EMORY UNIVERSITY SCHOOL OF MEDICINE | Department of Anesthesiology

Demystifying peripheral nerve stimulation

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DISCLOSURES

- Salary support as a KL2 scholar (mentored career development award) from 08/18 to 07/20 at Georgia Clinical and Translational Science Alliance, supported in part by the National Center for Advancing Translational Sciences of the National Institutes of Health under Award number UL1TR002378 and KL2TR002381

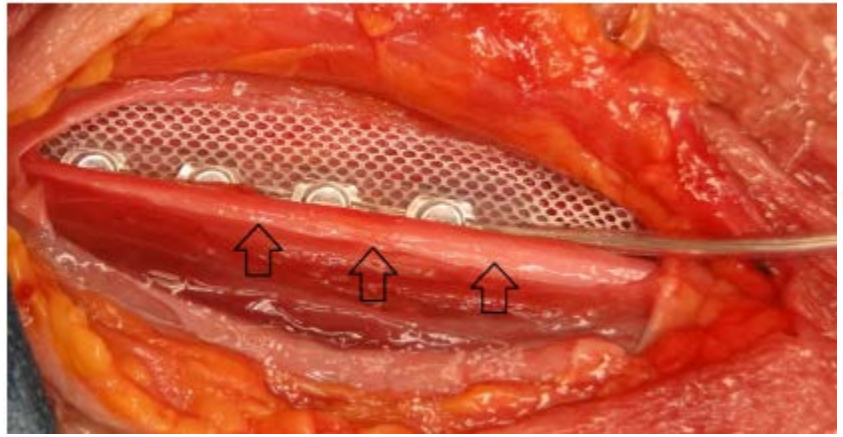
- Scientific Advisory Board, Releviate LLC

OBJECTIVES

- General considerations for PNS
- Types of PNS available
- Evidence
- Technique tips

PERIPHERAL STIMULATION INCLUDES

- Open PNS
  - Off label Paddle
  - Off label SCS leads
  - Cuff electrodes

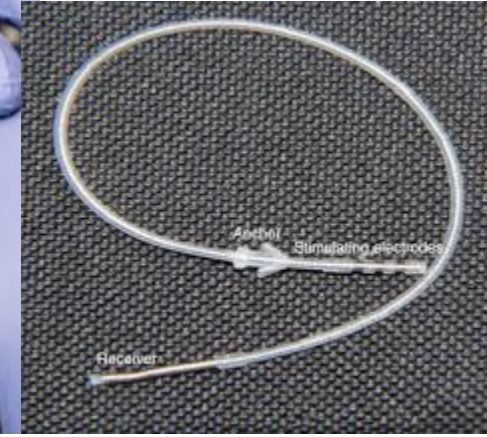


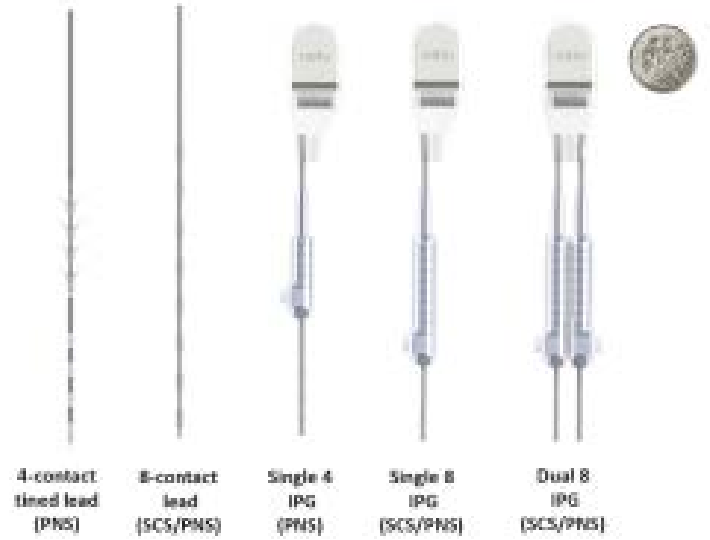
- Peripheral Field Stimulation

- Peripheral nerve stimulator
  - First introduced by Patrick Wall and William Sweet in the 1960s when they reported on the use of the therapy for craniofacial pain.

PNS ON THE RISE!

- Why?
- 4 companies with external pulse generator/battery available, allowing for percutaneous approach
  - Stimrouter/bioventus
  - Stimwave/StimQ
  - Sprint
  - Nalu
- Can implant leads with minimal incision
  - Often just a stab incision that may heal with just dermabond or require 1-2 sutures





FDA APPROVED PNS OPTIONS

Stimrouter/Bioventus, Stimwave/StimQ, and Nalu

- Indicated for chronic intractable pain of peripheral nerve origin.

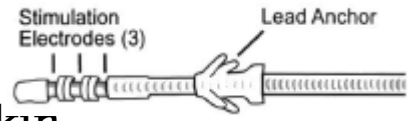
Sprint/SPR (intentionally reversible)

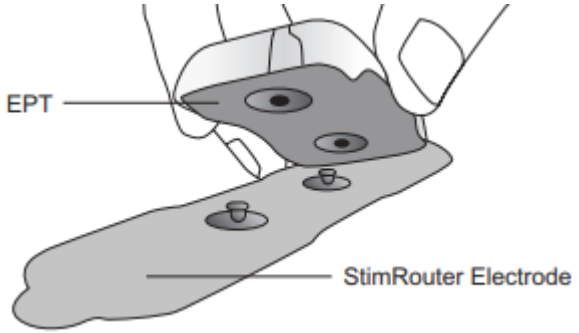
- Indicated for up to 60 days for:
  - Symptomatic relief of chronic, intractable pain, post-surgical and post-traumatic acute pain.
  - Symptomatic relief of posttraumatic pain; and
  - Symptomatic relief of postoperative pain.

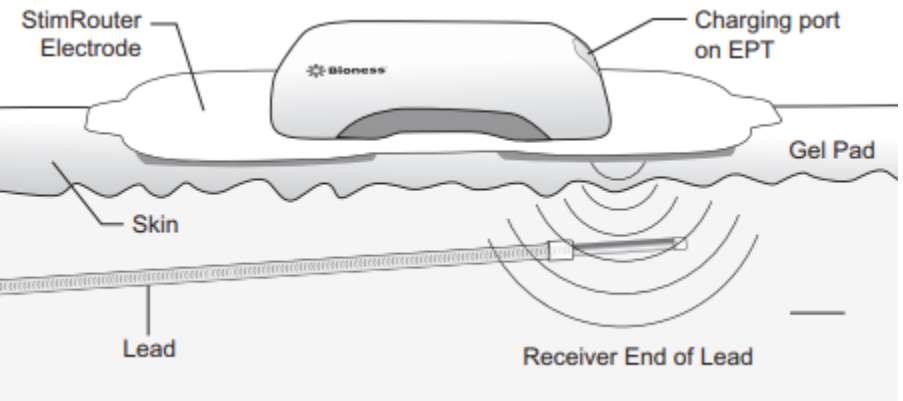
Use for pain of cranial or facial nerve origin is not approved

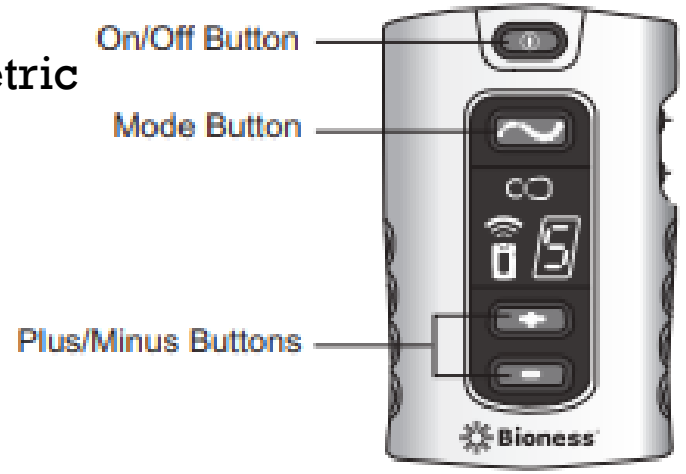
STIMROUTER/BIOVENTUS

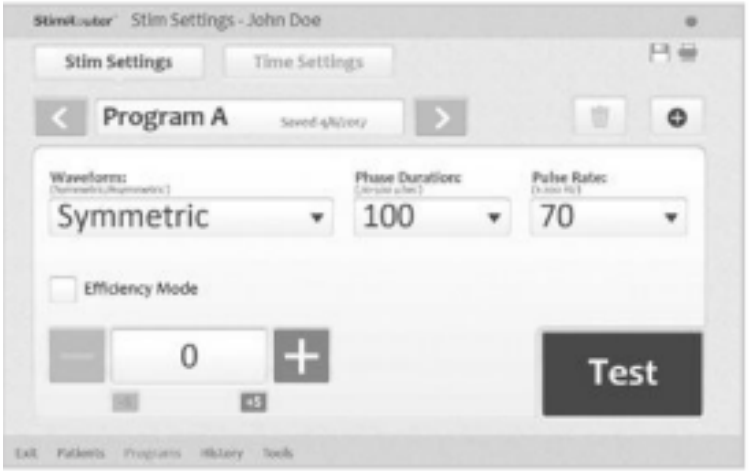
- Stimrouter lead
  - Flexible, 1.2mm dia, ~15 cm, platinum iridium, wrapped in silicone
  - Receiver (proximal part of the lead) and three stimulating electrodes (distal end) are not insulated; each electrode is 1mm long, spaced 1mm from adjacent electrode
  - Four pronged anchor just proximal to electrodes
  - Stimulation end near target nerve, receiver end near skin
- Program settings
  - Frequency/pulse rate- 2.4 to 2.48 GHz (usual 2-200 Hz)
  - Intensity/Amplitude- 0-30 mAmp
  - Pulse width/Duration- 0-2500µSec
  - Waveform-biphasic- symmetric or asymmetric



