

Emerging Treatments

Percutaneous Peripheral Nerve Stimulation

High Frequency Block

John Chae, MD

Exploring the Treatment and Management of Chronic Pain and Implications for
Disability Determination

National Academies of Science, Engineering and Medicine

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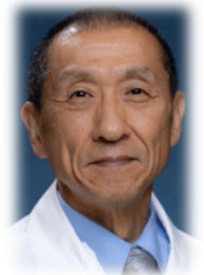
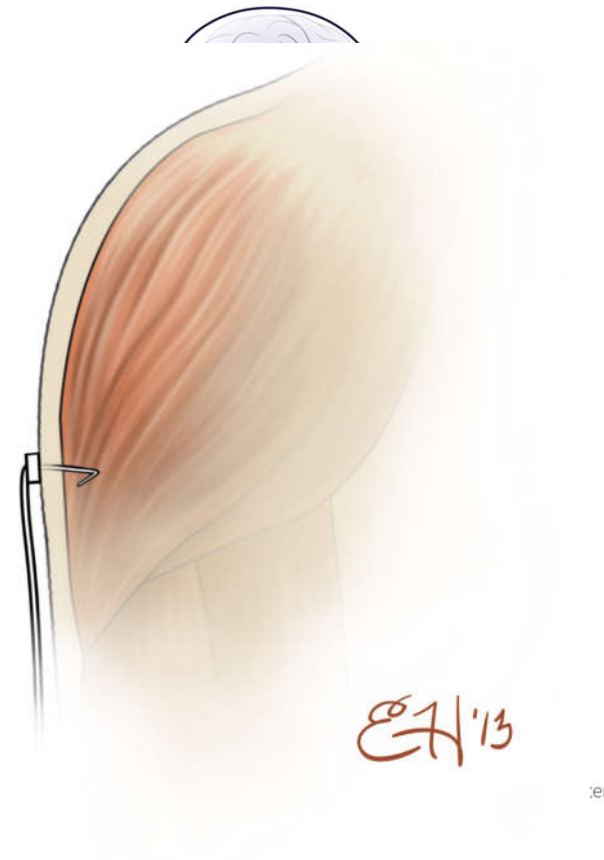


Disclosures

- Co-inventor of Percutaneous Peripheral Nerve Stimulation
- Patents
- Consultant to SPR Therapeutics
- Ownership interest in SPR Therapeutics

Percutaneous Peripheral Nerve Stimulation Hemiplegic Shoulder Pain

- Percutaneous electrode(s) anchored in deltoid, a muscle surrounding the painful shoulder
- External stimulator: stimulate the motor branches of axillary nerve to the deltoid
- **Muscle contraction**
 - Afferent feedback to central nervous system
 - Treat for 30-60 days
 - Remove lead(s)



Percutaneous Peripheral Nerve Stimulation Hemiplegic Shoulder Pain

RESEARCH ARTICLE

Intramuscular Electrical Stimulation for Hemiplegic Shoulder Pain

A 12-Month Follow-Up of a Multiple-Center, Randomized Clinical Trial

ABST

Chae
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ORIGINAL RESEARCH ARTICLE

