BEMS Reports, 2025; 11(2):28-31.
https://www.bemsreports.org

Brief Report

Peripheral Nerve Stimulation Enters the Mainstream: A New Era for Long-Term, Non-Pharmacologic Pain Management

Arun HS Kumar*

Stemcology, Department of Veterinary Biosciences, School of Veterinary Medicine, University College-Dublin, Belfield, Dublin, IRELAND.

ABSTRACT

Chronic pain affects over 150 million individuals across Europe and the United States, posing a major public health challenge due to its complexity, persistence, and limited treatment success. This report briefly outlines a recent study presenting the largest real-world registry to date on micro-implantable peripheral nerve stimulation (PNS), including over 2,200 patients with chronic peripheral neuralgia or neuropathy. In this study 94% of patients reported clinically meaningful improvements which highlights the broad applicability, consistency, and durability of micro-IPG PNS in clinical management of chronic pain. Compared to conventional non-pharmacologic modalities such as CBT, physical therapy, acupuncture, and TENS, implantable PNS offers deeper, more targeted neuromodulation without reliance on patient adherence or exposure to systemic side effects. While challenges such as surgical implantation, patient selection, and cost remain, PNS stands poised to become a front-line, precision-based therapy for chronic neuropathic pain. To realize its full potential, broader access through primary care integration, provider training, digital support tools, and reimbursement reform is essential. As healthcare shifts away from opioids, PNS offers a transformative option to address chronic pain with long-term efficacy, safety, and scalability.

Keywords: Chronic pain, Peripheral nerve stimulation, Micro-implantable device, Neuropathic pain, Non-pharmacologic therapy.

Correspondence:
Dr Arun HS Kumar
DVM, PhD., Stemcology, Department of Veterinary Biosciences, School of Veterinary Medicine, University College-Dublin, Belfield, Dublin-04, IRELAND.
Email: arun.kumar@ucd.ie

Received: 03-05-2025;
Revised: 25-05-2025;
Accepted: 17-06-2025.

INTRODUCTION

Chronic pain has long resisted easy solutions.[1,2] As opioid reliance wanes and the limitations of conventional therapies become more evident,[3,4] patients and clinicians alike are turning to more durable, targeted, and non-pharmacologic solutions. In this context, the large-scale real-world registry data presented by Hatheway *et al*.,[5] offers a pivotal moment in the evolution of chronic pain care. Their study the largest of its kind to date on implantable Peripheral Nerve Stimulation (PNS) builds decisively on earlier clinical trial evidence (COMFORT randomized controlled trial; Trial registration number: NCT05287373),[6] demonstrating that micro-implantable PNS devices offer consistent, long-lasting relief across a diverse chronic pain population.

Chronic pain affects an estimated 100 million people across Europe and more than 50 million adults in the United States, making it one of the most widespread and debilitating health conditions globally.[7-10] In the European Union alone, studies estimate that nearly 20-30% of adults suffer from chronic pain, with approximately 7-8% affected by neuropathic pain, a particularly persistent and distressing form caused by nerve damage or dysfunction.[11,12] Pharmacological options for managing chronic pain include Nonsteroidal Anti-Inflammatory Drugs (NSAIDs), opioids, anticonvulsants (gabapentin and pregabalin), antidepressants (duloxetine and amitriptyline), muscle relaxants (baclofen, tizanidine), NMDA receptor antagonists Ketamine), cannabinoids and topical agents (capsaicin or lidocaine).[13-15] While these therapies can offer symptomatic relief, particularly in nociceptive pain, their efficacy for neuropathic pain is often limited, with less than half of patients achieving clinically meaningful pain reduction.[16-19] Additionally, side effects ranging from dizziness, sedation, and gastrointestinal disturbances to the risk of dependence and misuse (especially with opioids) complicate long-term use.[20-22] As a result, a substantial proportion of chronic pain sufferers across both the EU and the U.S. remain inadequately managed,[23,24] reinforcing the urgent need for novel, safer, and more targeted non/pharmacological solutions.