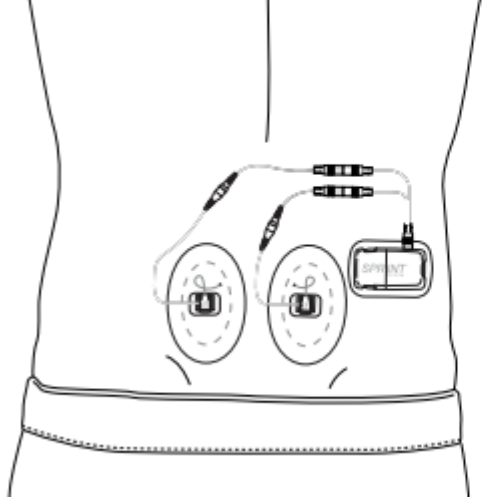


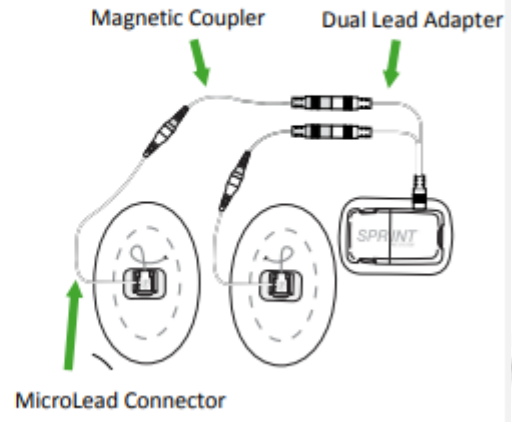




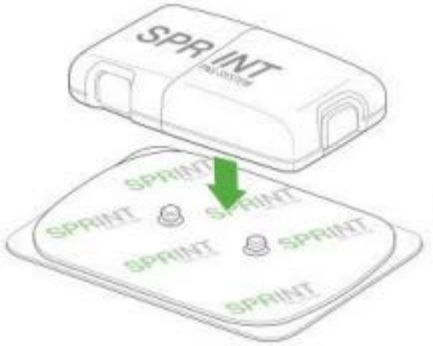


SPRINT



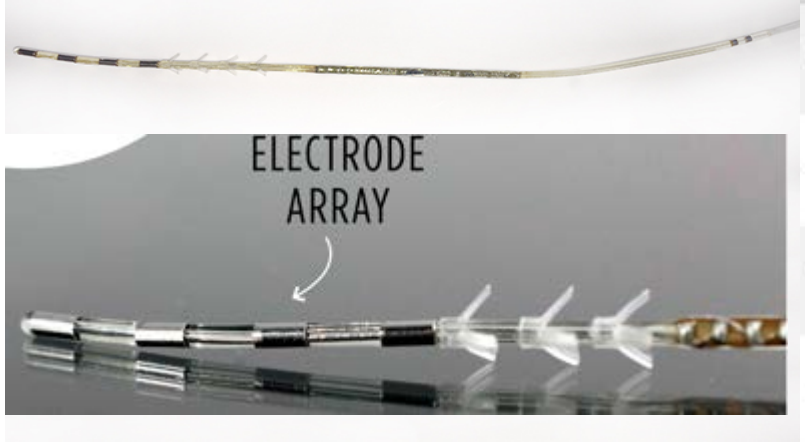


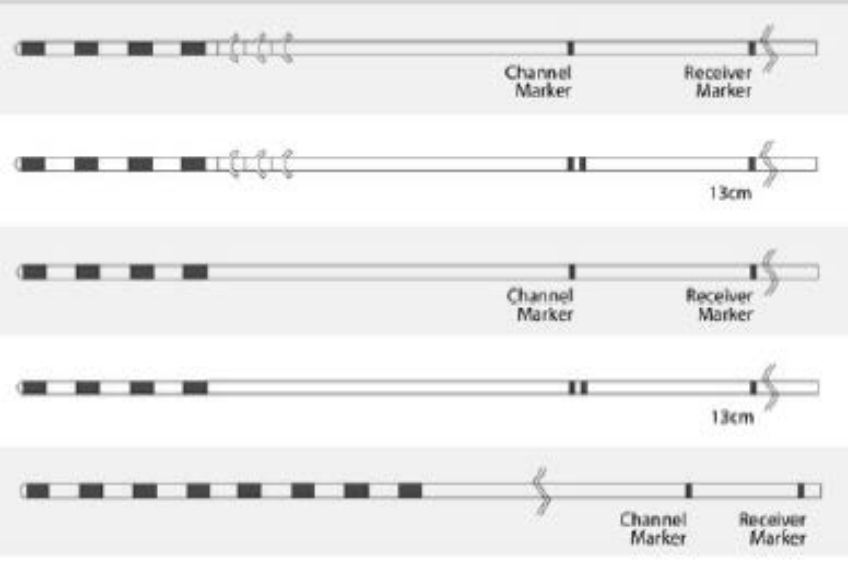
- Sprint lead
  - Thin, thread-like wire, 0.3mm dia. Coiled insulated; uninsulated stimulating surface-1.5 cm at tip
  - The stimulating end is inserted through skin near a nerve, need >3cm under skin; stim probe is 12.5cm
  - The other end remains outside of your body and attaches to the Pulse Generator using the MicroLead Connector and Cables



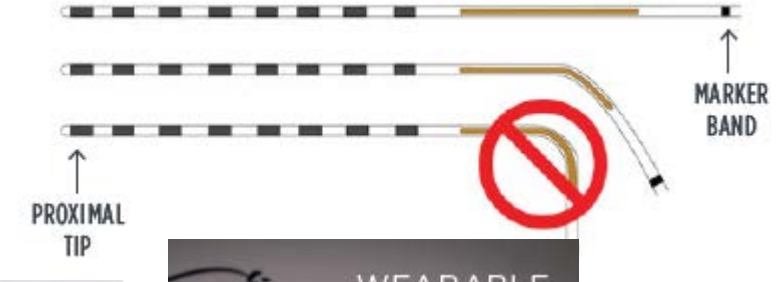
- Program settings
  - Frequency/pulse rate- 12 to 100Hz
  - Intensity/Amplitude- 0-30 mAmp
  - Pulse width/Duration- 10-200µSec
  - Waveform-biphasic

STIMWAVE/STIMQ

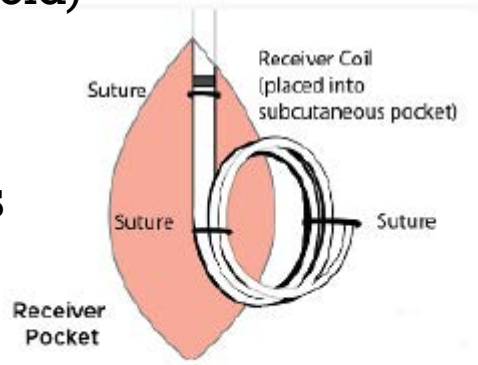


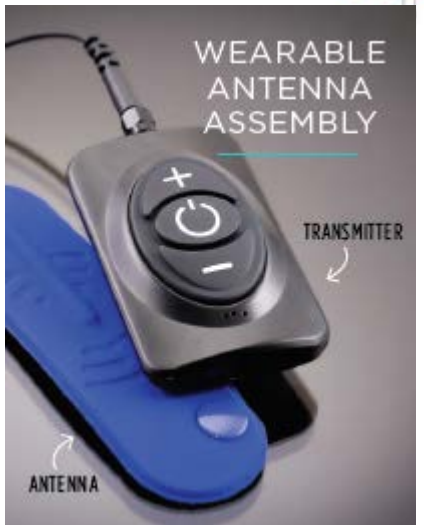


- Stimwave lead
  - Made of polyurethane, 1.35mm dia
  - 4 to 8 electrodes (platinum iridium); for PNS- 4 electrodes used
    - 3mm long, 4mm apart; each can be + to -
  - Tines prevent migration
  - Electrode array behind- 2.4 cm long
  - Channel Marker band from tip- 13 cm; Receiver marker band from tip- 23 cm
  - Length out of kit= 47 cm→ cut after receiver marker band
  - Copper RF receiver wire- 0.35mm wide
  - Maximum recommended implant depth for receiver end- 6cm



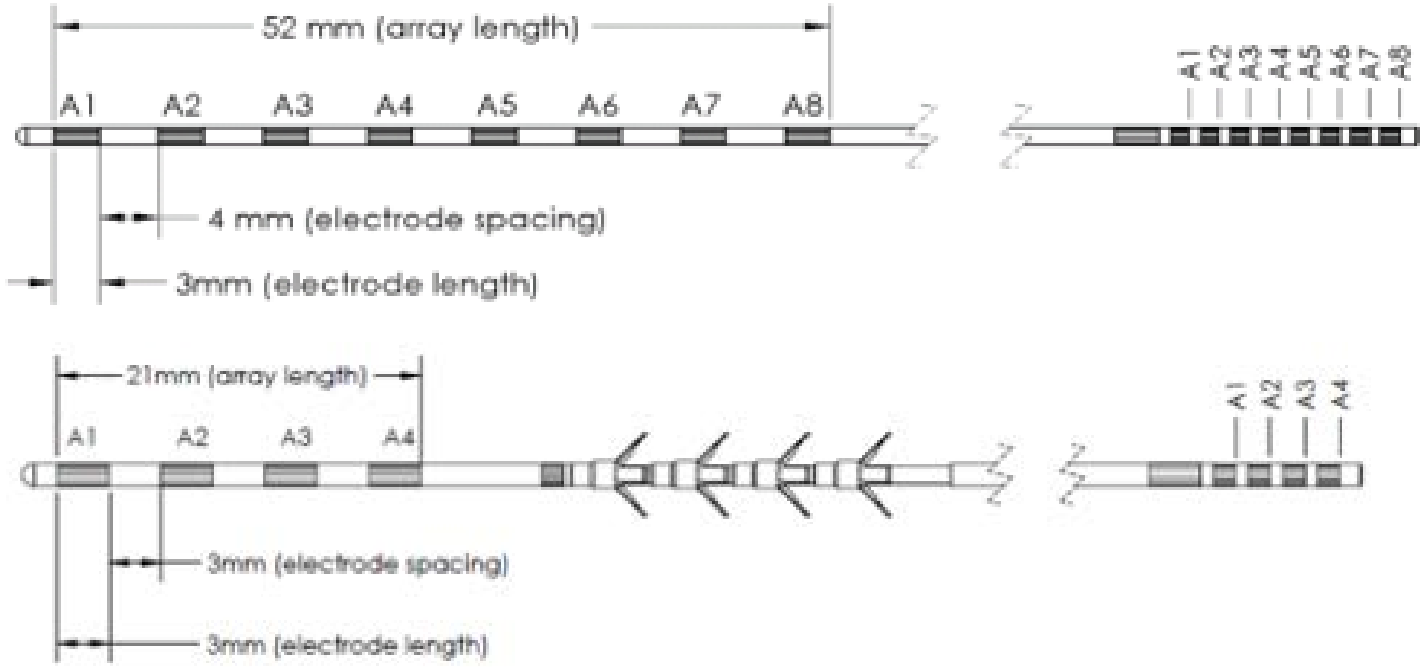
- Program settings
  - Frequency/pulse rate- 5 to 1499 Hz (>500- achieves sub-threshold)
  - Intensity/Amplitude- 0.1-12.7 mAmp
  - Pulse width/Duration- 30-1000μSec
  - Waveform-2 sec on, 16 sec off
    - Possible surge setting (2 sec- 5 quick burst, 16 sec off)- used for SCS



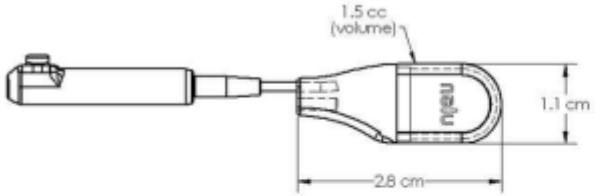


NALU

- Nalu lead
  - Made of polyurethane, 1.3 mm dia
  - 4 to 8 electrodes (platinum alloy)
    - 3mm long, 4 mm apart
  - 4 contact tined for perm
  - Total length 25 to 40 cm
  - IPG connects to the end of the end
- Therapy disc/ battery worn on skin through a adhesive pocket, placed over IPG
- Uses magnetic energy