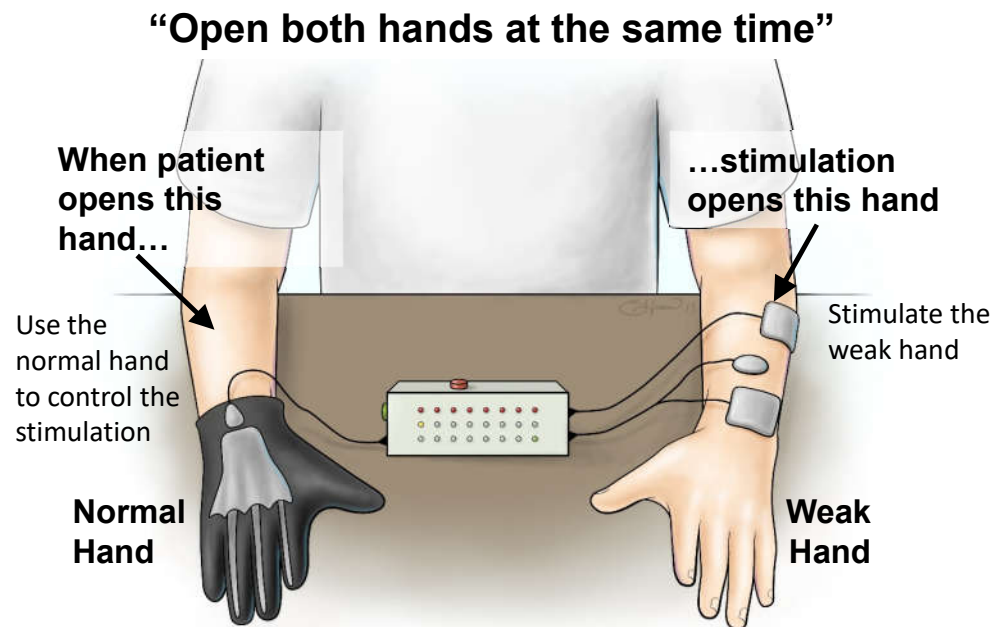
Peripheral Nerve Stimulation Compared with Usual Care for Pain Relief of Hemiplegic Shoulder Pain

A Randomized Controlled Trial

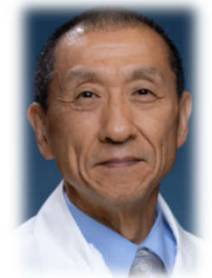
1. Pain relief and reduction in pain interference that persist after end of treatment (lead removal)
2. Postulated mechanism
 - Afferent feedback to central nervous system
 - Modulation of central sensitization