Addressing the unmet need the PNS registry included over 2,200 patients with chronic peripheral neuralgia or neuropathy who received a micro-implantable pulse generator (micro-IPG).[5,6] The diversity of cases spanning the trunk, extremities, head, and neck, reflects the widespread and often intractable nature of chronic pain. Yet the results were remarkably uniform: 94% of patients achieved a clinically meaningful response, with nearly two-thirds

OPEN ACCESS

Manuscript TECHNOMEDIA

DOI: 10.5530/bems.11.2.6

Publishing Partner : Manuscript Technomedia. [www.mstechnomedia.com]

reporting they were "very much" or "much" improved. These findings weren't limited to one anatomical area or pain condition, suggesting broad utility and reinforcing the generalisability of PNS as a front-line intervention. This study's strength lies not only in its impressive sample size but in its real-world setting. Randomized controlled trials are invaluable, but they often operate under highly controlled conditions, with strict inclusion criteria that limit broader applicability. Hatheway and colleagues' registry provides a compelling counterpoint: that micro-IPG PNS works consistently well outside the confines of a trial, in patients living with real-world complexities, comorbidities, and variable follow-up. This level of external validity is critical if PNS is to move from specialized clinics into widespread adoption across pain management practices.

These findings also demand a closer comparison with current non-medical and non-surgical pain management strategies.[25,26] Modalities such as physical therapy, Cognitive-Behavioural Therapy (CBT), acupuncture, mindfulness meditation, and Transcutaneous Electrical Nerve Stimulation (TENS) have long served as staples in conservative care.[27-30] They are generally safe, widely accessible, and can offer meaningful relief, especially when delivered as part of a comprehensive, multidisciplinary pain management program.[25,26] However, the effectiveness of each modality varies significantly depending on the individual, the nature of the pain, and the duration of treatment. Physical therapy focuses on restoring function and mobility through exercises and postural training. Its greatest strengths lie in its ability to improve musculoskeletal alignment, enhance circulation, and strengthen supportive muscle groups. It is especially effective for mechanical or injury-related pain.[31,32] However, its benefits often plateau in cases of chronic neuropathic pain, where structural rehabilitation may not address the underlying nerve dysfunction. CBT offers psychological tools to reshape pain perception, reduce anxiety and depression associated with chronic pain, and improve coping strategies. Its merit lies in addressing the emotional and cognitive components of pain, which can amplify or prolong discomfort. Nevertheless, CBT does not target the physiological source of neuropathic pain and may be insufficient as a standalone therapy for severe cases with pronounced sensory abnormalities.[33,34] Acupuncture, an ancient modality rooted in traditional medicine practice, is believed to stimulate the nervous system and promote endogenous pain-relief mechanisms through the release of neurotransmitters like endorphins.[35,36] Some patients experience significant symptom relief, particularly for musculoskeletal and tension-related pain. However, scientific evidence for its efficacy in chronic neuropathic pain is mixed, and therapeutic outcomes can be inconsistent across practitioners and treatment settings. Mindfulness meditation and other mind-body techniques can modulate pain perception by enhancing awareness and promoting relaxation. These approaches reduce stress, improve emotional resilience, and have been shown to positively affect pain intensity and quality of life.[37-39] However, their impact tends to be modest and highly dependent on patient commitment and consistency over time. They often work best as adjuncts rather than primary interventions. TENS delivers low-voltage electrical impulses to disrupt pain signalling pathways. It is non-invasive, easily administered at home, and can provide temporary relief.[40-42] That said, its analgesic effects are often short-lived, and its efficacy for chronic neuropathic pain remains inconclusive. Many patients develop tolerance or find the sensation unpleasant, which can reduce adherence.

What differentiates PNS from other currently used non-pharmacological approaches, especially the newer micro-IPG systems is not just its targeted delivery but also its durability and precision.[5,6] By directly stimulating specific peripheral nerves involved in pain signalling, PNS avoids systemic side effects and enhances localized neuromodulation. Unlike TENS, which delivers low-intensity stimulation superficially, implantable PNS reaches deeper, more clinically relevant targets and can be customized in terms of intensity, frequency, and timing. This translates to greater control over symptoms and fewer daily limitations particularly valuable for patients whose quality of life has been significantly eroded by chronic pain. Furthermore, PNS sidesteps the challenges of patient adherence that often limit behavioural and physical therapies.[37,41] The implantable nature of the device means continuous, passive benefit without reliance on patient motivation or access to trained therapists. This is especially relevant for patients in rural or underserved settings, where long-term access to pain psychologists or physical therapy is constrained. Despite the demonstrated benefits, challenges remain. PNS, while minimally invasive, requires surgical implantation. That necessitates access to trained pain specialists, upfront costs, and appropriate patient selection. Like any interventional therapy, it is not universally appropriate, and long-term safety and device longevity continue to be areas of active study. Yet, when placed alongside other conservative modalities, the magnitude and consistency of effect observed in this registry elevate PNS from an experimental option to a central pillar of pain care.