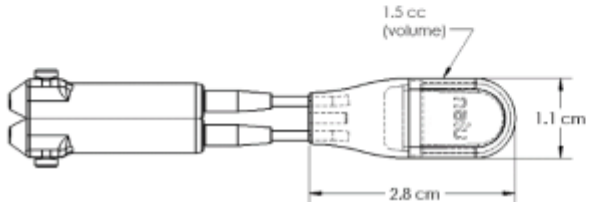
11003-002 **Implantable Pulse Generator (Ported, Single 8)**



Pulse Generator:
Length: 2.8 cm
Thickness: 4.9 mm
Width: 1.1 cm
Volume: 1.5 cc

Number of contacts: 8

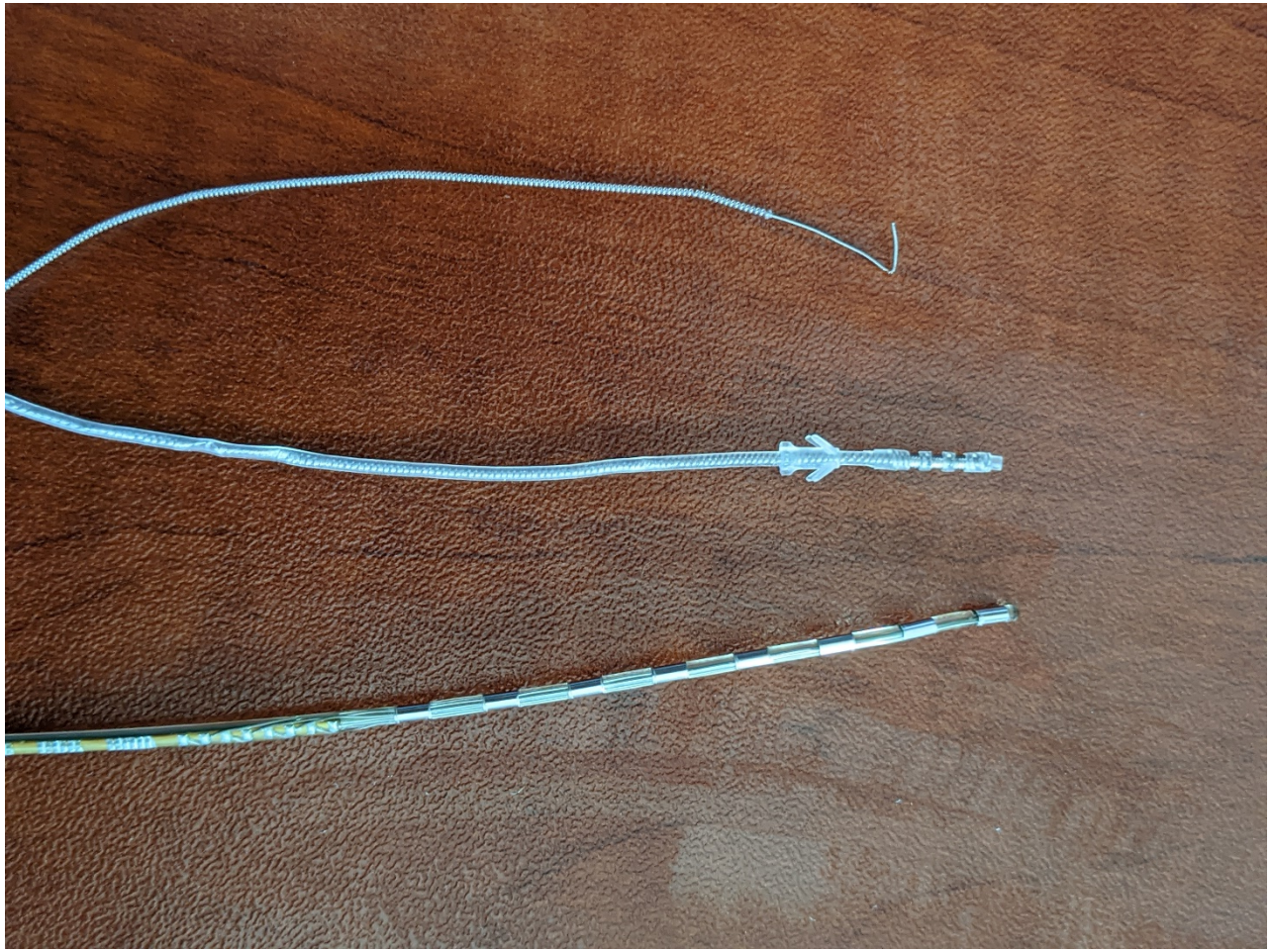
11004-002 **Implantable Pulse Generator (Ported, Dual 8)**



Pulse Generator:
Length: 2.8 cm
Thickness: 4.9 mm
Width: 1.1 cm
Volume: 1.5 cc

Number of contacts: 16

PNS LEADS WITH EXTERNAL PULSE GENERATOR



Feasibility of Ultrasound-Guided Percutaneous Placement of Peripheral Nerve Stimulation Electrodes in a Cadaver Model: Part One, Lower Extremity

Marc A. Huntoon, M.D., Elizabeth A. Huntoon, M.S., M.D., Jon B. Obray, M.D., and Timothy J. Lamer, M.D.

HUNTOON CADAVER FEASIBILITY STUDY

- The criteria for acceptable placement locations included:

  (1) relatively superficial area and where USG guidance and needle placement were possible;

  (2) avoid vascular structures to the extent possible;

  (3) min traversing of muscular tissue (avoidance of unwanted muscular/motor stimulation effects);

  (4) the ability to anchor the device in fascia; and

  (5) proximal locations for common areas of pathology, such as tarsal tunnel syndrome, common peroneal injury at the fibular head, lateral compartment pain, and distal tibial and peroneal nerve injuries.

HUNTOON CADAVER FEASIBILITY STUDY

- Following areas were selected:

  (1) the tibial nerve at a point approximately 8 to 14 cm superior to the medial malleolus,

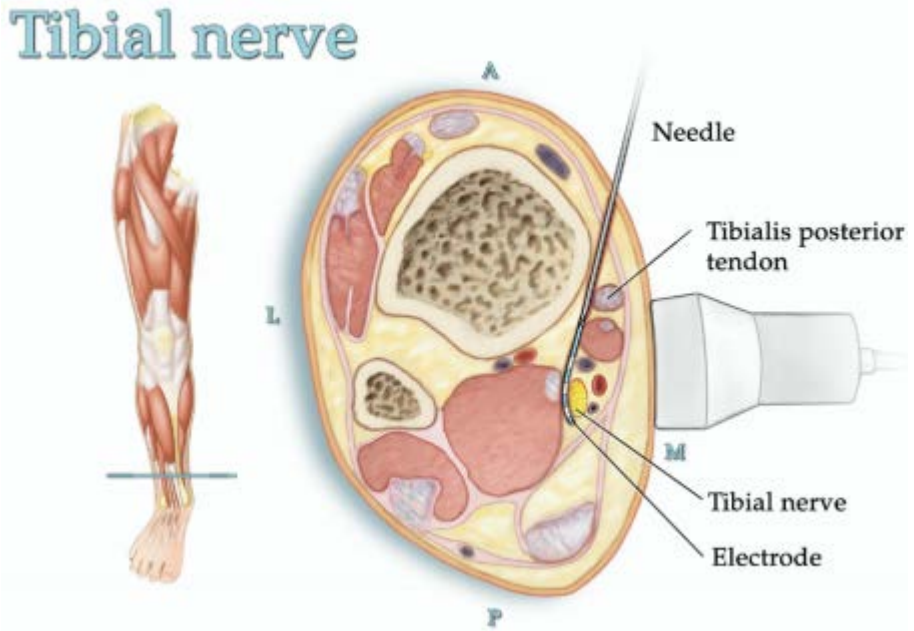
  (2) the tibial and peroneal nerves at 2 locations (the popliteal crease, and a point approximately 10 cm superior to the popliteal crease) in the popliteal fossa, and

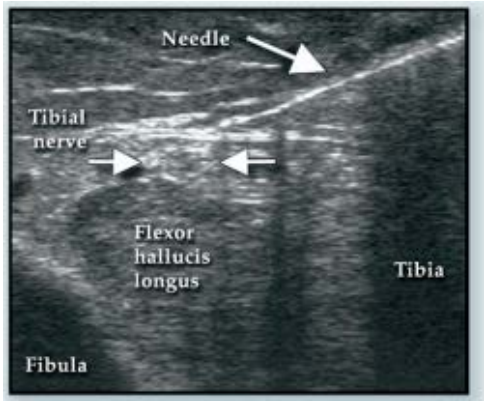
  (3) the peroneal nerve at a point 2 to 4 cm inferior to the lateral fibular head.

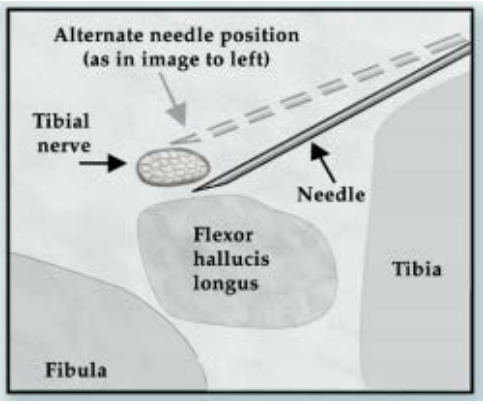
- Each lead was dissected to the area of interest to:

  (1) verify close proximity (within 2 mm) of the lead to the target nerve; and

  (2) verify no transection or grossly visible injury to the nerve







Regional Anesthesia and Pain Medicine
Volume 33, Issue 6, November–December 2008, Pages 558-565