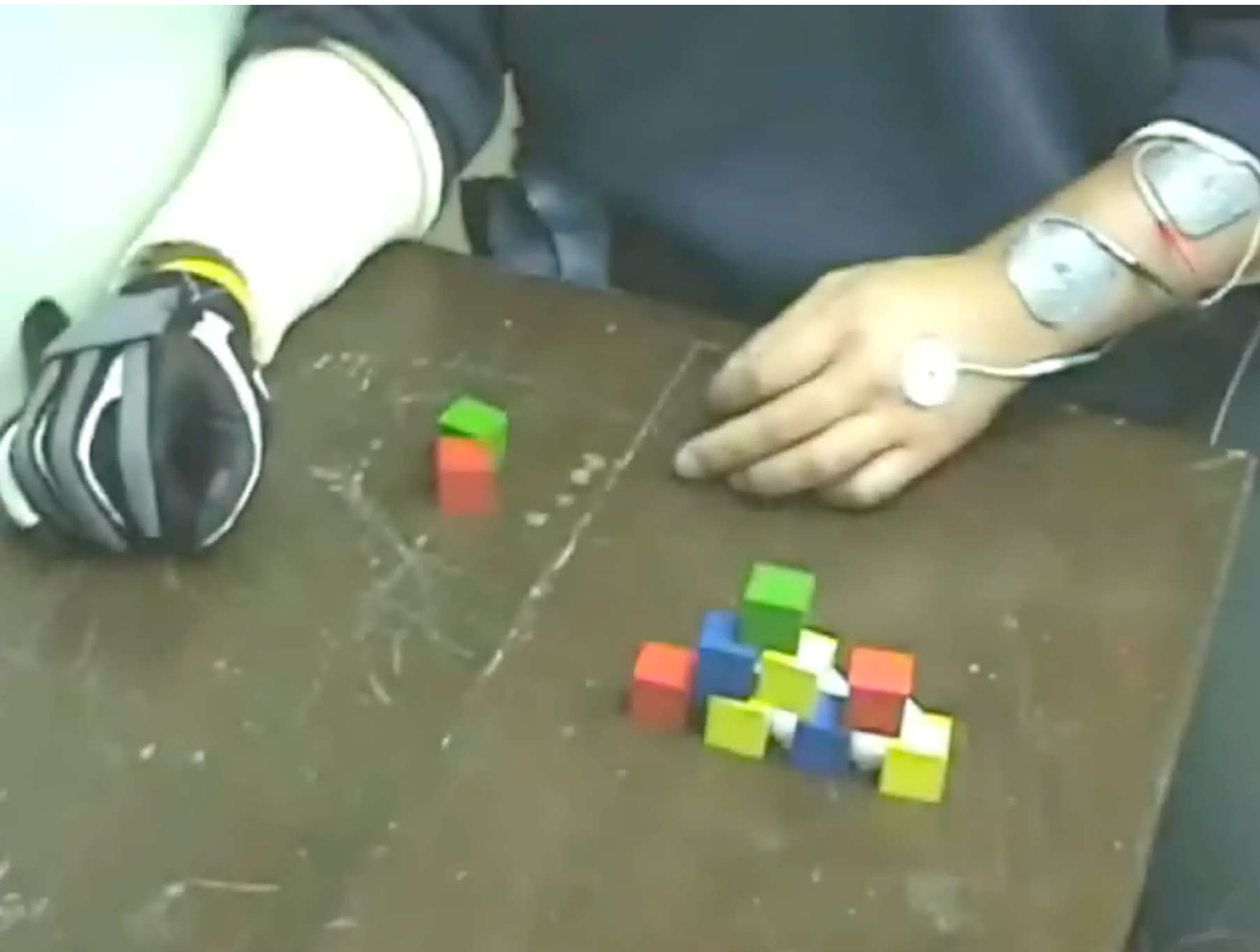
mulation
pain: a

Contralaterally Controlled FES (CCFES)



By participating in CCFES mediated functional tasks, activity dependent neuroplasticity is induced to facilitate motor recovery.





**Electrical
Stimulation-mediated
Activity-dependent
Neuroplasticity**



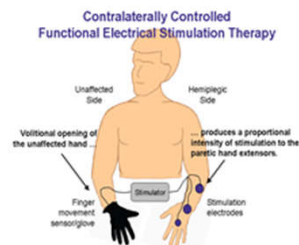
**Electrical
Stimulation-mediated
Activity-dependent
Neuroplasticity**

BASELINE



Electrical
Stimulation-mediated
Activity-dependent
Neuroplasticity

**AFTER
TREATMENT
(90 Days)**



CNS Injury

Stroke/TBI

CNS Neuronal Injury

Paralysis

Activity

Activity Dependent Neuroplasticity

Motor Restoration

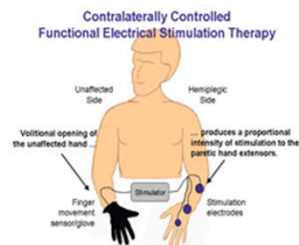


Chronic Musculoskeletal Pain

Musculoskeletal Tissue Injury

Maladaptive CNS Neuroplasticity (central sensitization)

Chronic Pain



CNS Injury

Stroke/TBI

CNS Neuronal Injury

Paralysis



Chronic Musculoskeletal Pain

Musculoskeletal Tissue Injury

Maladaptive CNS Neuroplasticity (central sensitization)

