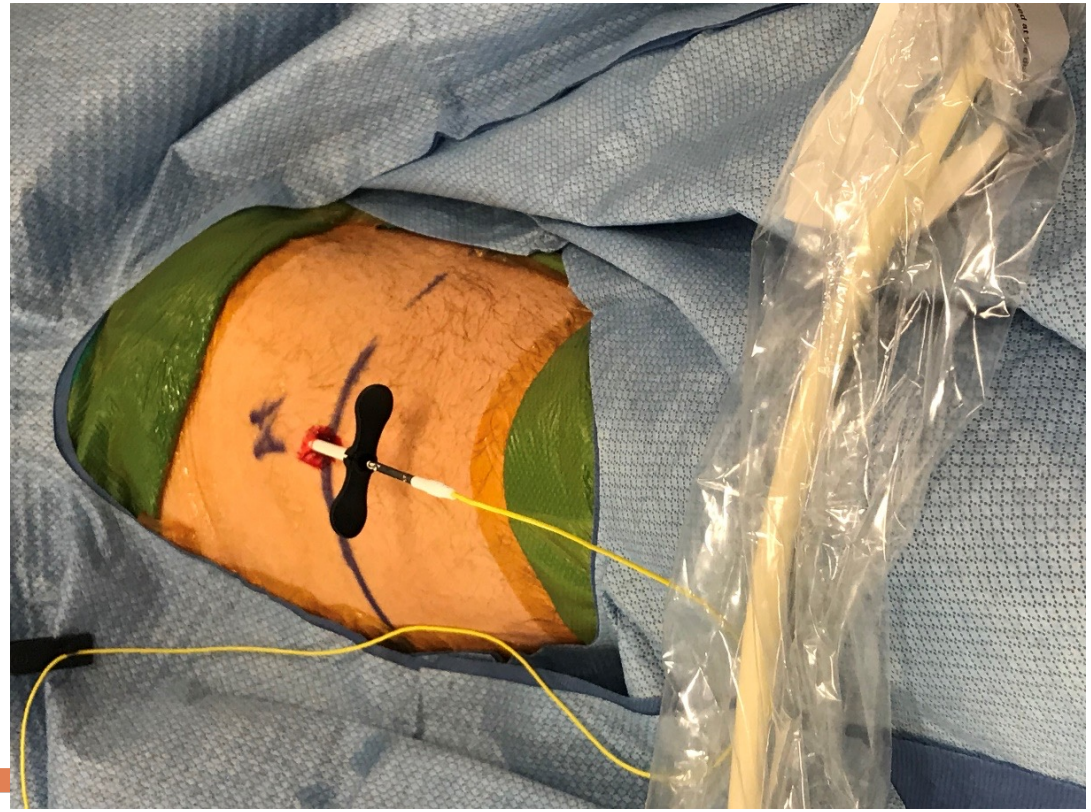


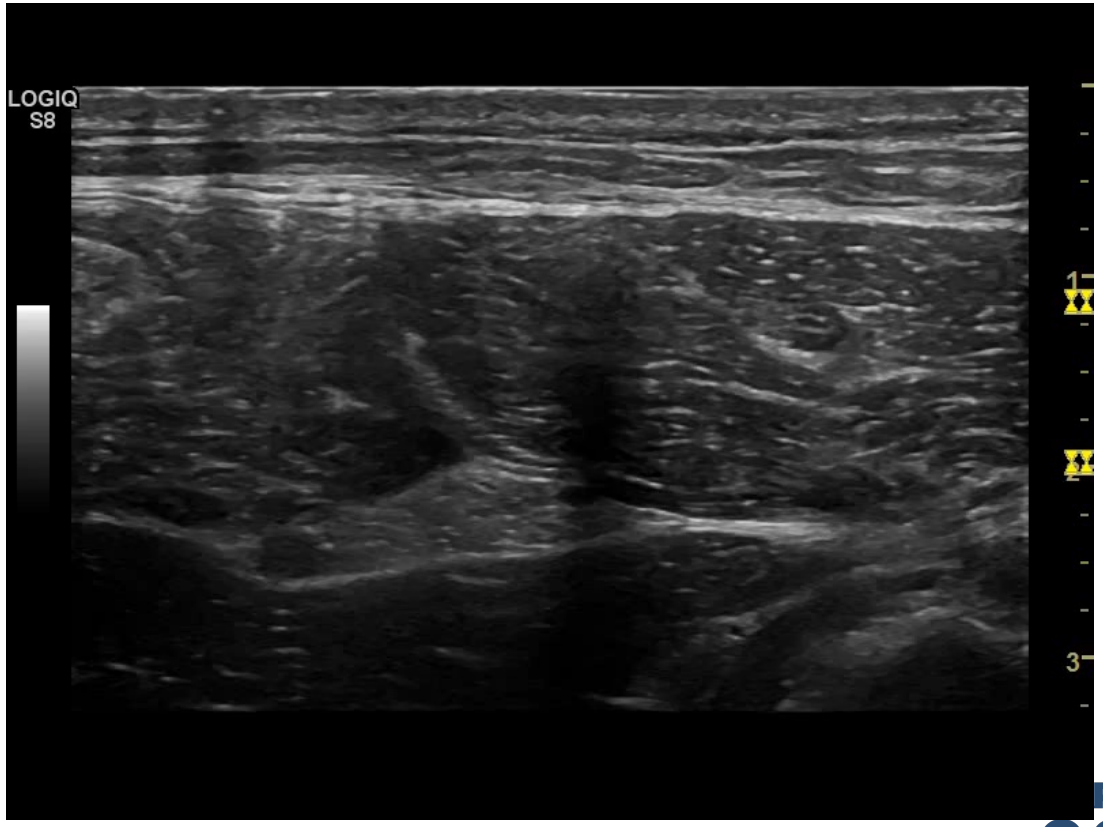
Sciatic Nerve Stimulation Probe in Plane View