Hatheway *et al.*,[5,6] have made a powerful case for the integration of implantable PNS systems into the broader landscape of chronic pain treatment. As healthcare systems shift away from opioids and demand more effective, non-pharmacologic, long-term solutions, PNS stands out not just as an adjunct but potentially as a first-line therapy for select patients. The real-world data confirms what trials have hinted: we now possess the tools to address chronic neuropathic pain with precision, safety, and lasting efficacy. One of the most promising developments enhancing the utility and adoption of PNS is the incorporation of image-guided approaches such as ultrasound and fluoroscopy, which allow for accurate lead placement, reduced procedural complications, and personalized targeting of the affected nerve. These techniques not only improve clinical outcomes but also shorten procedure

times and reduce the learning curve for new providers, making PNS more accessible in both specialist and primary care settings. Importantly, the integration of PNS with pharmacological therapies holds substantial potential for optimizing treatment outcomes. For patients with chronic neuropathic pain, combining PNS with targeted pharmacologic agents may provide additive or synergistic effects, enhance pain relief while potentially reduce the required dosage and duration of medication use. This multimodal approach supports individualized care plans that can address both peripheral and central mechanisms of pain, improve functional status, and minimize long-term drug-related side effects. As such, careful co-administration of PNS and pharmacological agents, guided by ongoing assessment and imaging technologies, represents a clinically pragmatic strategy to maximize patient benefit while advancing precision pain management.

To embed PNS more broadly into routine primary care practice, several solutions are needed: streamlined training programs for primary care providers, integration of device support teams for technical guidance, and simplified reimbursement pathways. Additionally, developing standardized protocols and leveraging digital platforms for remote monitoring and troubleshooting can enhance usability and follow-up efficiency. Expanding access to PNS delivery from pain specialists to trained primary care physicians offers significant advantages, most notably earlier intervention, increased patient reach in underserved areas, and reduced referral delays. With adequate support and training, primary care-led PNS delivery can complement specialist care, creating a tiered, scalable approach to managing chronic pain more effectively and equitably across diverse healthcare settings.

CONCLUSION

In conclusion, the findings from this recent large-scale real-world registry mark a pivotal advancement in chronic pain management, particularly for patients suffering from neuropathic pain conditions that have long eluded effective treatment. By demonstrating consistent, meaningful pain relief across a diverse patient population using micro-implantable PNS, the study provides compelling evidence for the broader clinical adoption of this technology. The integration of image-guided placement techniques and the potential for synergistic use with pharmacological agents may enhance its precision and utility.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

PNS: Peripheral nerve stimulation; **NSAID:** Nonsteroidal anti-inflammatory drug; **Micro-IPG:** Micro-implantable pulse generator; **CBT:** Cognitive-behavioural therapy; **TENS:** Transcutaneous electrical nerve stimulation.