Chronic Pain

Activity

Activity Dependent Neuroplasticity

Motor Restoration

Pain Reduction

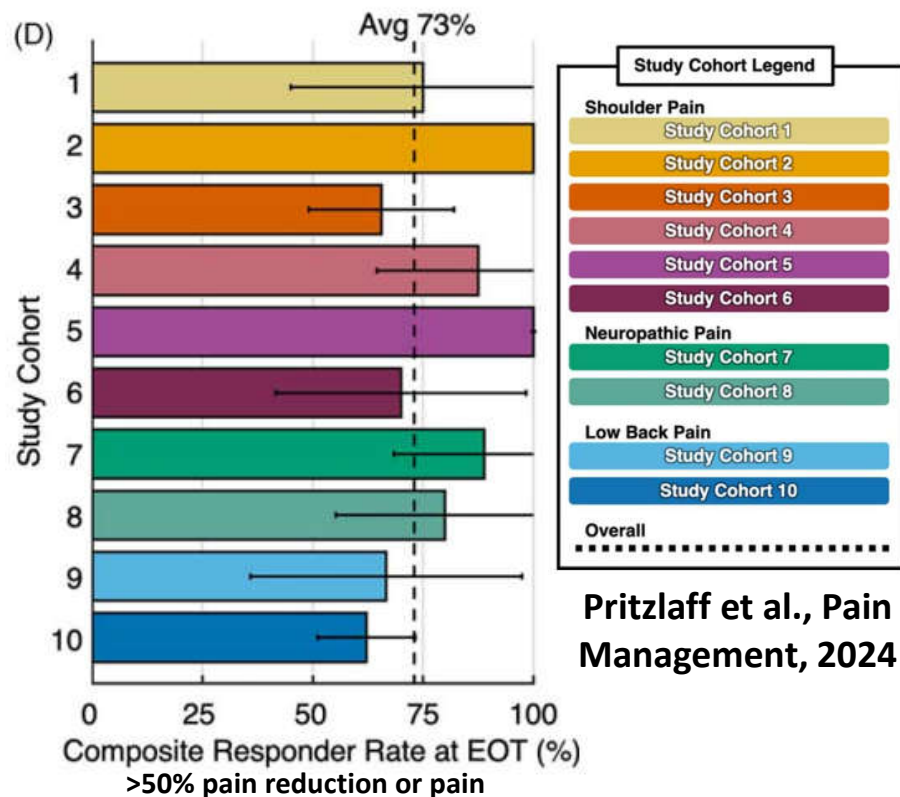
Functional Restoration

Beyond Hemiplegic Shoulder Pain...

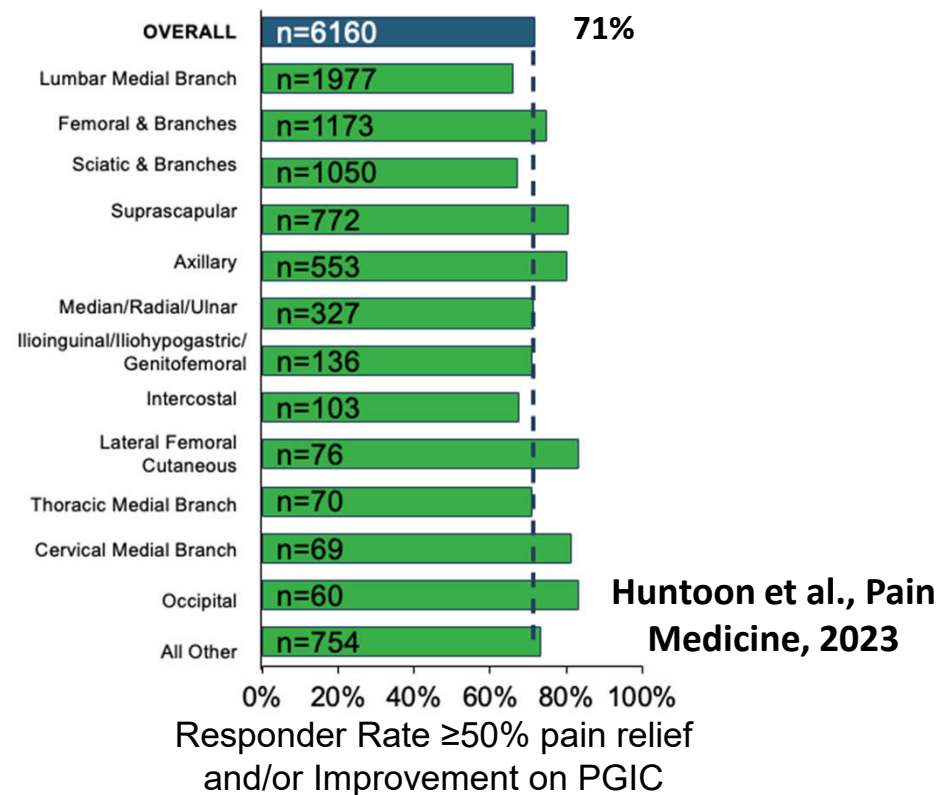
- If central sensitization is the convergent mechanism for chronic musculoskeletal pain in general, and...
- If percutaneous PNS reduces hemiplegic shoulder pain via modulation of central sensitization...
- Then, percutaneous PNS should reduce chronic musculoskeletal pain in general...