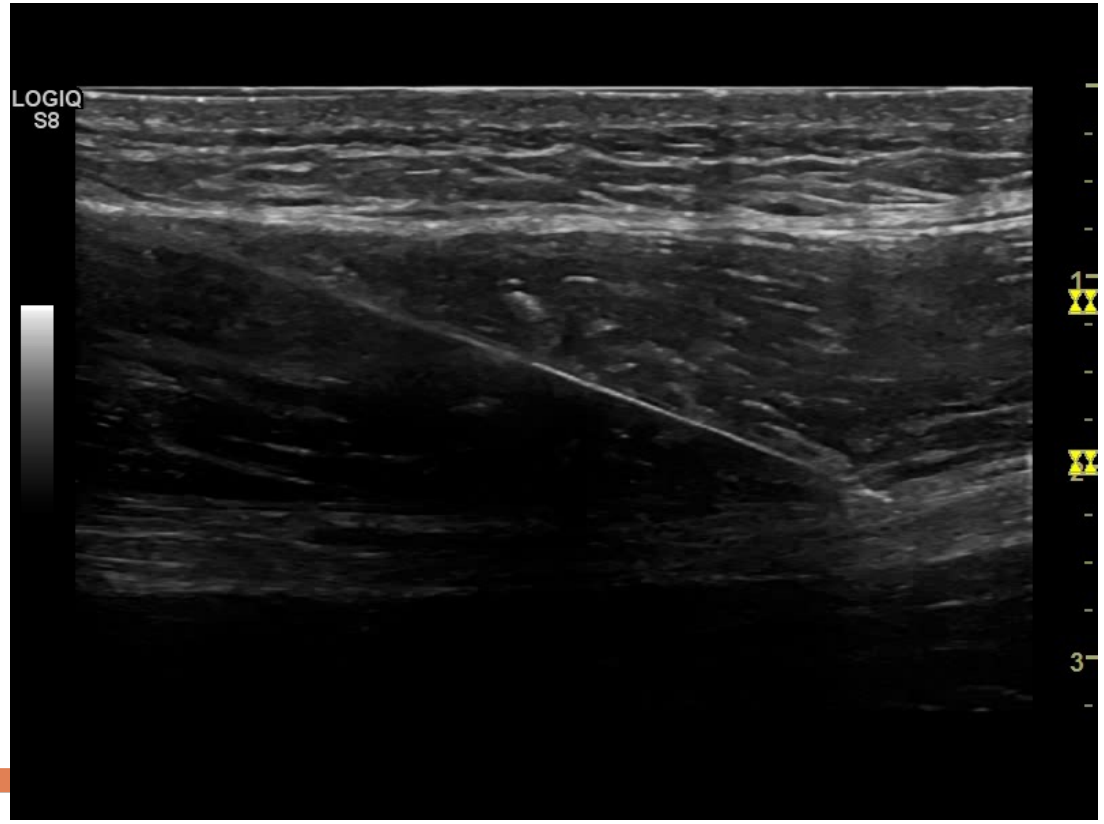


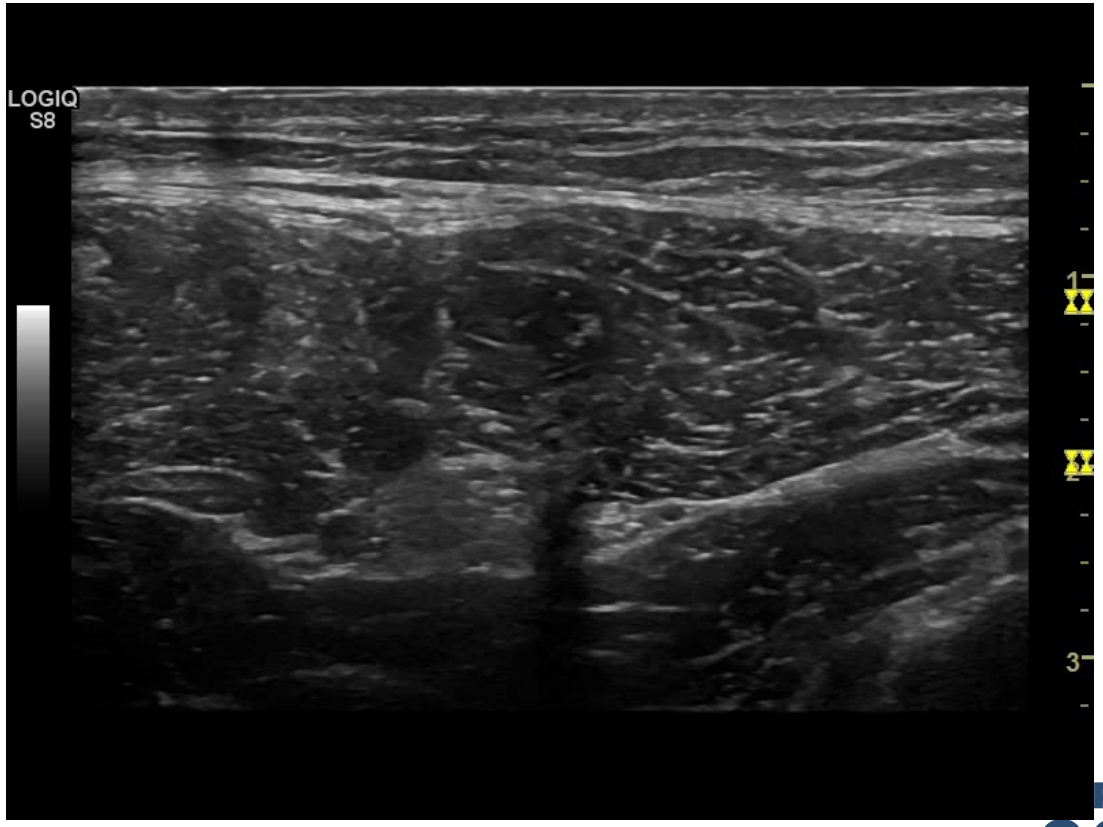
Sciatic Nerve with Introducer



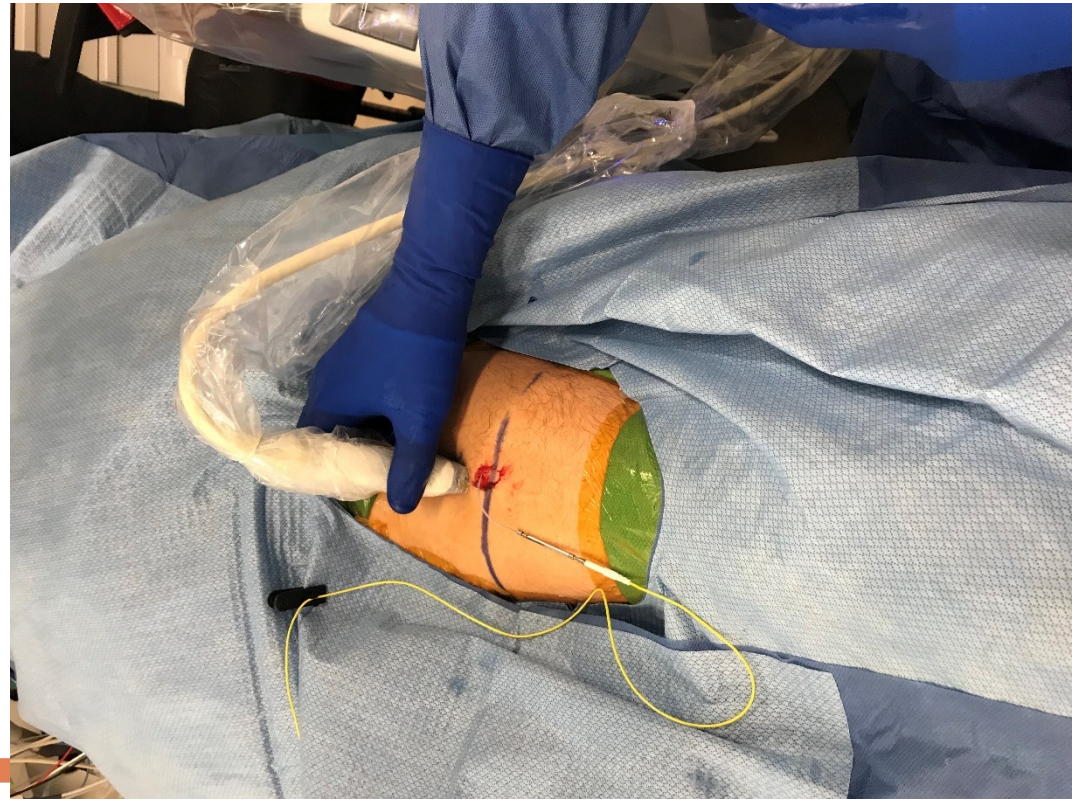


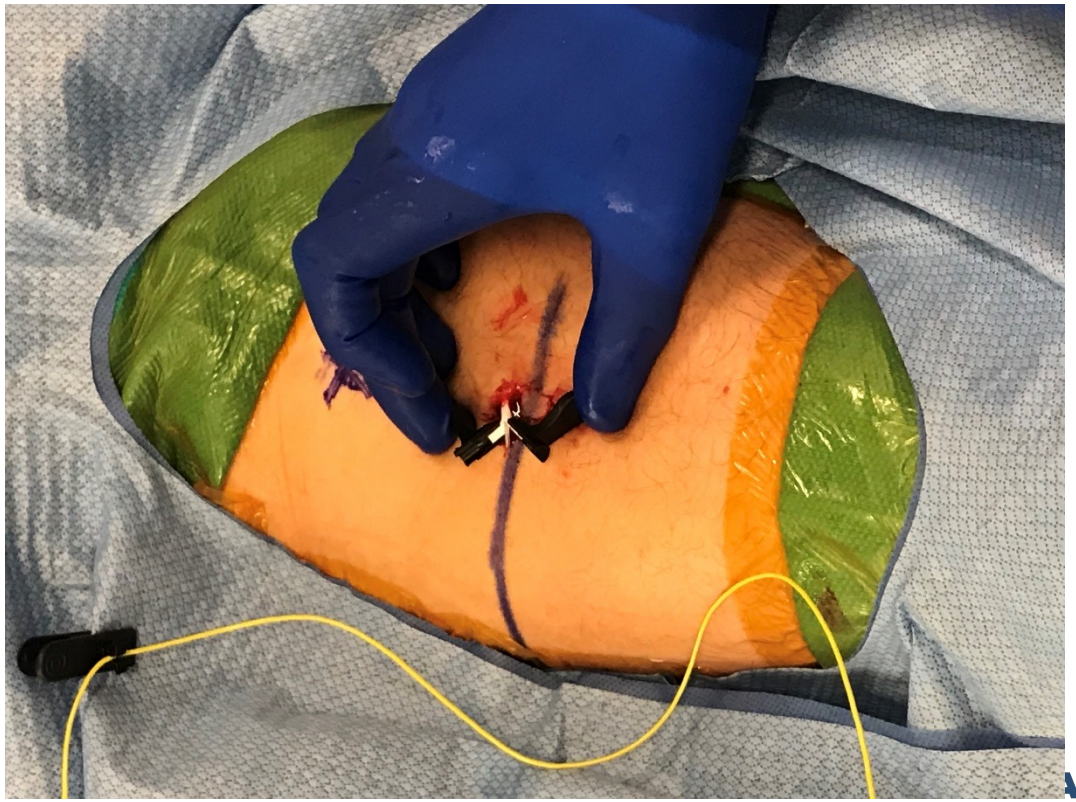
Sciatic Nerve Lead in Distal Introducer



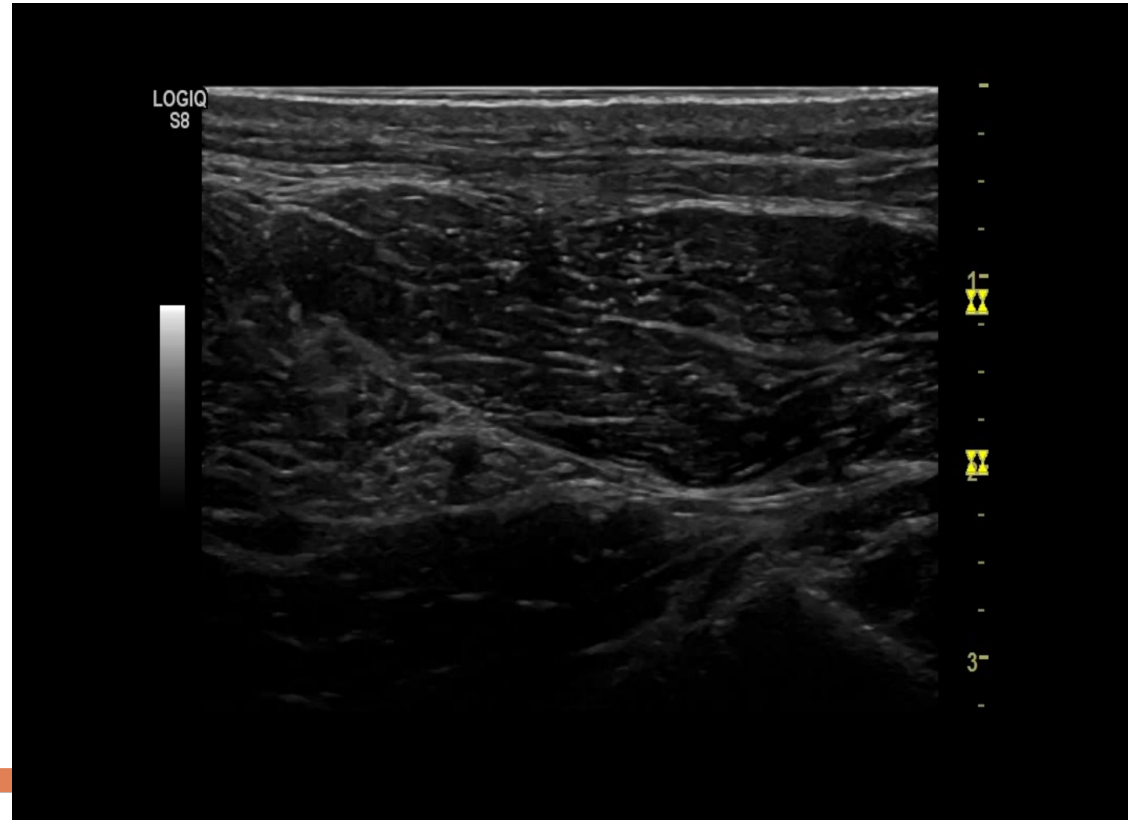


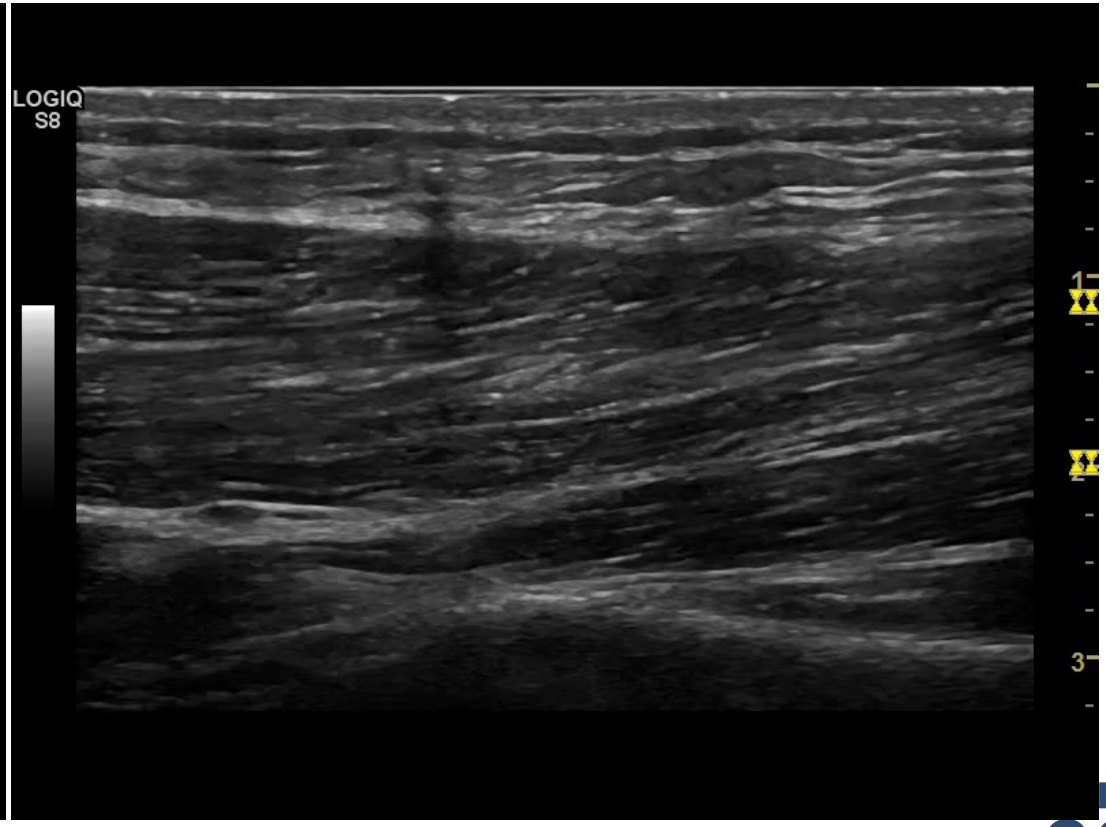