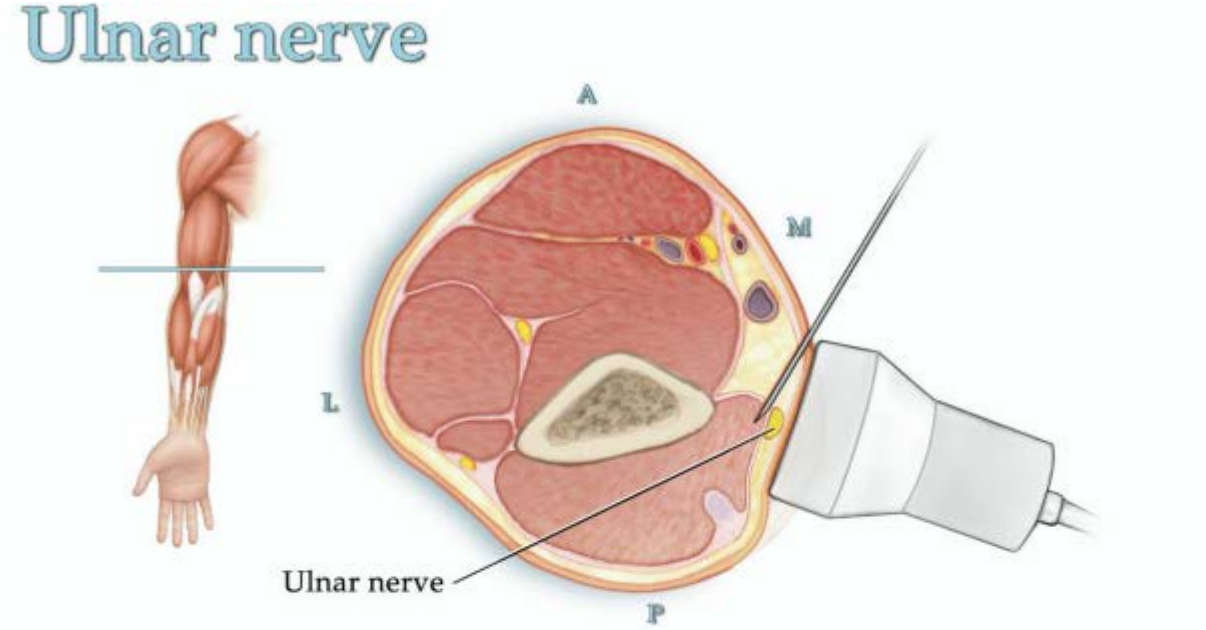
Ultrasound and regional anesthesia

Feasibility of Ultrasound-Guided Percutaneous Placement of Peripheral Nerve Stimulation Electrodes and Anchoring During Simulated Movement: Part Two, Upper Extremity

Marc A. Huntoon M.D. [a], Bryan C. Hoelzer M.D. [a], Abram H. Burgher M.D. [a], Mark Friedrich B. Hurdle M.D. [a, b], Elizabeth A. Huntoon M.S., M.D. [a]

HUNTOON CADAVER FEASIBILITY STUDY

- Following areas were selected:
  - Radial nerve approximately 10-14 cm superior to the lateral epicondyle;
  - Median nerve approximately 6 cm below the antecubital fossa; and
  - Ulnar nerve approximately 9 to 13 cm above the medial epicondyle.
- After careful exposure, visual inspection showed no gross nerve damage.



WHEN TO CONSIDER PNS?

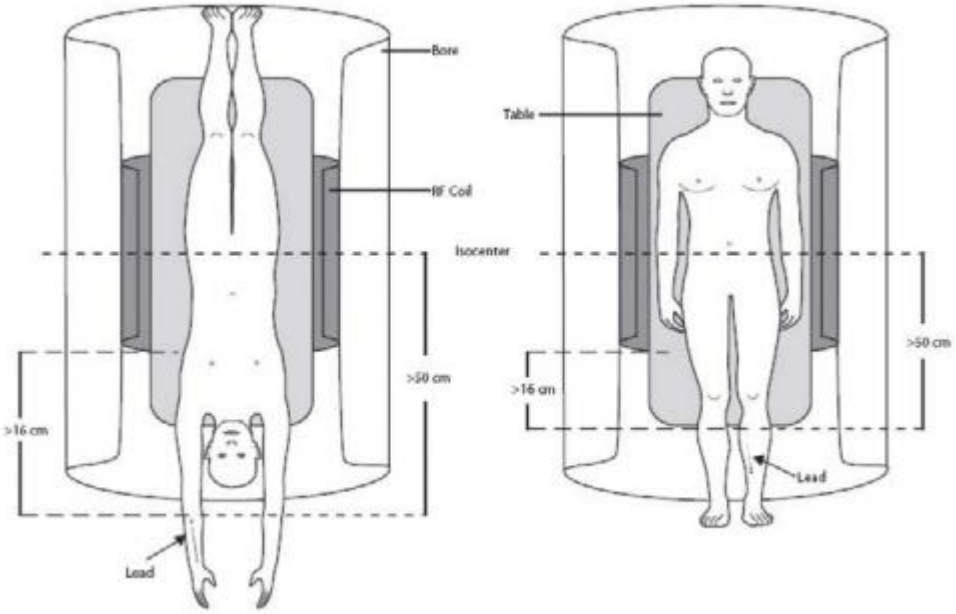
- Location: Intractable pain in 1-2 peripheral nerve distribution
- Relying on afferent signals: area of pain should have some sensation
- Accessibility: Patient can reach or has a caretaker that can reach the external pulse generator/area of stimulation.
- Trade-off: PNS may be preferable to SCS due to less invasive nature/ lower risk
  - Sometimes SCS may not be an option due to
    - Spine anatomy
    - Anticoagulation needs

GENERAL CONSIDERATIONS

- Pre-op imaging
  - Review MRI if available
  - Do in-clinic USG
- Co-morbidities
  - A foreign body will be placed
    - Asses infection risk, bleeding risk, Diabetes status
- No psychological contraindication- consider psych eval if necessary
  - Set expectations

MRI CONSIDERATIONS

- External pulse generator and array is not MRI safe with any manufacturer



- Bioness/stimrouter
  - MRI conditional- specifications regarding location and magnetic field
- Stimwave/StimQ
  - MRI conditional –full body at 1.5 T (no substantial concerns)
- Nalu
  - MRI conditional at 1.5 T, impedance check needed
- Sprint/SPR therapeutics
  - Even lead is not MRI safe
  - Retained lead remmanent is MRI conditional at 1.5 T

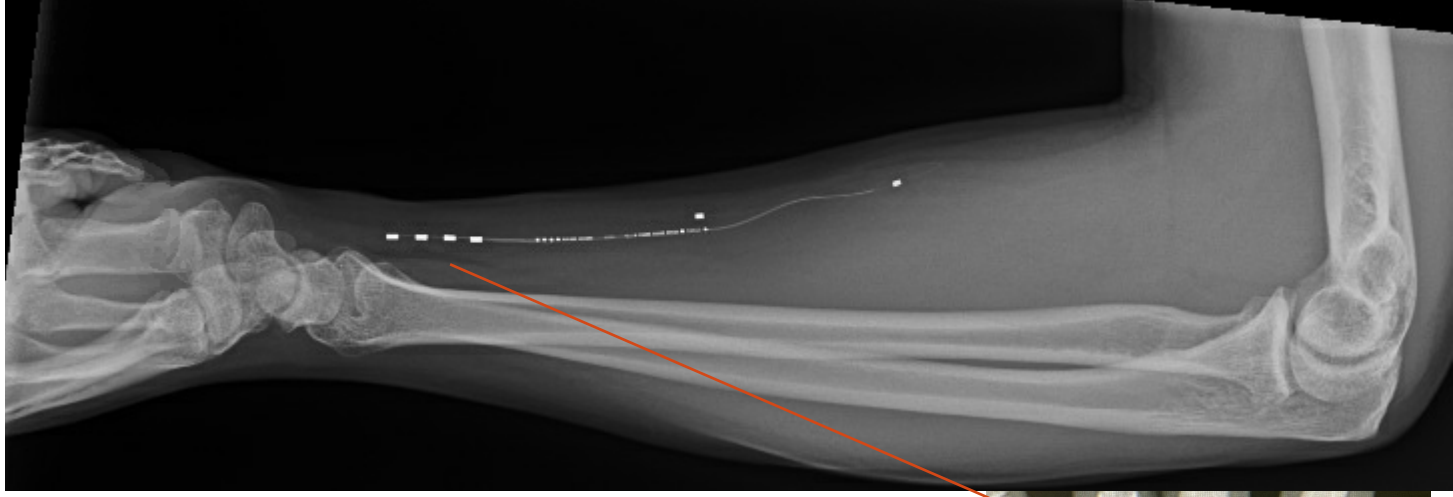
DIAGNOSTIC NERVE BLOCK

- Helps identify the correct nerve/level
- High volume can result in false positives

CONSIDER TRIAL BEFORE PERM

- May not be an option with some manufactures
- Some clinicians consider intra-op stimulation as trial
- Some do not have a perm option

RISKS



- Biggest risk if lead migration
- Other device related
  - Lead fracture
  - Erosion
  - Allergic reaction to implanted material
- Infection
- Bleeding
- Lack of pain relief

ANTICOAGULATION/BLEEDING RISK

The Neurostimulation Appropriateness Consensus Committee (NACC): Recommendations on Bleeding and Coagulation Management in Neurostimulation Devices, 2017, Deer et al.

- Adopted from ASRA anticoagulation guidelines
- Paucity of reports
  - One case repot of gluteal hematoma after sacral nerve PNS implant
- Bleeding is potential risk, but consequences are less serious than with intraspinal implantation
- Superficial bleeding
  - Easy to recognize and treat

NACC GUIDELINES CONT.D

- Similar to spinal neuromodulation except for
  - ASA and ASA combinations- Shared assessment and risk stratification
  - NSAIDs- no need to stop
  - Phosphodiesterase inhibitors (cilostazol, dipyridamole)- no

TECHNICAL TIPS

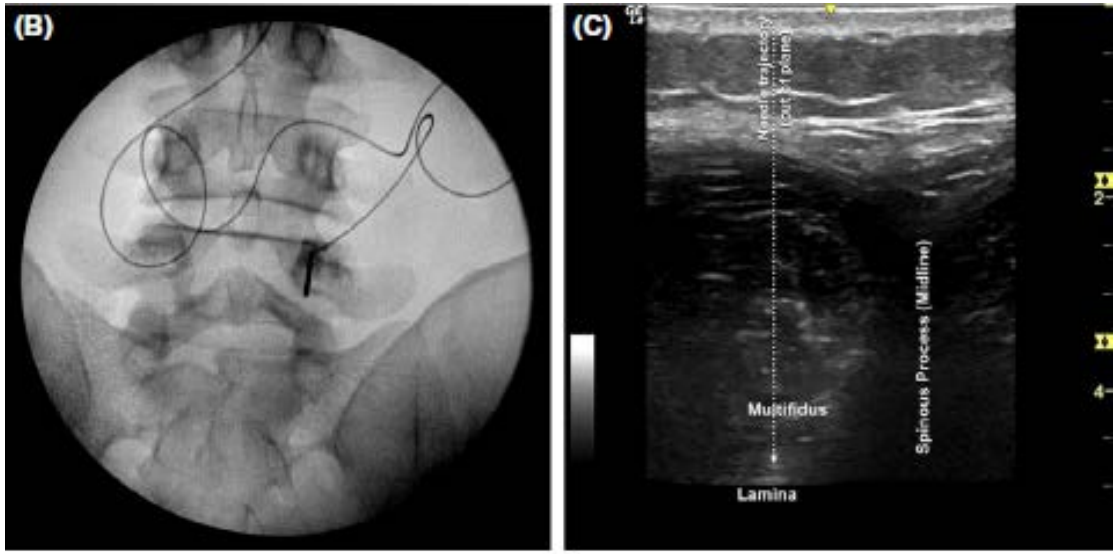
- Avoid being in muscle belly, in between fascial planes is better
- Do not cross joints
- Figure out ideal placement of the receiver end in pre-op based on reachability
- Mapping out nerve in pre-op or intra-op before needle insertion is helpful
- You will be holding the USG for a long time, ensure ergonomics
  - Good gel coating at the tip underneath probe cover, no air bubbles
- Lay out the stimulator lead on the skin to get an idea of ideal starting point
  - Some recommend placement perpendicular to the nerve, some parallel
- Take X-ray of the final lead position for documentation