Percutaneous Peripheral Nerve Stimulation Multiple Clinical Indications



Pritzlaff et al., Pain Management, 2024

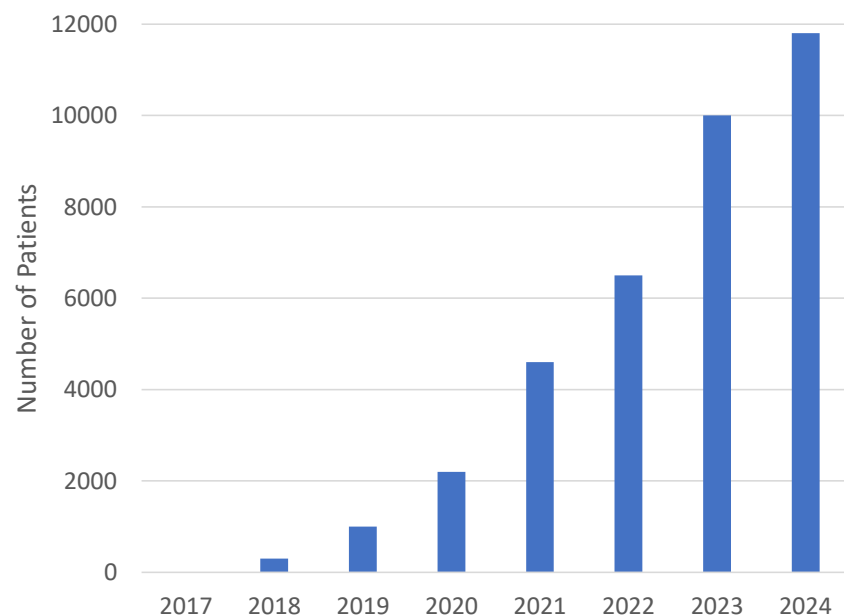


Huntoon et al., Pain Medicine, 2023

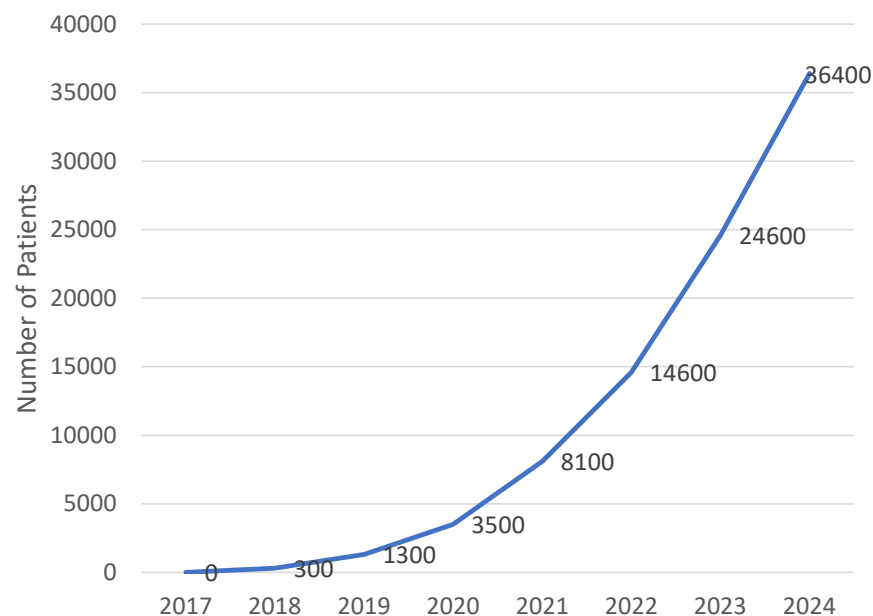