Sciatic PNS Burying Lead





Marking Lead and Antenna Location

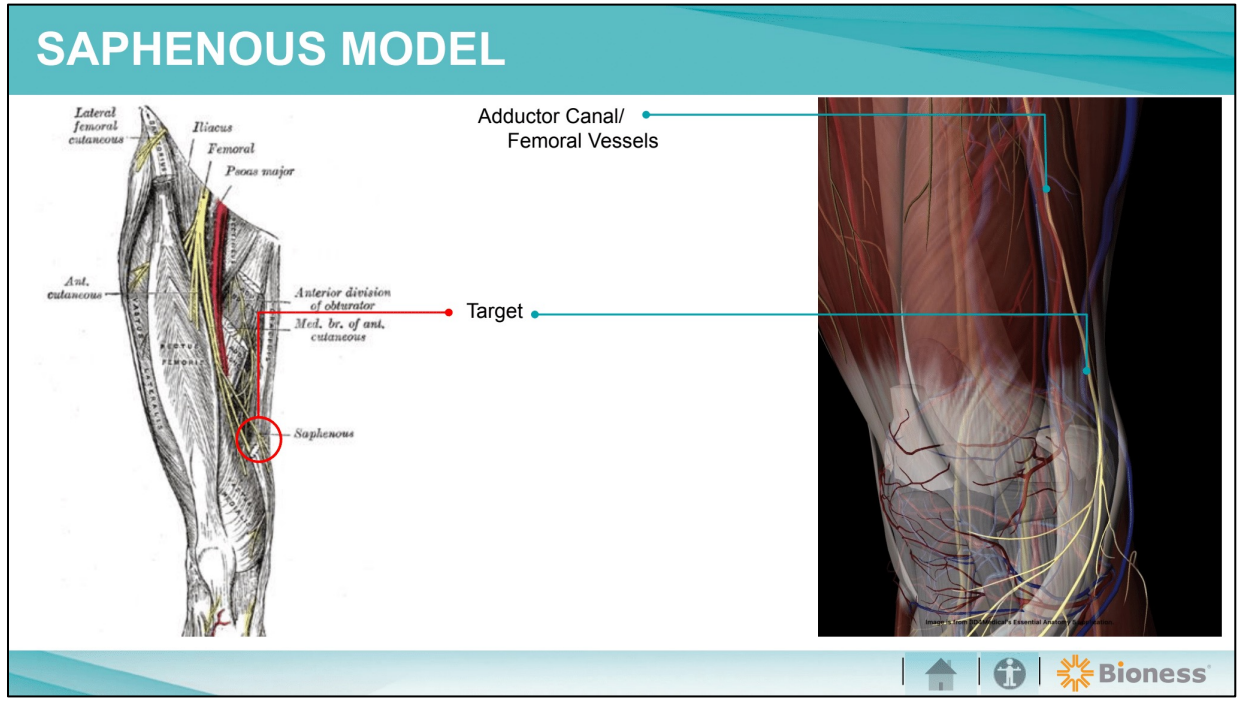




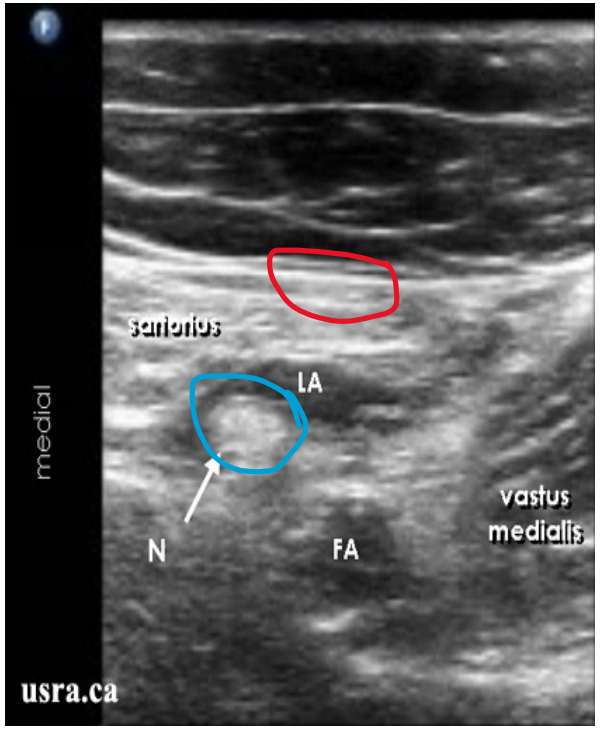
EPT location

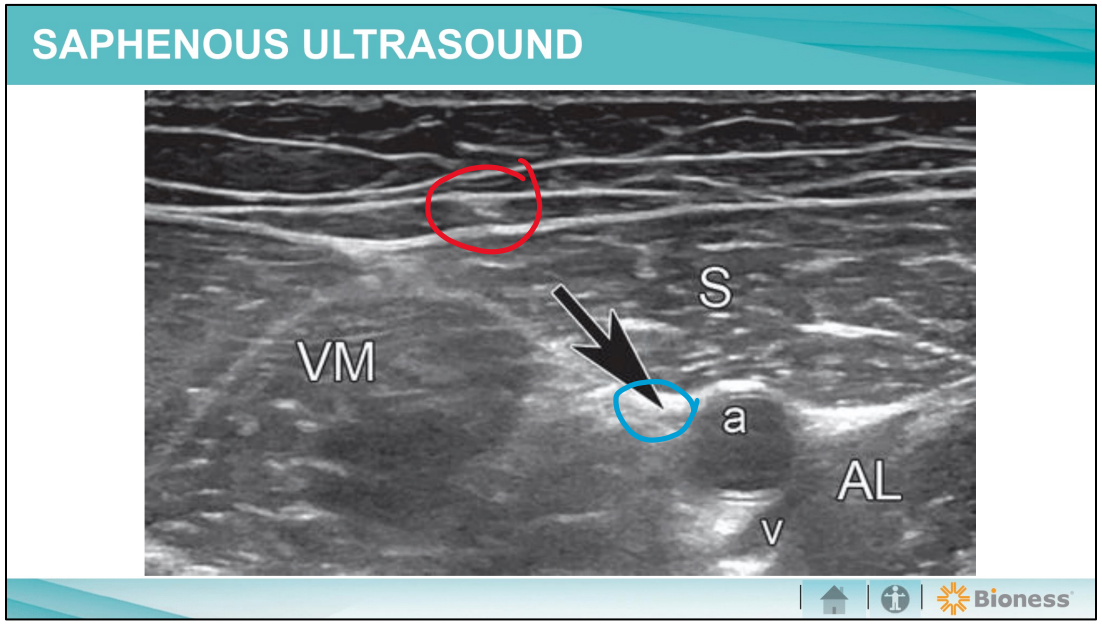
PNS of the Saphenous Nerve

- Top referrals for this nerve include Orthopedic Surgery for patients before OR after TKA.
- Infrapatellar branch of the Saphenous Nerve versus other Saphenous lead locations?
- In many TKA procedures a Saphenous nerve branch is cut, causing post-op chronic pain.



- Saphenous Nerve easy to find on ultrasound near FA under sartorius.
- Infrapatellar branch over sartorius.