REFERENCES

1. Kohrt BA, Griffith JL, Patel V. Chronic pain and mental health: integrated solutions for global problems. Pain. 2018; 159: S85-90.
2. Glajchen M. Chronic pain: treatment barriers and strategies for clinical practice. The Journal of the American Board of Family Practice. 2001; 14: 211-8.
3. Mielau J, Vogel M, Gutwinski S, Mick I. New approaches in drug dependence: opioids. Current Addiction Reports. 2021; 8: 298-305.
4. Phillips JK, Ford MA, Bonnie RJ. Pain management and the opioid epidemic: balancing societal and individual benefits and risks of prescription opioid use. 2017.
5. Hatheway JA, Ratino T, Swain A, Ratino T, Latif U, Arulkumar S, *et al.* Long-Term Pain Relief Delivered by MicroImplantable Pulse Generator: Findings from a Large-Scale, Real-World Data Peripheral Nerve Stimulation Patient Registry. Chronic Pain and Management Journal. 2025; 9: 1-7.
6. Hatheway J, Hersel A, Song J, Engle M, Gutierrez G, Khemlani V, *et al.* Clinical study of a micro-implantable pulse generator for the treatment of peripheral neuropathic pain: 3-month and 6-month results from the COMFORT-randomised controlled trial. Regional Anesthesia & Pain Medicine. 2024.
7. Fricton J, Lawson K, Gerwin R, Shueb S. Preventing Chronic Pain: Solutions to a Public Health Crisis. addiction. 2025; 14: 18.
8. Carrico J, Hicks KA, Wilson E, Panozzo CA, Ghaswalla P. The annual economic burden of respiratory syncytial virus in adults in the United States. The Journal of Infectious Diseases. 2024; 230: e342-e352.
9. Leadley R, Armstrong N, Lee Y, Allen A, Kleijnen J. Chronic diseases in the European Union: the prevalence and health cost implications of chronic pain. Journal of pain & palliative care pharmacotherapy. 2012; 26: 310-325.
10. Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. European journal of pain. 2006; 10: 287-333.
11. Liechti M, Menegon M, Schurz AP, Taeymans J, Baur H, Clijsen R, *et al.* Association between pain intensity and body composition in adults with chronic non-specific low back pain: A systematic review and meta-analysis. Obesity Reviews. 2025; 26: e13875.
12. Kovacs N, Biro E, Piko P, Ungvari Z, Adany R. Age-related shifts in mental health determinants from a deprived area in the European Union: informing the national healthy aging program of Hungary. GeroScience. 2024; 46: 4793-4807.
13. Patel NP, Bates CM, Patel A, Bates C. Developmental approaches to chronic pain: a narrative review. Cureus. 2023; 15.
14. Nadeau SE, Wu JK, Lawhern RA. Opioids and chronic pain: an analytic review of the clinical evidence. Frontiers in Pain Research. 2021; 2: 721357.
15. Cohen SP, Vase L, Hooten WM. Chronic pain: an update on burden, best practices, and new advances. The Lancet. 2021; 397: 2082-2097.
16. Gérard B, Bailly F, Trouvin A-P. How to treat chronic pain in Rheumatic and Musculoskeletal Diseases (RMDs)-A pharmacological review. Joint Bone Spine. 2024; 91: 105624.
17. Climent-Sanz C, Hamilton KR, Martínez-Navarro O, Briones-Vozmediano E, Gracia-Lasheras M, Fernández-Lago H, *et al.* Fibromyalgia pain management effectiveness from the patient perspective: a qualitative evidence synthesis. Disability and rehabilitation. 2024; 46: 4595-610.
18. Johnson MI, Paley CA, Jones G, Mulvey MR, Wittkopf PG. Efficacy and safety of transcutaneous electrical nerve stimulation (TENS) for acute and chronic pain in adults: a systematic review and meta-analysis of 381 studies (the meta-TENS study). BMJ open. 2022; 12: e051073.
19. Gianola S, Bargeri S, Del Castillo G, Corbetta D, Turolla A, Andreano A, *et al.* Effectiveness of treatments for acute and subacute mechanical non-specific low back pain: a systematic review with network meta-analysis. British journal of sports medicine. 2022; 56: 41-50.
20. Shkodina AD, Bardhan M, Chopra H, Anyagwa OE, Pinchuk VA, Hryn KV, *et al.* Pharmacological and non-pharmacological approaches for the management of neuropathic pain in multiple sclerosis. CNS drugs. 2024; 38: 205-24.
21. Shetty A, Delanerolle G, Cavalini H, Deng C, Yang X, Boyd A, *et al.* A systematic review and network meta-analysis of pharmaceutical interventions used to manage chronic pain. Scientific Reports. 2024; 14: 1621.
22. Karunarathna I. Morphine Sulfate: clinical applications and pharmacological considerations. Uva Clin Lab. 2024; 10.
23. Karra R, Holten-Rossing S, Mohammed D, Parmeggiani L, Heine M, Namnún OC. Unmet needs in the management of functional impairment in patients with chronic pain: A multinational survey. Pain Management. 2021; 11: 303-14.
24. Häuser W, Morlion B, Vowles KE, Bannister K, Buchser E, Casale R, *et al.* European* clinical practice recommendations on opioids for chronic noncancer pain-Part 1: Role of opioids in the management of chronic noncancer pain. European Journal of Pain. 2021; 25: 949-68.
25. Morrissey MC, Laakso E-L, Belafsky PC. Cancer treatment-related head and neck fibrosis: a narrative perspective of epidemiology, pathophysiology, prevention, assessment and non-surgical treatment. Physical Therapy Reviews. 2025: 1-11.
26. Brisman MH. Non-surgical Management of Neurosurgery Patients. In: Put Down the Knife: A Fresh Look at Adult Brain Surgery. Springer; 2023: 121-7.