Percutaneous Peripheral Nerve Stimulation Multiple Clinical Indications

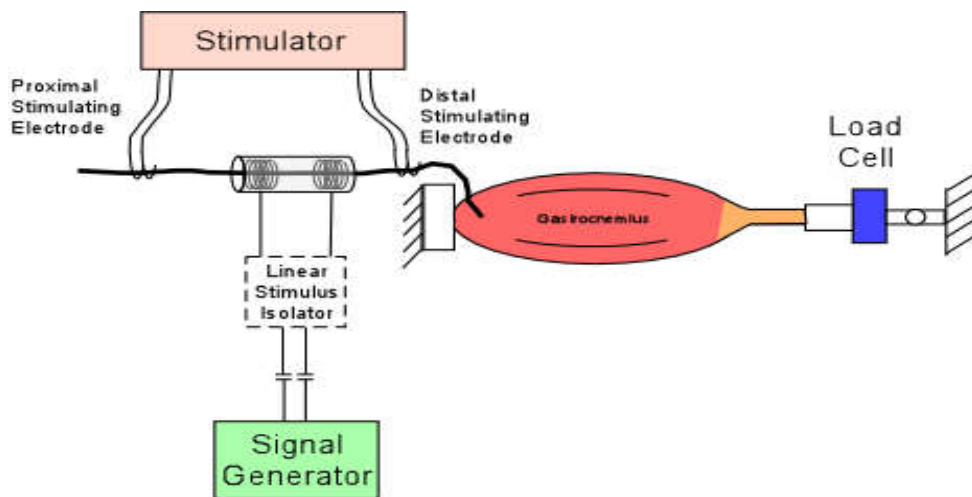
Annual



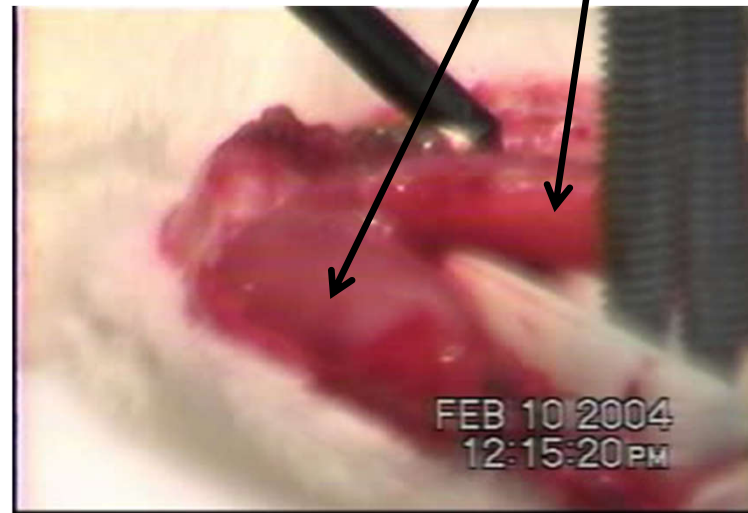
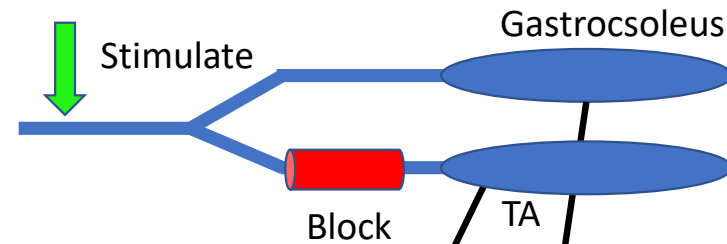
Cumulative