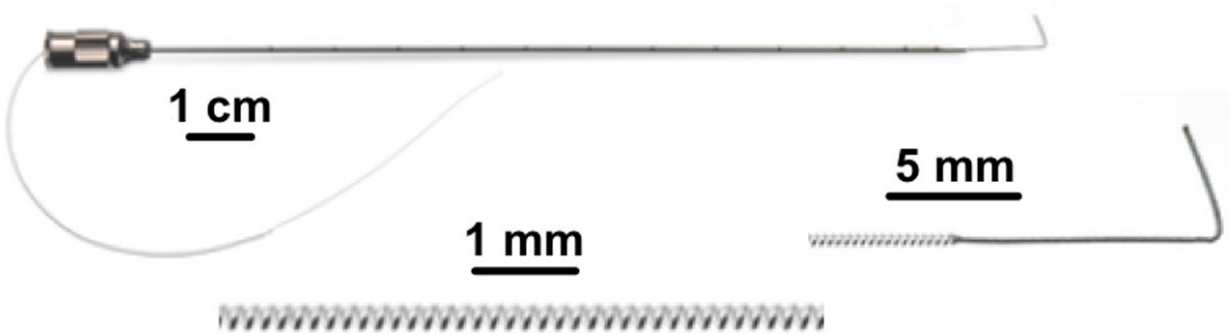




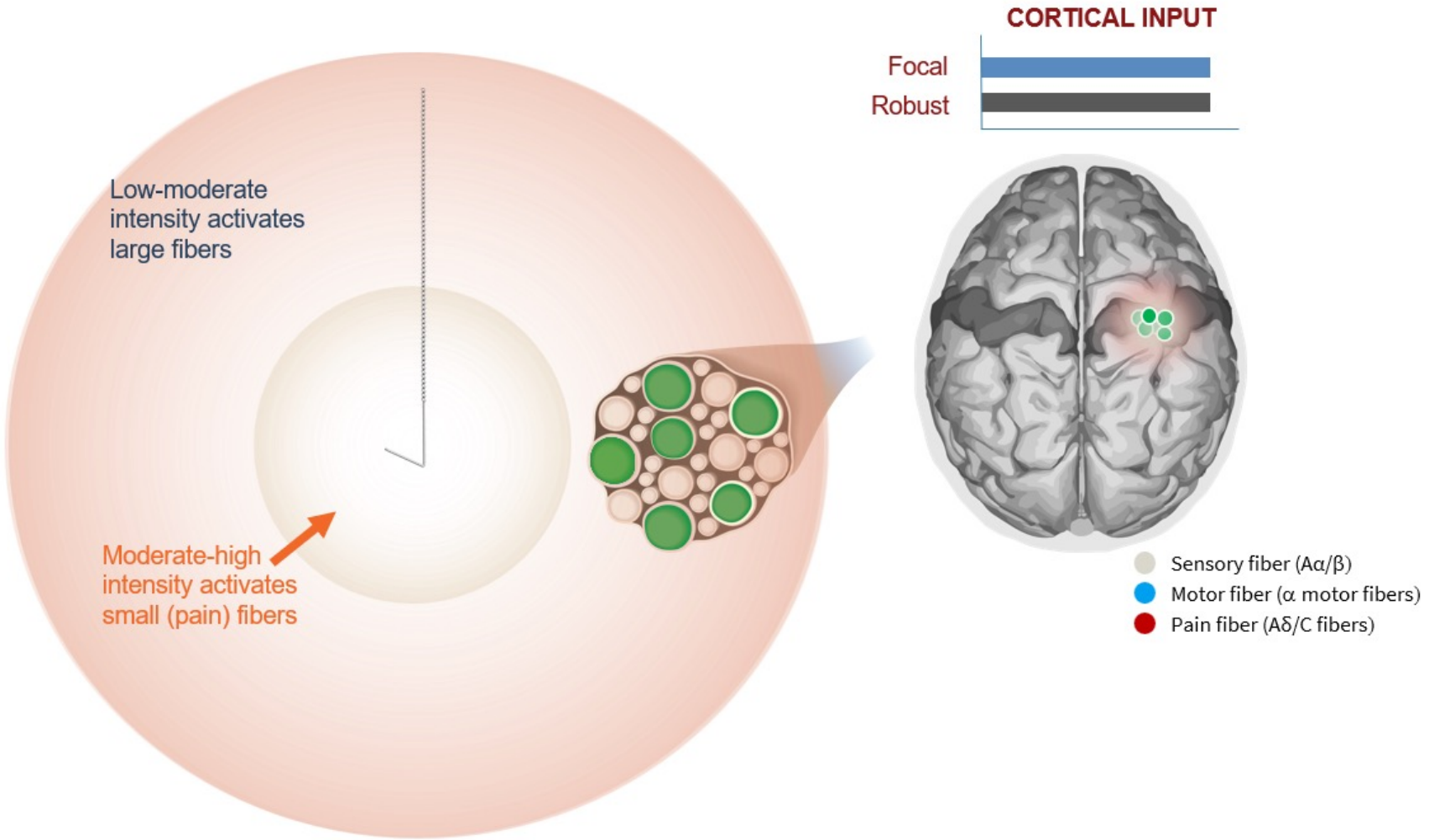
Infrapatellar Saphenous PNS Implant

Temporary PNS

B

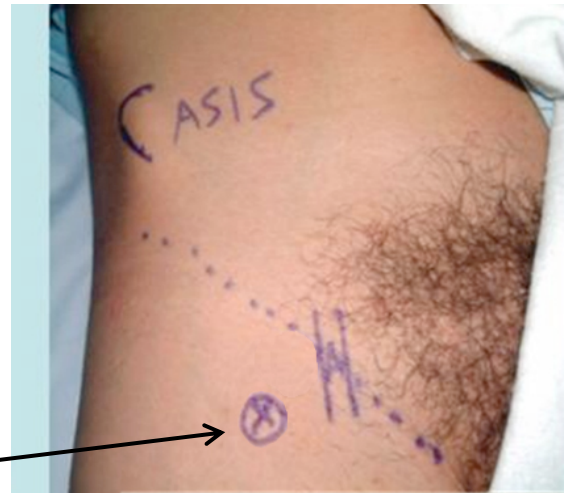


- *Percutaneous delivery (20 gauge)*
- *No incisions, tunneling, anesthesia*
- *Ultrasound-guided placement*
- *Intentionally reversible*
- *Pain relief following 60-day therapy*
- *Cleared for treatment of chronic and acute pain*

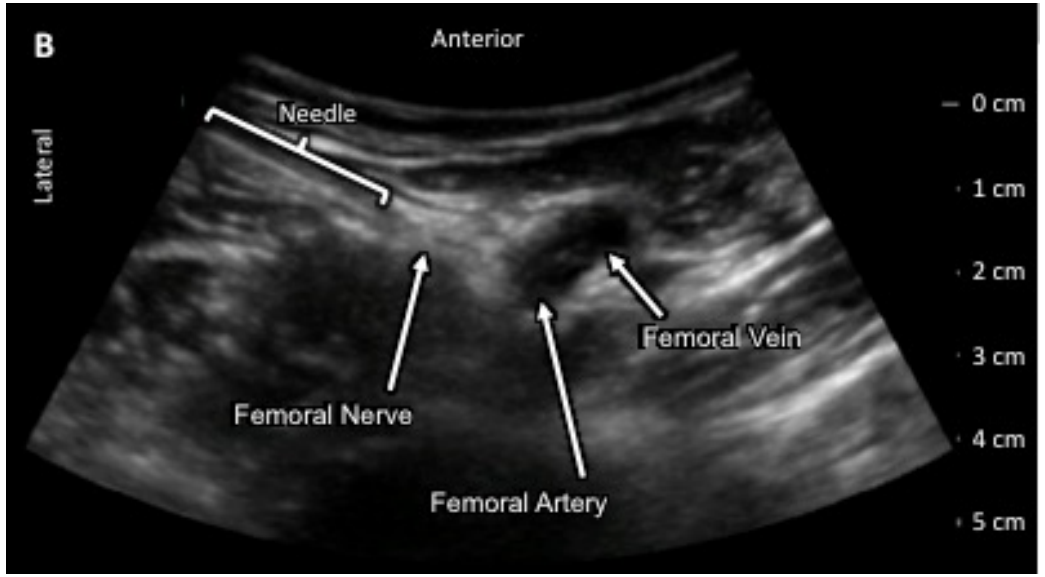

CORTICAL INPUT
Focal
Robust
Low-moderate intensity activates large fibers
Moderate-high intensity activates small (pain) fibers
Sensory fiber (Aα/β)
Motor fiber (α motor fibers)
Pain fiber (Aδ/C fibers)