27. Vieira S, Liang X, Guiomar R, Mechelli A. Can we predict who will benefit from cognitive-behavioural therapy? A systematic review and meta-analysis of machine learning studies. Clinical Psychology Review. 2022; 97: 102193.
28. Nielsen A, Dusek JA, Taylor-Swanson L, Tick H. Acupuncture therapy as an evidence-based nonpharmacologic strategy for comprehensive acute pain care: the academic consortium pain task force white paper update. Pain Medicine. 2022; 23: 1582-612.
29. Jones I, Johnson MI. Transcutaneous electrical nerve stimulation. Continuing Education in Anaesthesia, Critical Care & Pain. 2009; 9: 130-5.
30. Schreiner I, Malcolm JP. The benefits of mindfulness meditation: Changes in emotional states of depression, anxiety, and stress. Behaviour Change. 2008; 25: 156-68.
31. Vieira ER, Svoboda S, Belniak A, Brunt D, Rose-St Prix C, Roberts L, *et al.* Work-related musculoskeletal disorders among physical therapists: an online survey. Disability and rehabilitation. 2016; 38: 552-7.
32. Kolski MC, O'Connor A, Van Der Laan K, Lee J, Kozlowski AJ, Deutsch A. Validation of a Pain Mechanism Classification System (PMCS) in physical therapy practice. Journal of Manual & Manipulative Therapy. 2016; 24: 192-9.
33. Eccleston C, Hearn L, de C Williams AC. Psychological therapies for the management of chronic neuropathic pain in adults. Cochrane Database of Systematic Reviews. 2015.
34. Heutink M, Post MW, Luthart P, Schuitemaker M, Slangen S, Sweers J, *et al.* Long-term outcomes of a multidisciplinary cognitive behavioural programme for coping with chronic neuropathic spinal cord injury pain. Journal of rehabilitation medicine. 2014; 46: 540-5.
35. Coutaux A. Non-pharmacological treatments for pain relief: TENS and acupuncture. Joint Bone Spine. 2017; 84: 657-61.
36. Ondrejkovičová A, Petrovics G, Svitkova K, Bajtekova B, Bangha O. Why acupuncture in pain treatment? Neuroendocrinology Letters. 2016; 37.
37. Voss S, Boachie DA, Nieves N, Gothe NP. Mind-body practices, interoception and pain: a scoping review of behavioral and neural correlates. Annals of Medicine. 2023; 55: 2275661.
38. Poletti S, Abdoun O, Zorn J, Lutz A. Pain regulation during mindfulness meditation: Phenomenological fingerprints in novices and experts practitioners. European Journal of Pain. 2021; 25: 1583-602.
39. Hassed C. Mind-body therapies: Use in chronic pain management. Australian family physician. 2013; 42: 112-7.
40. Angelini E, Josefsson C, Ögren C, Andréll P, Wolf A, Ringdal M. Patients´ experiences of TENS as a postoperative pain relief method in the post-anesthesia care unit after laparoscopic cholecystectomy: a qualitative study. BMC anesthesiology. 2025; 25: 18.
41. Ögren C, Varkey E, Wolf A, Larsson C, Ringdal M, Andréll P. High-frequency, high-intensity TENS compared to standard treatment with opioids for postoperative pain relief after laparoscopic cholecystectomy: A multicentre randomized controlled trial. European Journal of Pain. 2024; 28: 1772-84.
42. Arik MI, Kiloatar H, Aslan B, Icelli M. The effect of TENS for pain relief in women with primary dysmenorrhea: A systematic review and meta-analysis. Explore. 2022; 18: 108-13.

Cite this article: Kumar AHS. Peripheral Nerve Stimulation Enters the Mainstream: A New Era for Long-Term, Non-Pharmacologic Pain Management. BEMS Reports. 2025;11(2):28-31.