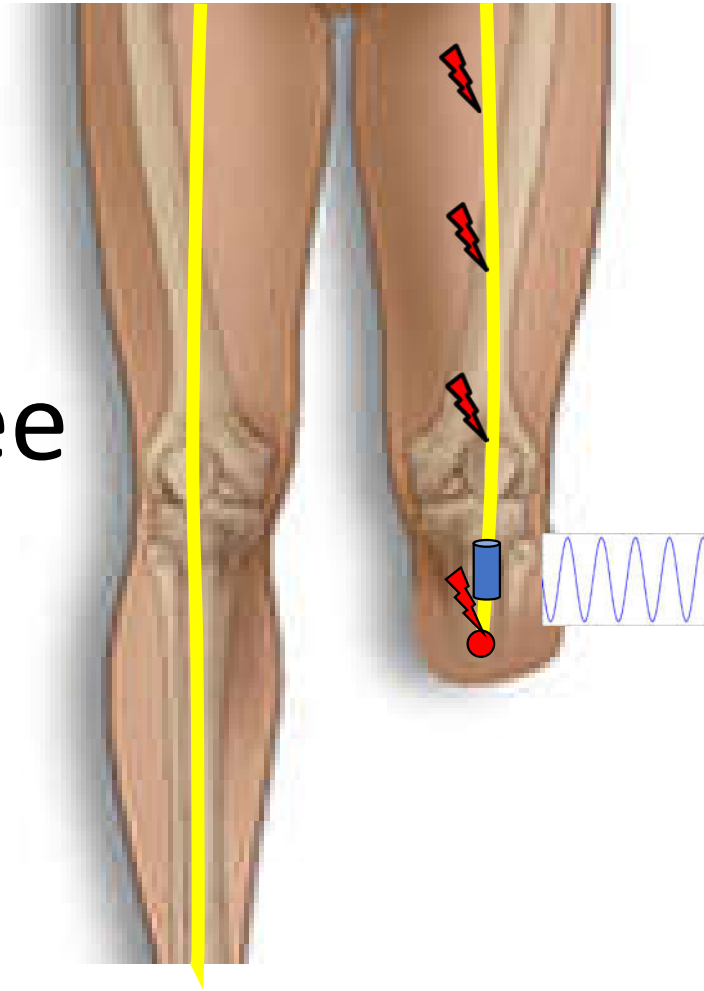
High Frequency Block



Bhadra & Kilgore, Muscle Nerve 2005
NIBIB R01



Amputee
Pain

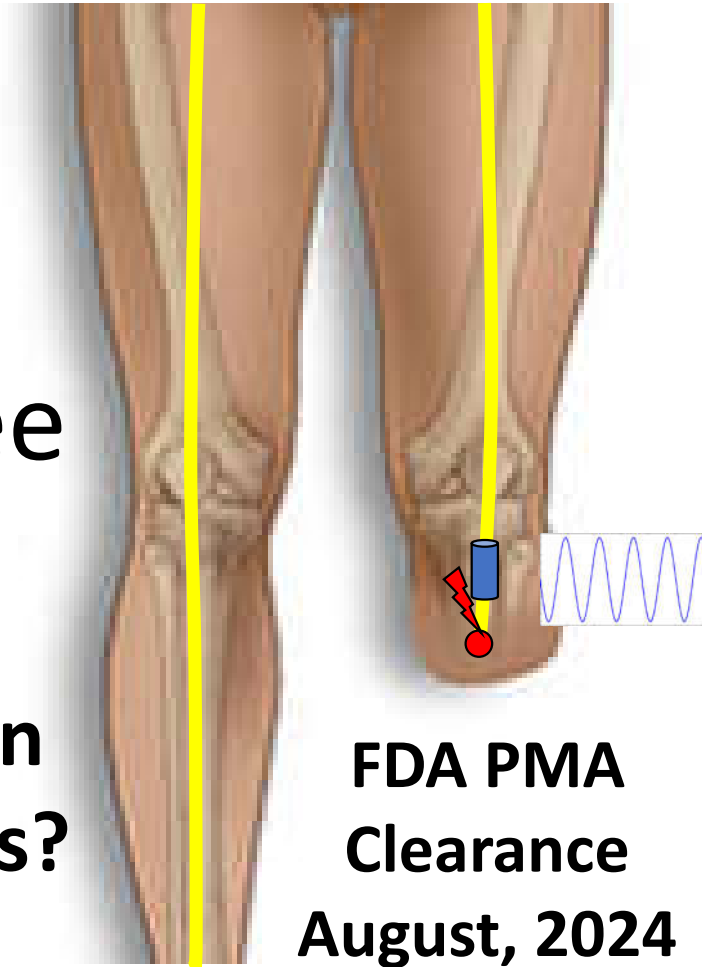


High
Frequency
Block

Amputee Pain

Other Pain Indications?

FDA PMA Clearance August, 2024



Long-Term Treatment of Chronic Postamputation Pain With Bioelectric Nerve Block: Twelve-Month Results of the Randomized, Double-Blinded, Cross-Over QUEST Study

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ABSTRACT

Objective: The multicenter, randomized, double-blinded, active-sham controlled trial (high-frequency nerve block for postamputation pain [QUEST]) was conducted to show the safety and efficacy of a novel, peripherally placed high-frequency nerve block (HFNB) system in treating chronic postamputation pain (PAP) in patients with lower limb amputations. The primary outcomes from QUEST were reported previously. This study presents the long-term, single-cross-over, secondary outcomes of on-demand HFNB treatment for chronic PAP.

Materials and Methods: After the three-month randomized period, subjects in the active-sham group were crossed over to receive therapy for 12 months. Subjects self-administered HFNB therapy as needed and reported their pain (numerical rating scale [NRS]; range, 1–10) before and 30 and 120 minutes after each treatment. Pain medication use was reported throughout the study. Pain-days per week and quality of life (QOL) were assessed using the Brief Pain Inventory (BPI). Adverse events (AEs) were recorded for all subjects implanted for 12 months.