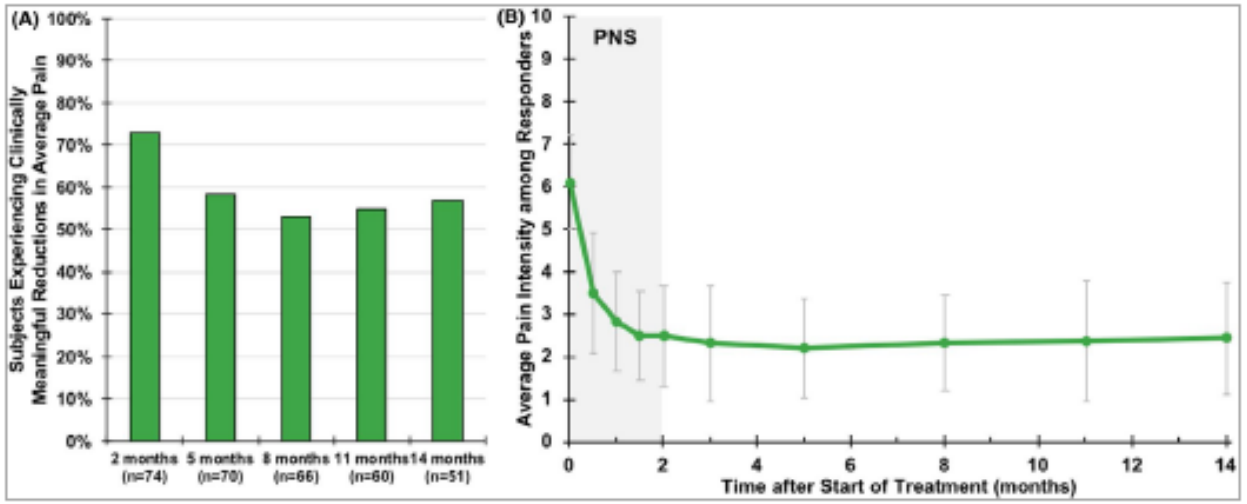
INDICATIONS

- Numerous!
- Stimulation of named nerves
- Greater occipital for occipital headache
- Suprascapular and axillary for shoulder pain
- Superior cluneal, multifidus for low back pain
- Genicular, infrapatellar saphenous for knee pain
- Median, ulnar and radial for upper extremity pain
  - CRPS, failed carpal tunnel, failed cubital tunnel, phantom limb, post traumatic
- Femoral/saphenous, sciatic, tibial, peroneal etc. for lower extremity pain
  - Phantom limb, peripheral neuropathy, CRPS, post traumatic, post surgical,
- Truncal- illioinguinal, iliohypogastric

TREATMENT OF CHRONIC AXIAL BACK PAIN WITH 60- DAY PERCUTANEOUS MEDIAL BRANCH PNS: PRIMARY END POINT RESULTS FROM A PROSPECTIVE, MULTICENTER STUDY- GILMORE ET AL. PAIN PRACTICE 2021

- 74 patients with chronic axial back pain underwent percutaneous PNS leads targeting the lumbar medial branch nerves for up to 60 days
- 73% (54 out of 74) of the patient reported ≥30% reductions in back pain intensity after the 2- month per-cutaneous PNS treatment, sustained at 12 month
  - Clinically and statistically significant reductions in pain, disability, and pain interference were reported by a majority of participants with percutaneous PNS, along with reductions in opioid consumption and statistically significant improvements in health- related Quality of Life.





Reg Anesth Pain Med. 2019 Jun;44(6):637-645. doi: 10.1136/rapm-2018-100109. Epub 2019 Apr 5.

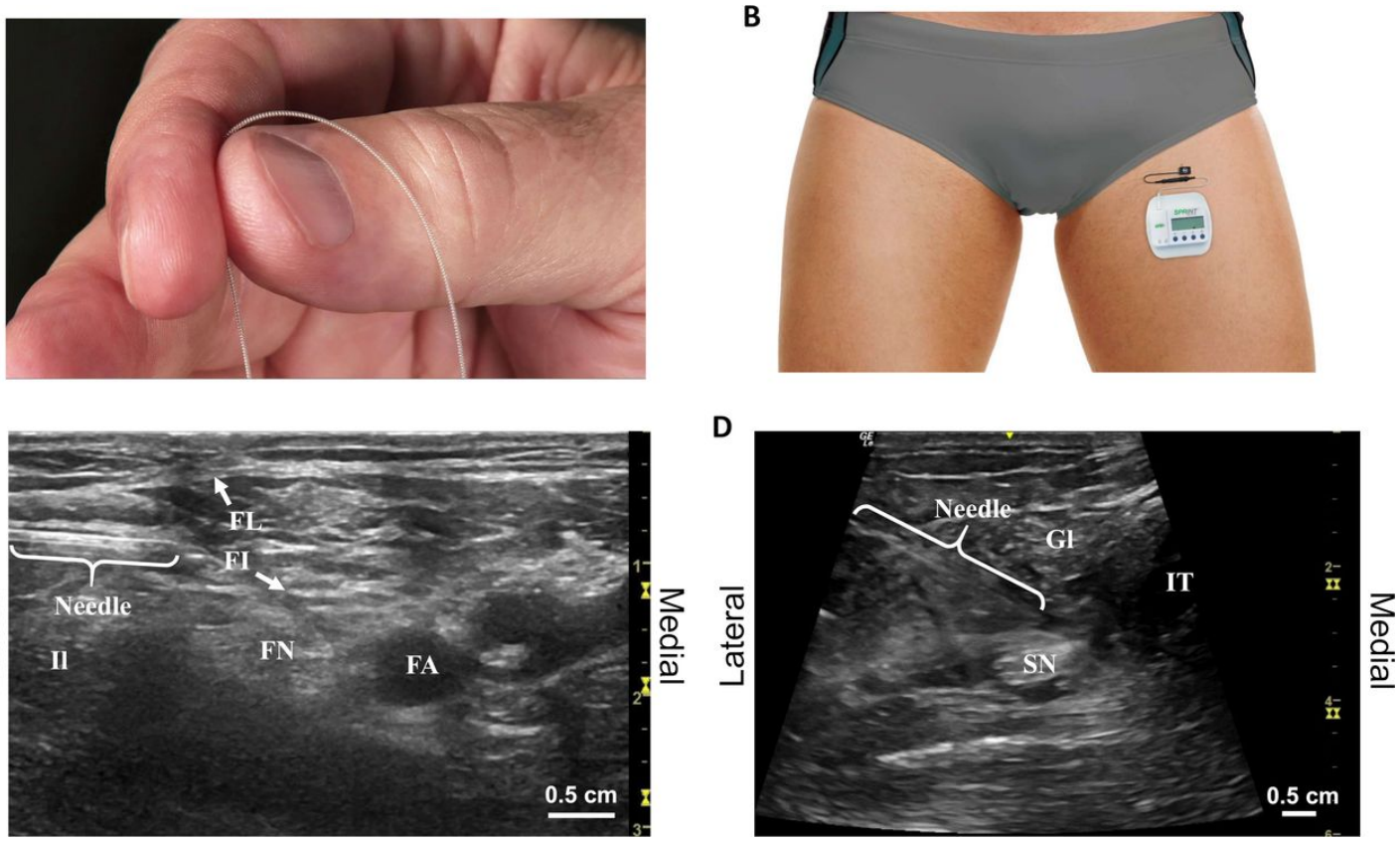
Percutaneous peripheral nerve stimulation for the treatment of chronic neuropathic postamputation pain: a multicenter, randomized, placebo-controlled trial.

Gilmore C[1], Ilfeld B[2], Rosenow J[3], Li S[4], Desai M[5], Hunter C[6], Rauck R[7], Kapural L[7], Nader A[8], Mak J[4], Cohen S[9], Crosby N[10], Boggs J[10].

- 28 lower extremity amputees with post-a
- Ultrasound-guided implantation of perc
- Randomized to receive PNS or placebo f subjects received PNS for four additiona

RESULTS:

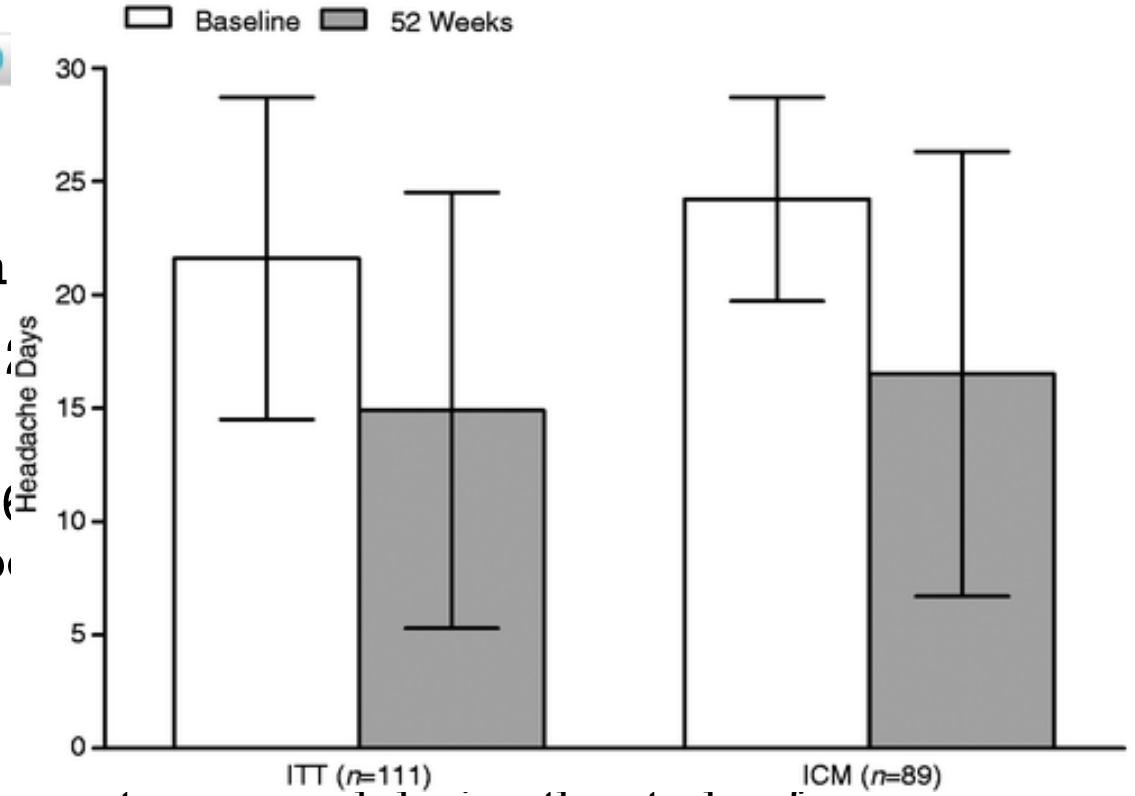
- 58% of subjects receiving PNS (n=7/12, during weeks 1-4 compared with subjec
- 67 - 80% PNS subjects reported ≥50% r (n=8/10, p=0.003) after 8 weeks of thera 14%; pain interference: n=2/13, 15%).
- At 12 mo (FU study) -Significantly more average weekly pain at 12 months (67% period (0%, 0/14, p=0.001).