Femoral PNS Placement

Lead insertion location

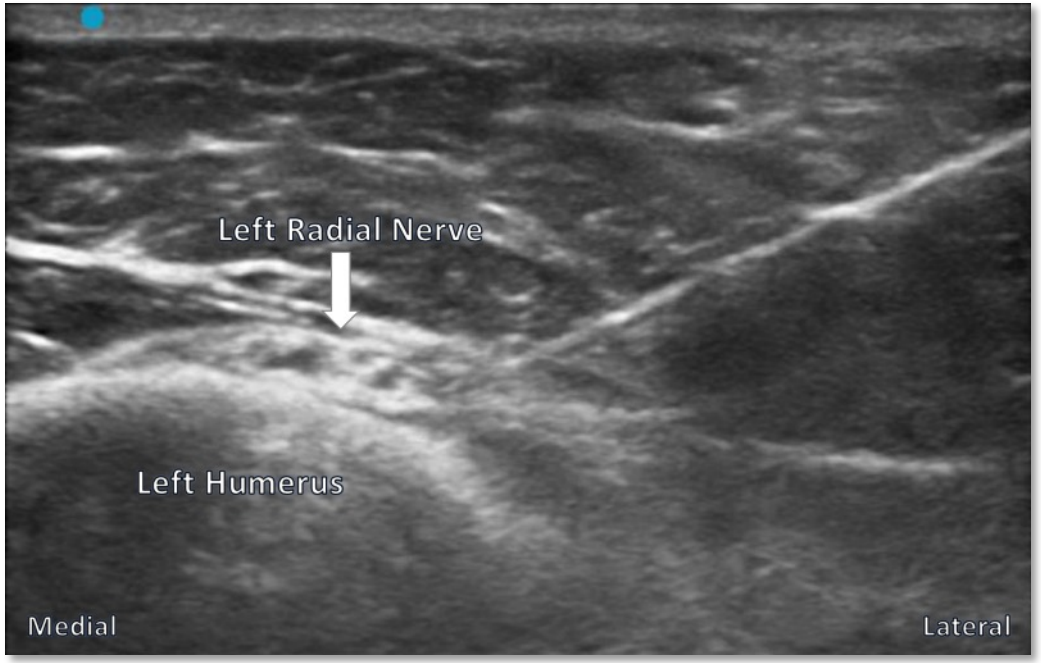


Ultrasound Image



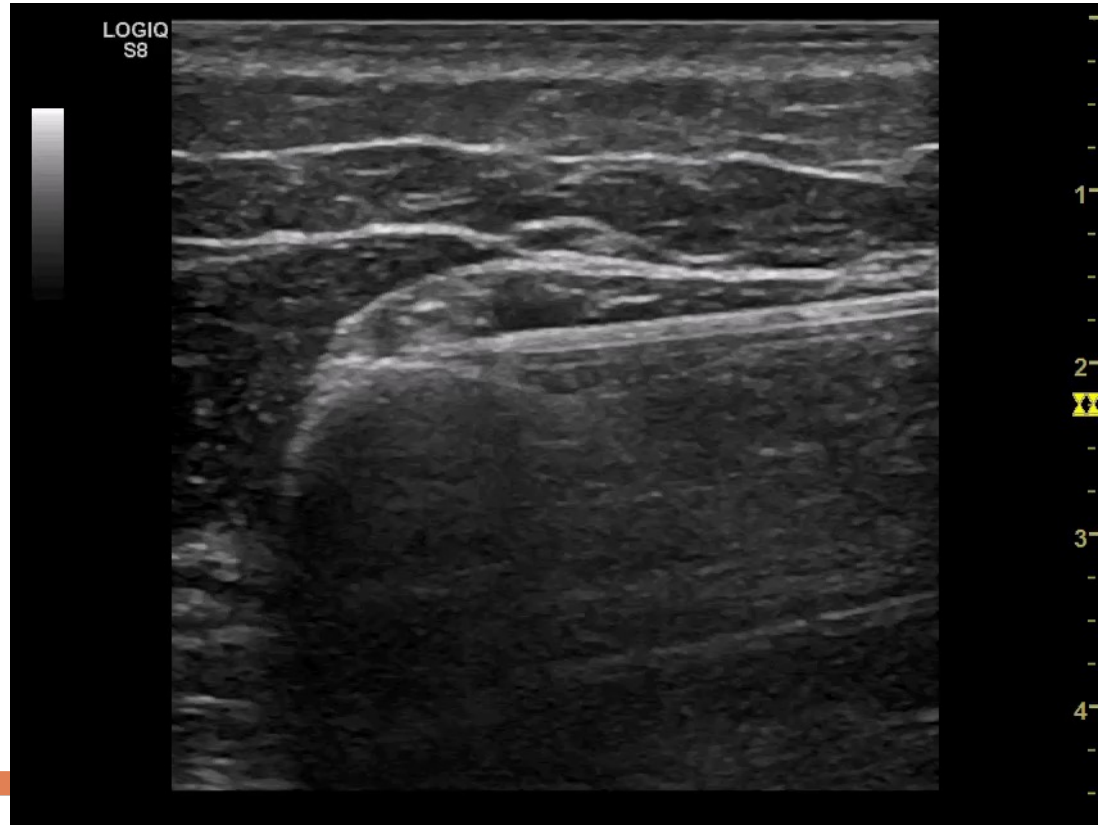
Anatomy images from usra.com. Ultrasound images from Rauck et al . 2013