Results: Of 180 subjects implanted in QUEST, 164 (91%) were included in the cross-over period, and 146 (82%) completed follow-up. By month 12, average NRS pain in the combined cohort was reduced by 2.3 ± 2.2 points (95% CI, 1.7–2.8; $p < 0.0001$) 30 minutes after treatment and 2.9 ± 2.4 points (95% CI, 2.2–3.6; $p < 0.0001$) 120 minutes after treatment. Mean pain-days per week were significantly reduced (-3.5 ± 2.7 days; $p < 0.001$), and subject daily opioid use was reduced by 6.7 ± 29.0 morphine equivalent dose from baseline to month 12 ($p = 0.013$). Mean BPI-interference scores (QOL) improved by 2.7 ± 2.7 points from baseline ($p < 0.001$). The incidence of nonserious AEs and serious AEs was 72% (130/180) and 42% (76/180), respectively; serious device-related AEs occurred in 15 of 180 subjects (8%).

Conclusion: Overall, HFNB delivered directly to the damaged peripheral nerve provided sustained, on-demand relief of acute PAP exacerbations, reduced opioid utilization, and improved QOL for patients with lower limb amputations with chronic PAP.

Keywords: High-frequency nerve block, neuropathic pain, peripheral nerve stimulation, phantom limb pain, postamputation pain

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Thank You!