Safety and efficacy of peripheral nerve stimulation of the occipital nerves for the management of chronic migraine: Long-term results from a randomized, multicenter, double-blinded, controlled study

David W Dodick, Stephen D Silberstein, Kenneth L Reed, Timothy R Deer, Konstantin V Slavin, Billy Huh, Ashwini D Sharan, Samer Narouze, Alon Y Mogilner, Terrence L Trentman, Joe Ordia, Julien Vaisman, Jerome Goldstein, Nagy Mekhail Show less

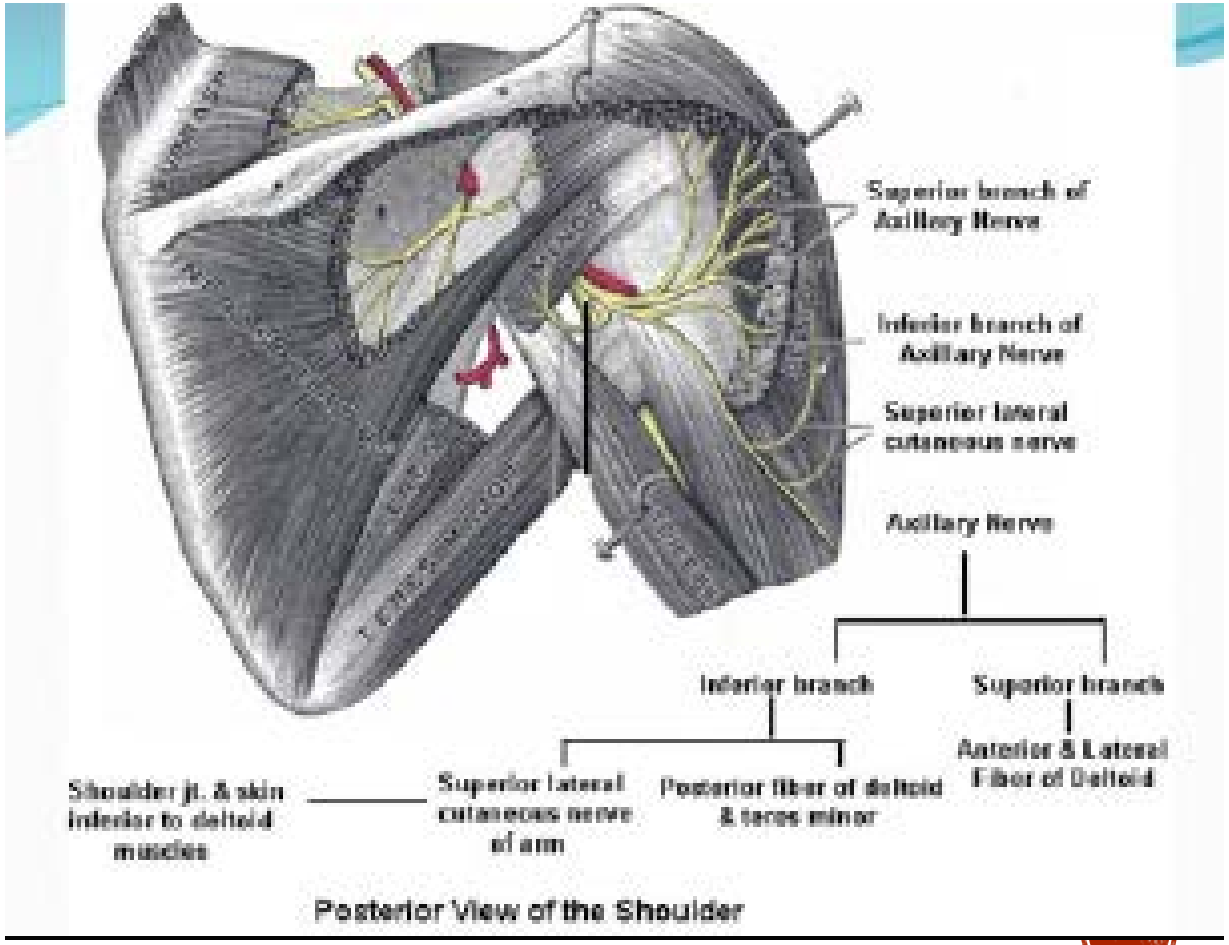
First Published July 30, 2014 | Research Article | Find in PubMed



- 157 patients with chronic intractable migraine
- Implanted with a neurostimulation system with
- Randomized to an active or control group for 1
  treatment for an additional 40 weeks.
- Headache days were significantly reduced by
  ($p < 0.001$) and by 7.7 (±8.7) days in the ICM p
- 2/3 patients had significant relief
- Significant infections and reoperations
  - A total of 183 device/procedure-related adverse events occurred during the study, of which 18 (8.6%) required hospitalization and 85 (40.7%) required surgical intervention; 70% of patients experienced an adverse event.

POST STROKE SHOULDER PAIN

- Axillary nerve
  - Supplies portion of the GH joint
  - tcutaneous (regimental patch) and
  - motor component- Teres Minor and Deltoid
    - provides the best mechanical solution for subluxed shoulder as it provides mechanically efficient reduction, rotation, compression, and elevation of the GH joint via activation of the Teres Minor and Deltoid muscles.



Pain Medicine

Peripheral Nerve Stimulation: Update for the 21st Century

Review Articles

Einar Ottestad, MD, FIPP, CIPS and Daniel S. Orlovich, MD, PharmD

History of Peripheral Nerve Stimulation—Update for the 21st Century

Tiffany Lin, MD, Akshat Gargya, MD, Harmandeep Singh, MD, Eellan Sivanesan, MD, and Amitabh Gulati, MD

Mechanism of Peripheral Nerve Stimulation in Chronic Pain

A comprehensive literature review on the mechanism of peripheral nerve stimulation (PNS) in chronic pain. Th of PNS is based on the gate control theory by Wall and Melzack in 1965. However, further studies have demo its peripheral and central analgesic mechanisms by modulating the inflammatory pathways, the autonomic ner system, endogenous pain inhibition pathways, and involvement of the cortical and subcortical areas.

Original Research Articles

Vafi Salmasi, MD, MS, Oludare O. Olatoye, MD, Abdullah Sulieman Terkawi, MD, Jennifer M. Hah, MD, MS, Einar Ottestad, MD, and Matthew Pingree, MD

Peripheral Nerve Stimulation for Occipital Neuralgia

In this manuscript, we present a case series of a novel occipital nerve stimulation approach. We use ultrasou ance to implant devices designed specifically for peripheral nerve stimulation. We also briefly discuss other in tions for occipital neuralgia.

Thiago Nouer Frederico, MD and Tiago da Silva Freitas, MD, PhD, FIPP

Peripheral Nerve Stimulation of the Brachial Plexus for Chronic Refractory CRPS Pain of the Upper Li Description of a New Technique and Case Series

This article presents a new neuromodulation technique for implant of percutaneous electrodes in the brachial using ultrasound, for the treatment of neuropathic pain in upper limb. We use this technique in 10 patients wit plex regional pain syndrome in upper limb and reported the results in this paper.

Review Article

Vinita Singh, MD, Diya Sandhu, MD, and Nan Xiang, MD

Techniques for Peripheral Nerve Stimulator Implantation of the Upper Extremity

Peripheral nerve stimulation has recently become popular with the development and availability of peripheral n stimulators with an external pulse generator. Here, we describe ultrasound anatomy and technical details for p nerve stimulation in the upper extremity for three major nerves: median, ulnar and radial.

Original Research Article

Sahil Gupta, MBBS, Steven Clendenen, MD, Guilherme Ferreira-Dos-Santos, MD, MSc, and Mark Friedrich Hurdle, MD

Ultrasound-Guided Intercostal Peripheral Nerve Stimulator Implantation: Technique Report and Feasibility Study in a Cadaver

Intercostal neuralgia is a common cause of chronic pain in a number of patients. This is the first study of its kind to determine the feasibility of an ultrasound guided intercostal peripheral nerve stimulator (PNS) implantation technique using a cadaveric specimen.

Technical Note

Akshat Gargya, MD, FIPP, CIPS, Harmandeep Singh, MD, Tiffany Lin, MD, and Amitabh Gulati, MD

Extraforaminal Thoracic and Lumbar Spinal Nerve Ultrasound-Guided Percutaneous Peripheral Nerve Stimulation

This technical case report provides a method to perform selective spinal nerve stimulation of thoracic and lumbar spinal nerves using ultrasonography. This technique allows better visualization of soft tissue anatomy and planning of needle trajectory. Ultrasound guided peripheral nerve stimulation procedures may provide a safer method for neurostimulation lead placement when compared to fluoroscopic guided techniques.

Review Article

Christopher A. Gilmore, MD, Janus Patel, MD, Lasha-Giorgi Esebua, MD, and Michael Burchell, MD

A Review of Peripheral Nerve Stimulation Techniques Targeting the Medial Branches of the Lumbar Dorsal Rami in the Treatment of Chronic Low Back Pain

Two emerging techniques in the treatment of chronic low back pain involve stimulation of the medial branch of the lumbar dorsal ramus. Long a target for ablative techniques, these two approaches offer a new stance on the medial branch nerve's role in CLBP management and functional restoration. These two devices are firsthand evidence of the advances in technology specifically for use in the periphery that have come about in the last several years.

Technical Notes

Harmandeep Singh, MD, Akshat Gargya, MD, Tiffany Lin, MD, and Amitabh Gulati, MD, FIPP, CIPS

Sciatic, Femoral, and Lateral Femoral Cutaneous Nerve Ultrasound-Guided Percutaneous Peripheral Nerve Stimulation

This technical note describes the utilization of ultrasonography for percutaneous placement of peripheral nerve stimulation leads at the sciatic, femoral, and lateral femoral cutaneous nerves. Various ultrasound techniques and transducer orientations allow for multiple options for lead placement relative to the targeted nerve.