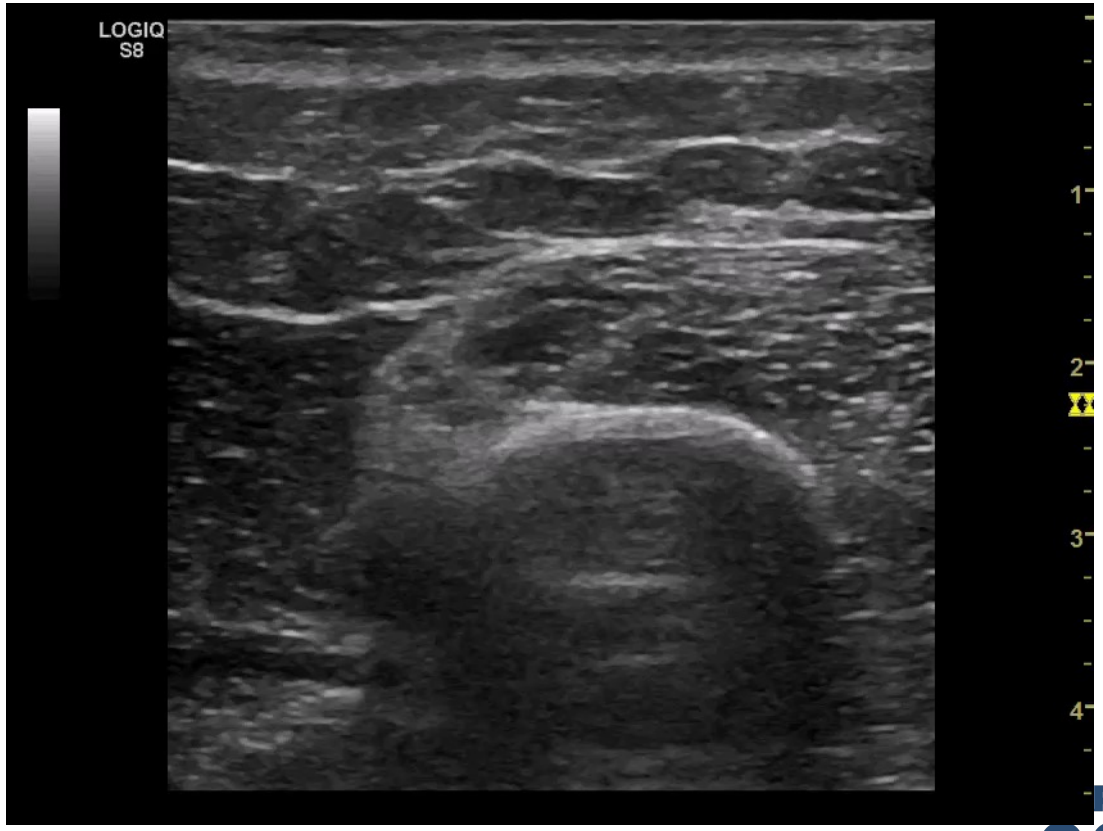
Radial Nerve in Spiral Groove



Photos: Scott Pritzlaff, MD

Radial Nerve Implant



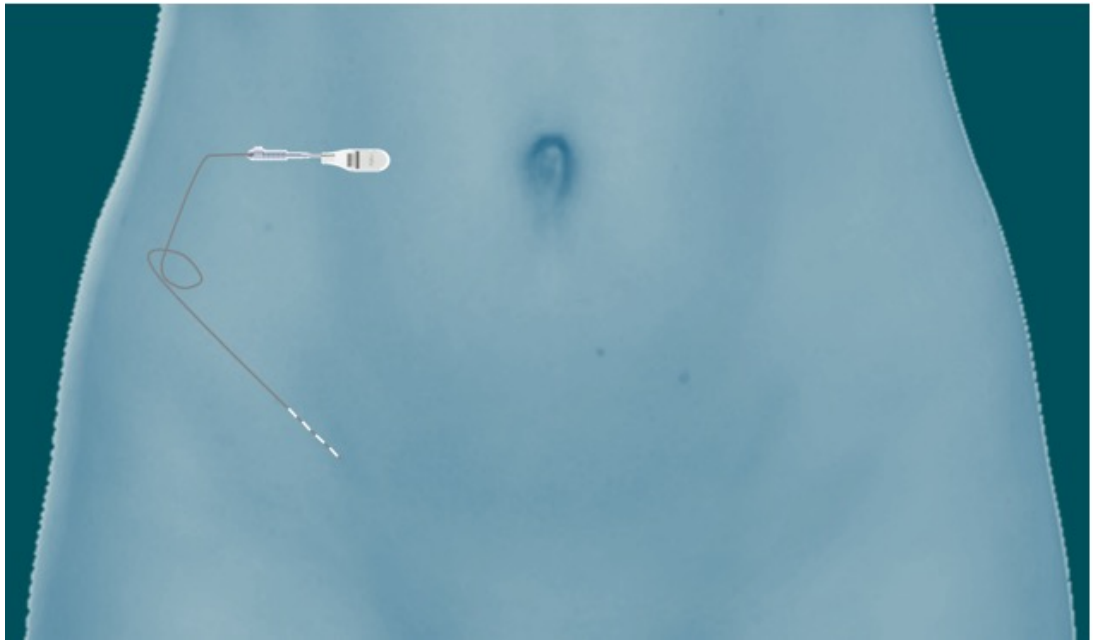


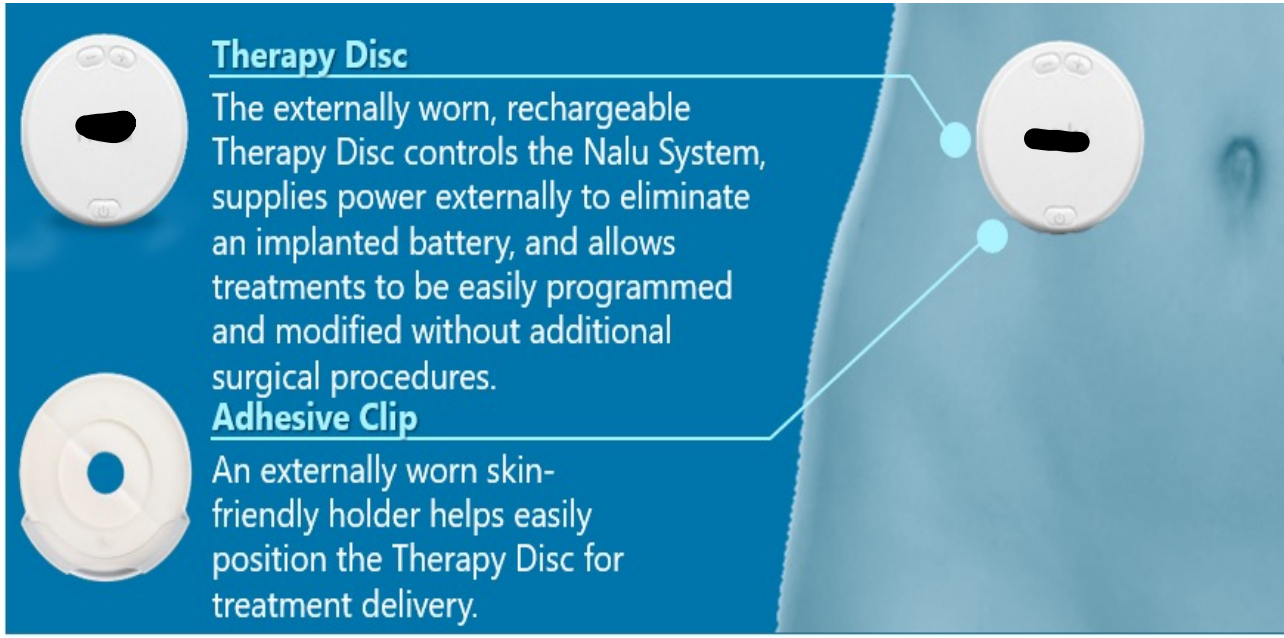
Temporary Implants: Intercostal and Thoracic Selective Spinal Nerve

Multipolar Implant

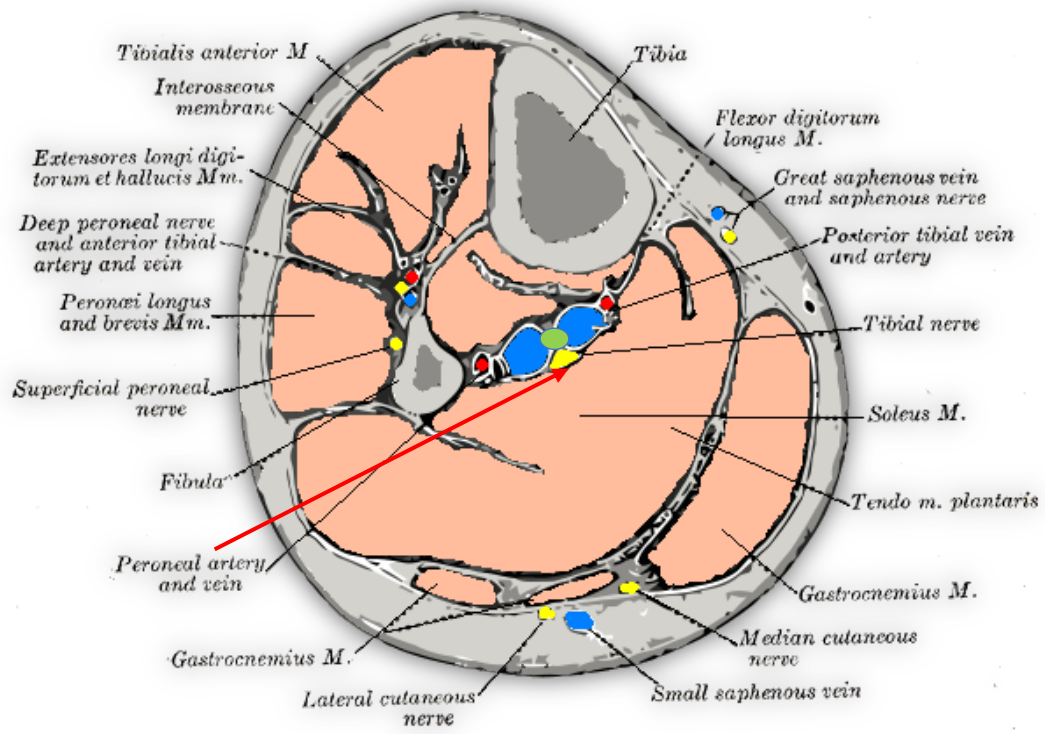
4-contact tined lead (PNS) | 8-contact lead (SCS/PNS) | Single 4-contact IPG (PNS) | Single 8-contact IPG (SCS/PNS) | Dual 8-contact IPG (SCS/PNS)

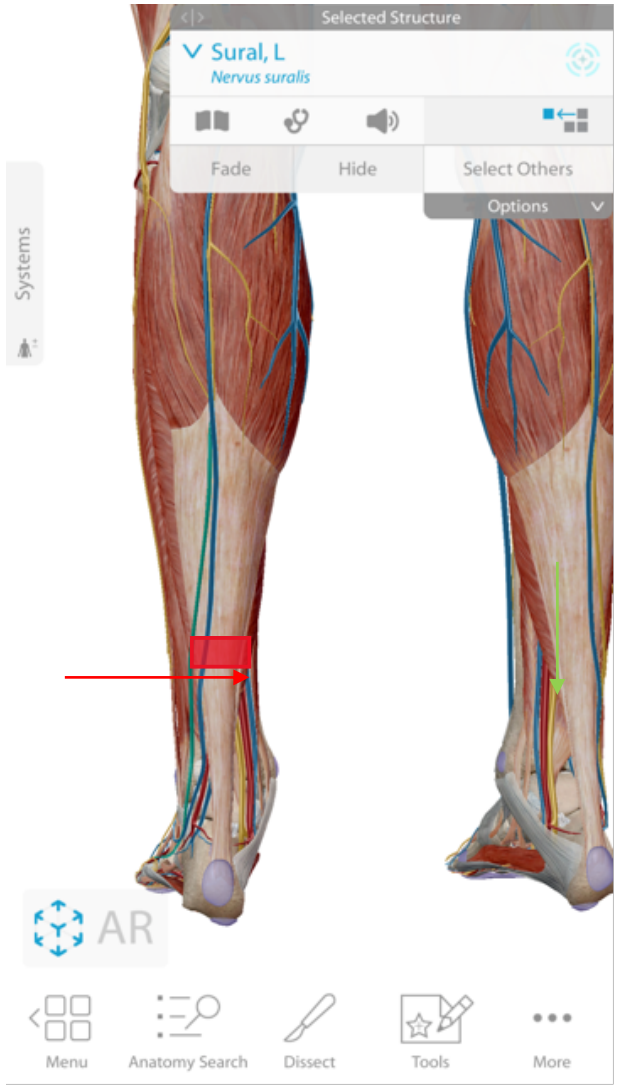
Permanent Implant





Tibial Nerve Implant Perpendicular Parallel





- 62 YO Female
- 14 years of bilateral plantar foot pain due to small fiber neuropathy
- Tried conservative treatments
  - Multiple medications
  - Nerve blocks
  - SCS trial
  - Temporary PNS treatment
  - Permanent PNS system
- Two systems were then implanted on both the L and R legs
- 4 contact tined leads with single ported iPG

Procedure Overview

Introducer Placement

Lead placement
proximal to distal

iPG pocketing
Using the Nalu pocket tunneler

Impedance & paresthesia check
Using the therapy disc and iPG

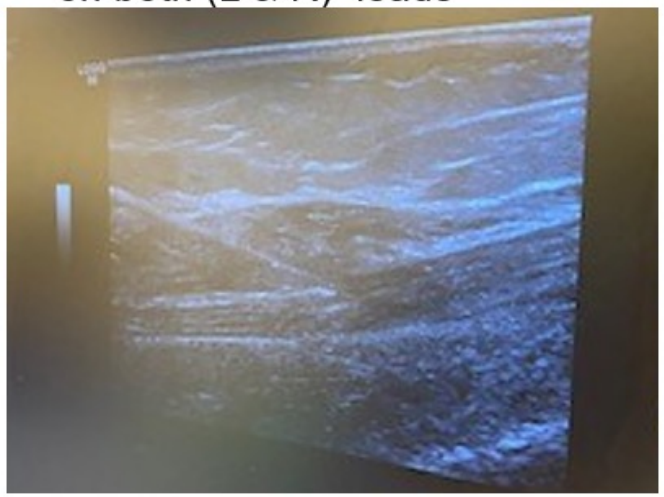
iPG Placement

Approach:

Both leads were placed parallel to the nerve

Approached proximal to distal

Tested impedance and paresthesia distribution on both (L & R) leads



Long axis view of the tibial nerve, and an in-plane view of the introducer approaching the tibial nerve

Outcome:

Patient has reported 70% pain relief

Pain score from a 10 to a 3

Ability to do daily activities such as walk her (4) dogs, cook & swim

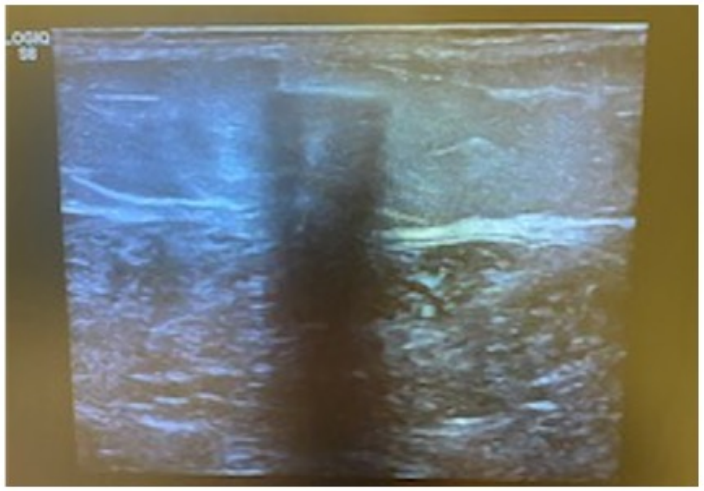
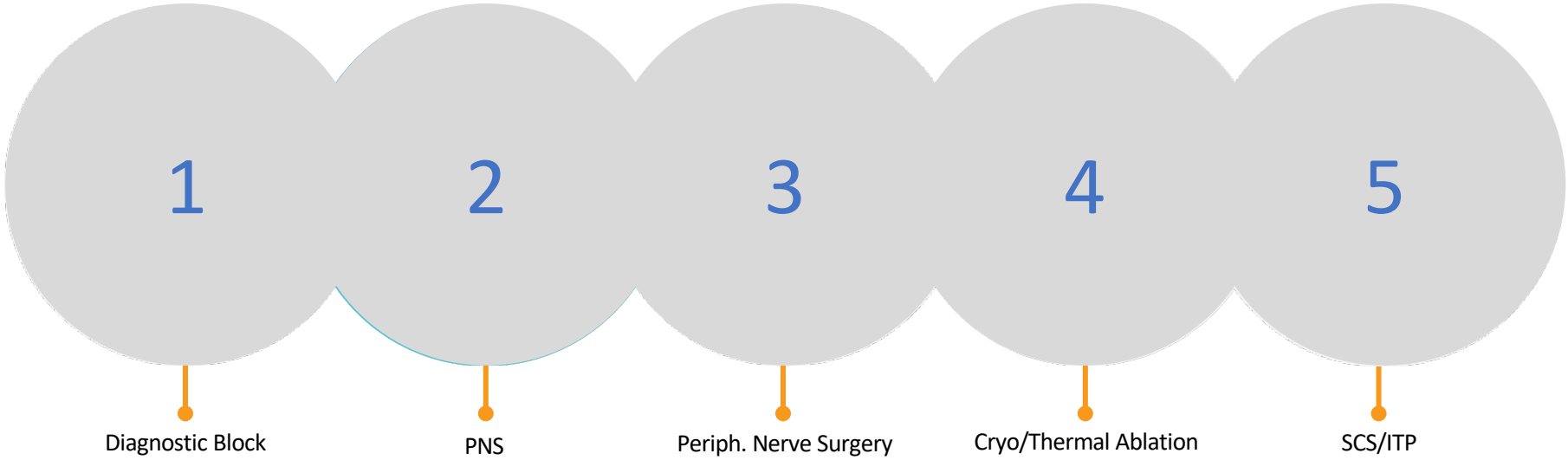


Image of the iPG in the pocket

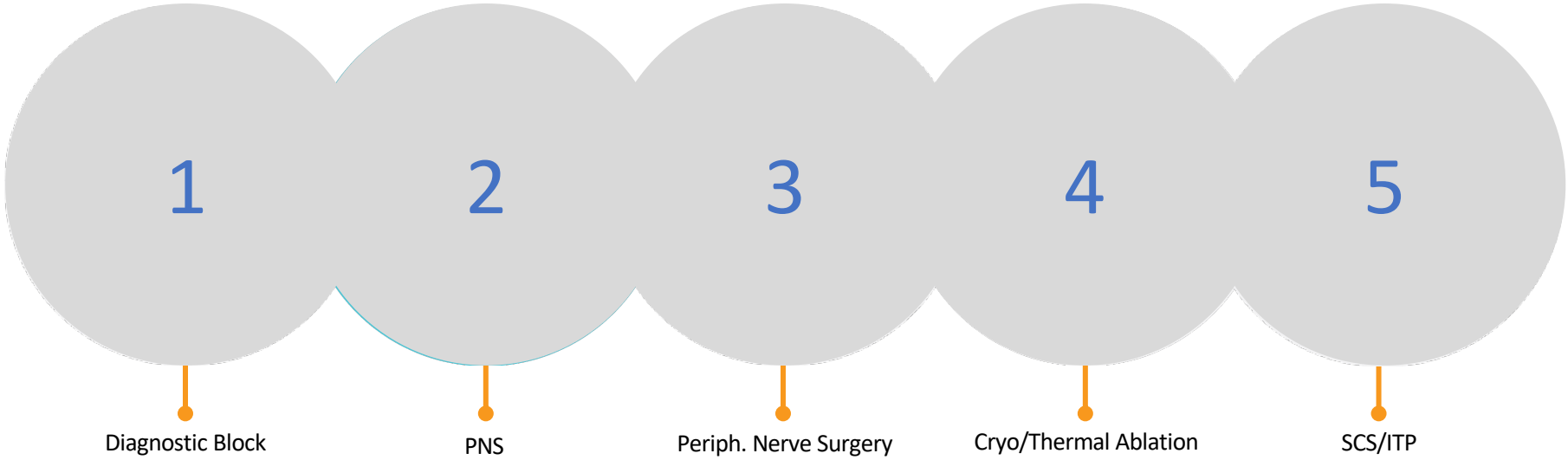
Implant Video

- Scott Pritzlaff, MD
- UC Davis

New Treatment Algorithm

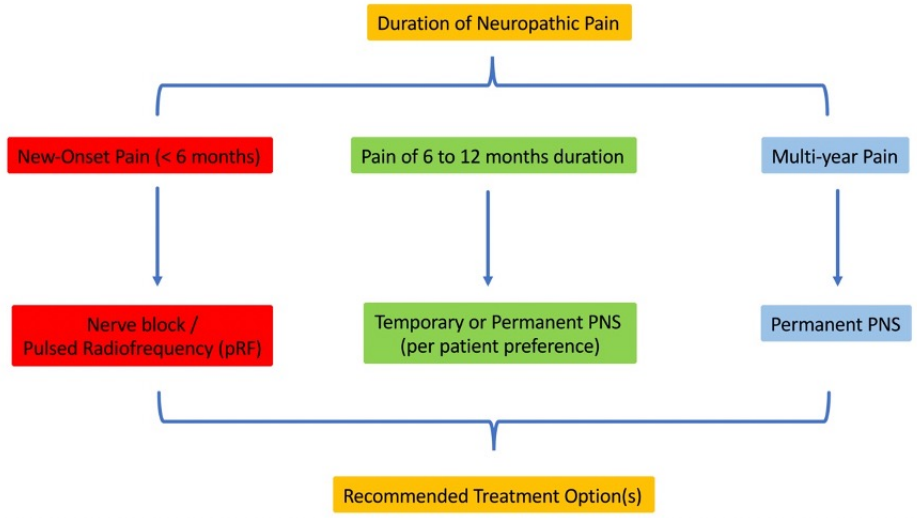


New Treatment Algorithm



Conclusion

- Multiple options for PNS
- Temporary or permanent
- Single or multiple electrodes
- Increasing levels of evidence



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AAPM 2022 38TH ANNUAL MEETING