Nicholas S. Gregory, MD, Abdullah S. Terkawi, MD, Nitin K. Prabhakar, MD, Johnathan V. Tran, MD, Vafi Salmasi, MD, MS, and Jennifer M. Hah, MD, MS

Peripheral Nerve Stimulation for Pudendal Neuralgia: A Technical Note

Pudendal neuralgia causes genital pain and can be a target for peripheral neuromodulation. Stimulator leads can be placed using ultrasound guidance. This case report suggests restricted movement after placement may decrease lead migration

Review Articles

Chih-Peng Lin, MD, PhD, Ke-Vin Chang, MD, PhD, Wei-Ting Wu, MD, and Levent Özçakar, MD

Ultrasound-Guided Peripheral Nerve Stimulation for Knee Pain: A Mini-Review of the Neuroanatomy and the Evidence from Clinical Studies

Peripheral nerve stimulation (PNS) with electrodes placed under ultrasound guidance emerged as a safe and feasible technique. As PNS has a novel clinical application for knee pain, a few systematic reviews have been performed for it. This present mini-review aims to brief innervation and neural sonoanatomy of the knee joint and summarize the newest evidence of PNS in the management of knee pain, especially in the postoperative period.

Aaron Hanyu-Deutmeyer, DO and Scott G. Pritzlaff, MD, CIPS, FIPP

Peripheral Nerve Stimulation for the 21st Century: Sural, Superficial Peroneal, and Tibial Nerves

While most nerves in the lower extremity can be PNS targets, consideration must be given to the ergonomics of pulse

Peripheral Nerve Stimulation for Occipital Neuralgia

Vafi Salmasi, MD, MS,* Oludare O. Olatoye, MD,† Abdullah Sulieman Terkawi, MD,*
Jennifer M. Hah, MD, MS,* Einar Ottestad , MD,* and Matthew Pingree, MD†

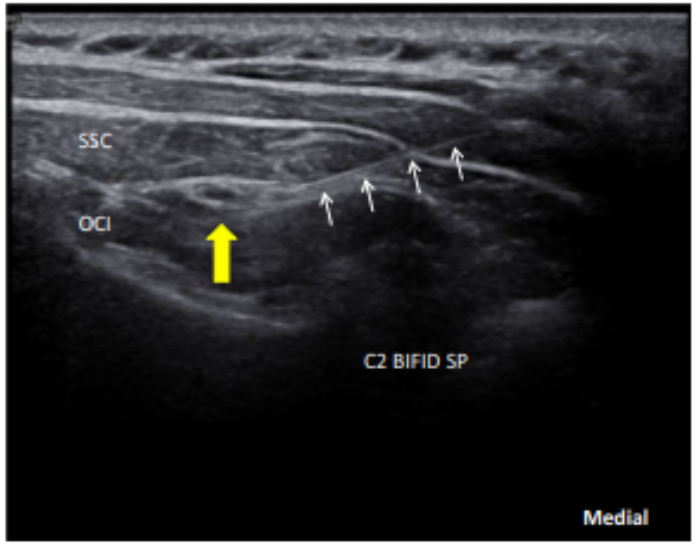


Figure 1. Ultrasound image showing the left greater occipital nerve (GON; large arrow) lying in the fascial plane between the semispinalis capitis (SSC) and obliquus capitis inferior muscle (OCI). The shadow of the C2 bifid SP (spinous process) is also depicted to show the level of needle entry. Also shown is the path of the needle (skinny arrows) from medial to lateral toward the left GON (large arrow).

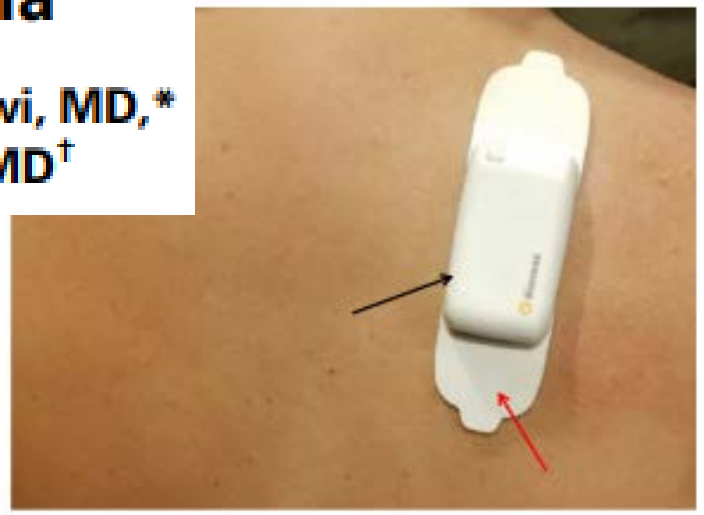


Figure 2. Bioness StimRouter peripheral nerve stimulation system placed over the right trapezius muscle. External pulse transmitter (upper arrow) is placed in close proximity to the subcutaneously implanted lead. The transmitter is adhered to the skin using an adhesive strip (lower arrow).

Table 1. Characteristics and outcome of patients with occipital nerve stimulation

	Age, y, and Sex	Laterality	Secondary Diagnosis*	Other Comorbidities	Time to Last Follow-up, mo	Percent Pain Relief	Stimulation Use, h/d
1	62 male	Right	Migraine headache	History of sinus surgery, hypertension, obstructive sleep apnea, coronary artery disease	16	25	8
2	63 male†	Left	Migraine headache	History of sinus surgery, hypertension, obstructive sleep apnea, coronary artery disease	8	25	8
3	29 female	Right	Cervicogenic headache	None	6	100	7
4	70 female	Bilateral	Migraine headache	History of lung cancer, chronic obstructive pulmonary disease, bilateral hip and right knee arthroplasty	6	70	24

*Primary diagnosis for all these patients is "occipital neuralgia."
†Same patient as number 1.

Peripheral Nerve Stimulation of the Brachial Plexus for Chronic Refractory CRPS Pain of the Upper Limb: Description of a New Technique and Case Series

Thiago Nouer Frederico, MD* and Tiago da Silva Freitas, MD, PhD, FIPP†

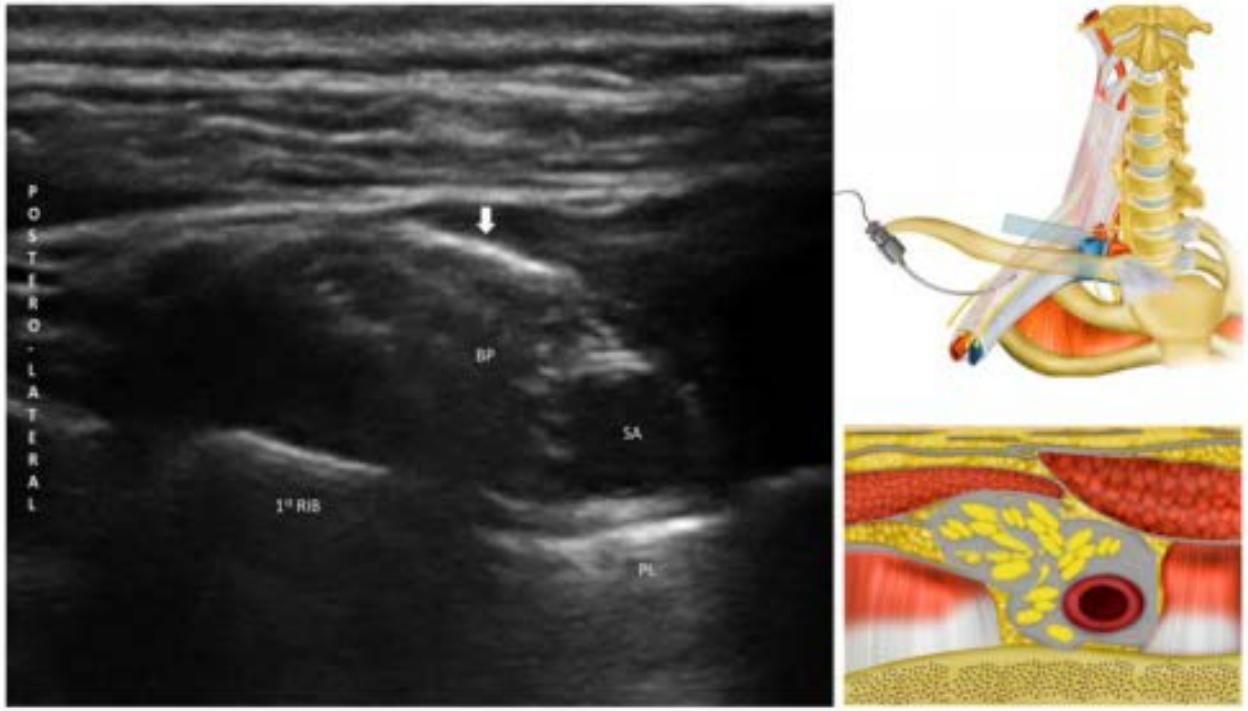
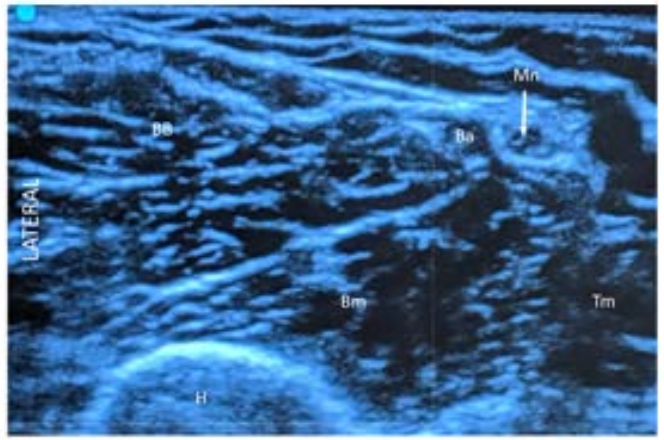


Figure 6. Ultrasound of supraclavicular area and electrode artifact placed inside the brachial plexus sheath. Bold arrow = electrode. BP = brachial plexus; PL = pleura; SA = subclavian artery.

Results(n=14). After the initial trial, 10 patients had a pain reduction of 50% and received a permanent implant. At 12-month follow-up, VAS, Neuropathic Pain Scale, SF-12 physical and mental scores improved by 57.4% þ/- 10% (P ¼ 0.005), 60.2% þ/- 12.9% (P ¼ 0.006), and 21.9% þ/- 5.9% (P ¼ 0.015), respectively.

Techniques for Peripheral Nerve Stimulator Implantation of the Upper Extremity FREE

Vinita Singh, MD ✉, Diya Sandhu, MD, Nan Xiang, MD



H = Humerus
Mn = Median Nerve
Ba = Brachial artery
BB = Biceps brachii muscle
Bm = Brachialis muscle
Tm = Triceps muscle

Ua = Ulnar artery
Un = Ulnar Nerve

FCU = Flexor carpi ulnaris muscle
FDP = Flexor digitorum profundus muscle
FDS = Flexor digitorum superficialis muscle

H = Humerus
Bm = Brachialis muscle

Peripheral Nerve Stimulation for Pudendal Neuralgia: A Technical Note

Nicholas S. Gregory, MD,* Abdullah S. Terkawi, MD,* Nitin K. Prabhakar, MD,† Johnathan V. Tran, MD,* Vafi Salmasi, MD, MS,* and Jennifer M. Hah, MD, MS*

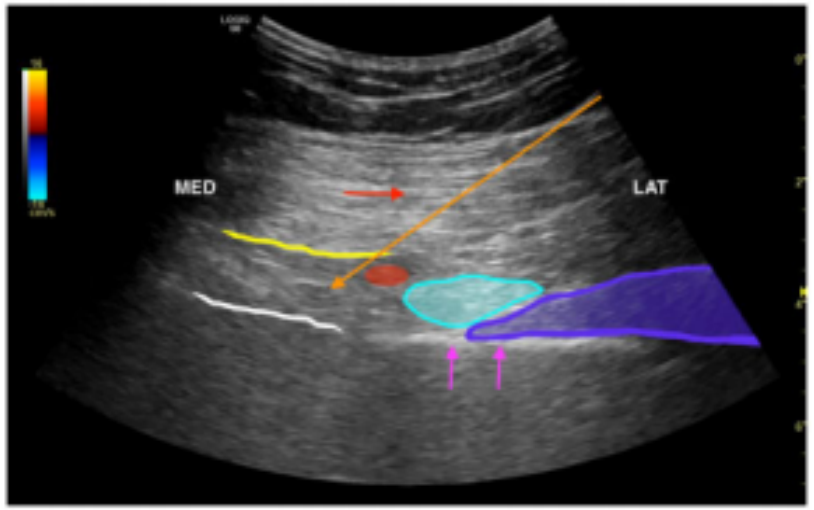
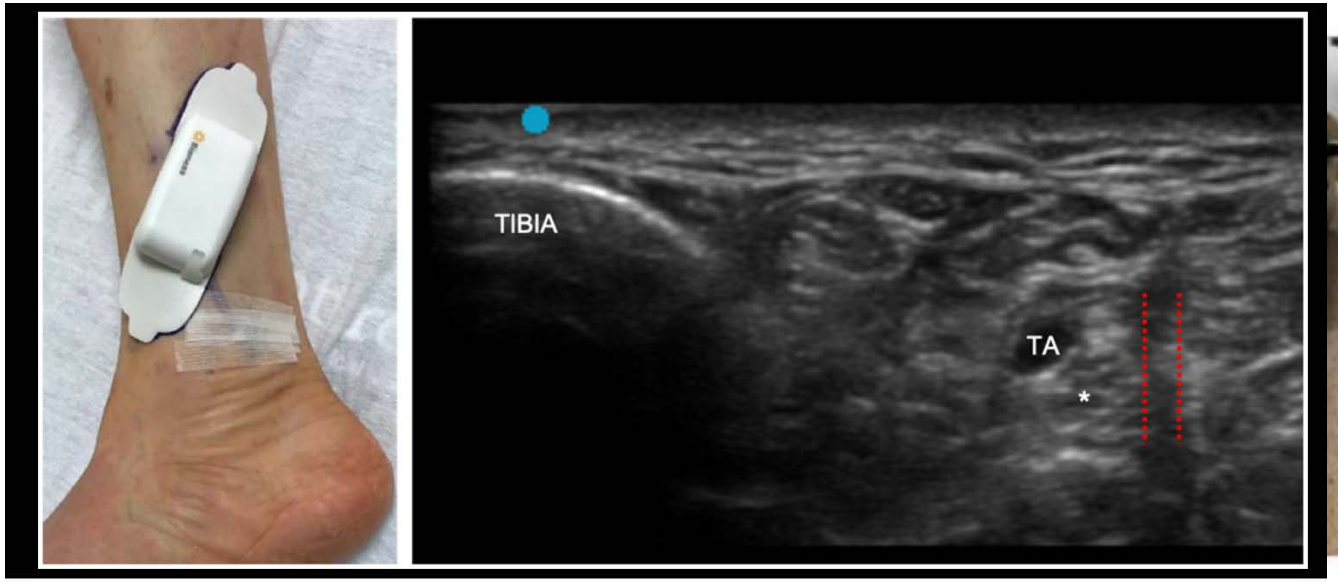


Figure 3. Right posterior buttock at the level of the ischial spine with highlighted trajectory for peripheral nerve stimulator lead placement (orange arrow). Gluteus maximus (red arrow), sacrotuberous ligament (yellow line), sacrospinous ligament (white line), pudendal artery (red circle), sciatic nerve (aqua outline), ischial spine (magenta arrows), superior gemellus muscle (purple outline).

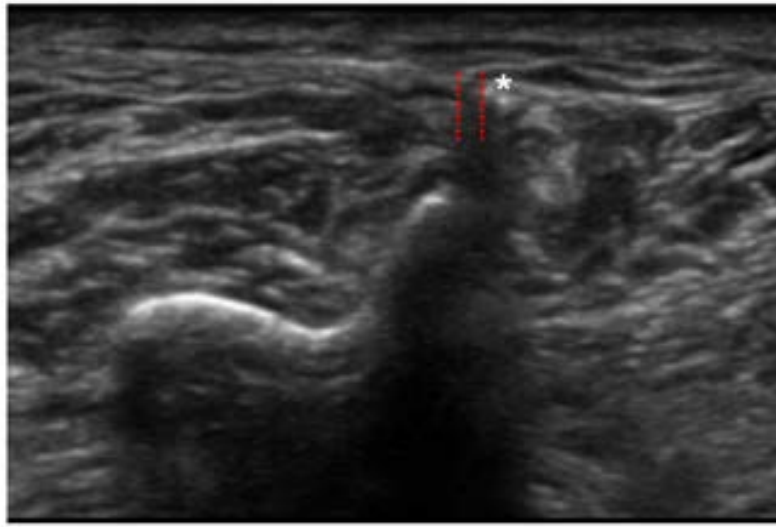
Results. A lateral to medial approach with ultrasound guidance at the level of the ischial spine is likely to facilitate proper lead placement along the course of the pudendal nerve. Aftercare and adherence to post-implant activity restrictions–particularly avoiding use of the extremes of hip flexion and extension for four weeks, to lie supine or in a lateral decubitus position rather than sitting for extended periods of time--lead to the absence of lead migration.

Peripheral Nerve Stimulation for the 21st Century: Sural, Superficial Peroneal, and Tibial Nerves FREE

Aaron Hanyu-Deutmeyer, DO ✉, Scott G Pritzlaff, MD, CIPS, FIPP



Placement of a permanent, percutaneous peripheral nerve stimulation lead targeting the tibial nerve (*) above the tarsal tunnel. An out-of-plane approach is employed with ultrasound. The lead (red line) is placed parallel to the nerve proximally to distally and subsequently tunneled laterally.



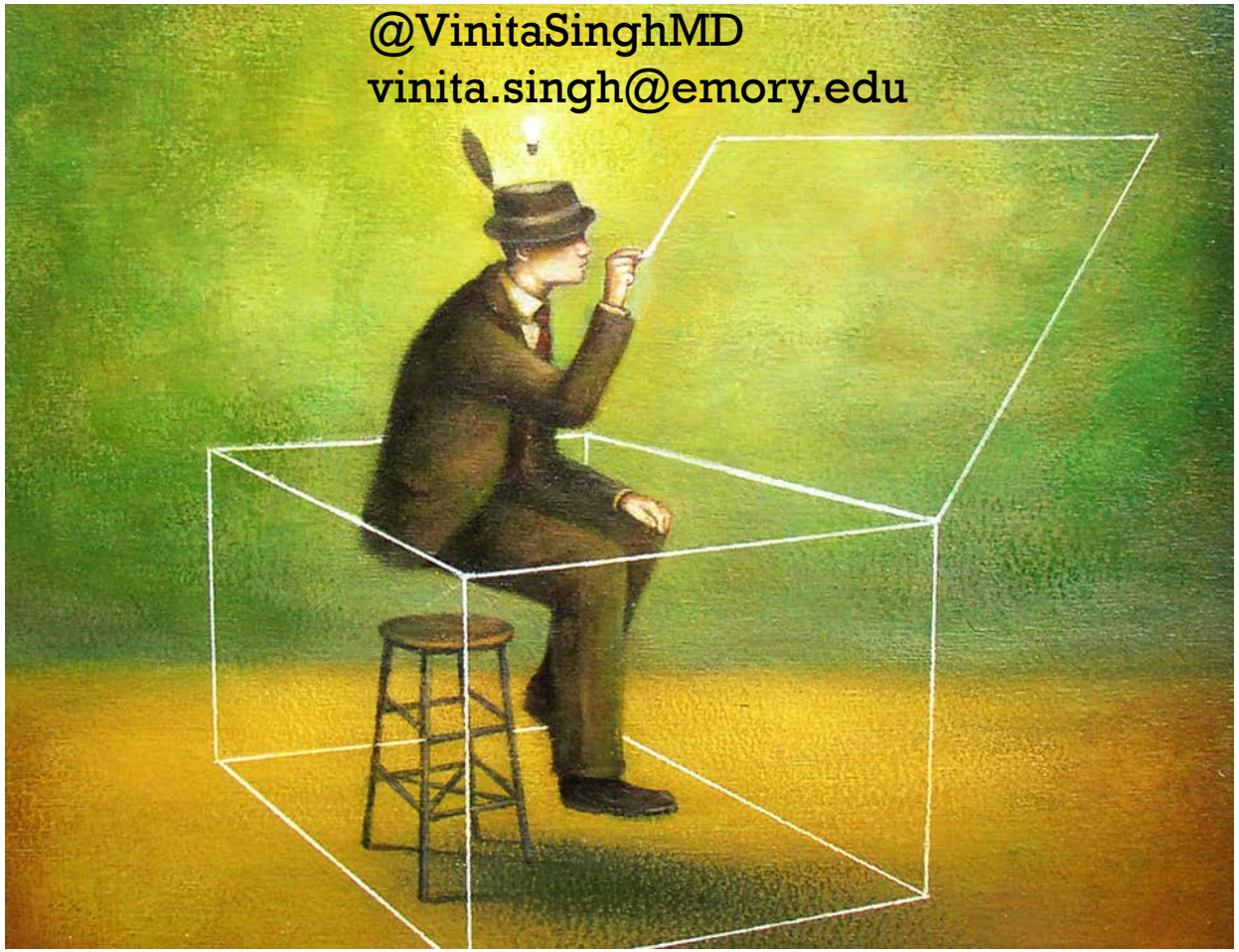
Superficial peroneal peripheral nerve stimulation lead placement in the lower leg. The nerve (*) can be visualized between the extensor digitorum longus and the peroneus brevis muscles and superficial to the fibula. The lead (red dotted line) was placed parallel to the nerve via an out-of-plane approach.

HURDLES

- Lack of awareness regarding percutaneous PNS
- Not many robust clinical trials supporting use– changing landscape
- Lack of long term follow-up
- Which translates to variable insurance coverage
  - Considered new and experimental by many

CONCLUSIONS

- Consider PNS after positive diagnostic block, before SCS
- Good anatomical knowledge and ultrasound skills is key
- The field is evolving and we will likely see more in future
  - Expanding outside of neuropathic pain
    - Knee, low back pain
- Need for research
- Variable insurance coverage, hopefully will change with more data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