Peripheral Nerve Stimulation for Knee Pain: A Systematic Review of Emerging Evidence

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Background:
Chronic knee pain, affecting approximately 25% of adults, often results from osteoarthritis (OA) or post-surgical complications, significantly impacting mobility, quality of life, and reliance on pain management strategies. Traditional treatments, including opioids, injections, and surgery, can yield suboptimal results, highlighting the need for innovative solutions. Peripheral nerve stimulation (PNS) offers a minimally invasive alternative by disrupting nociceptive signaling, which refers to the transmission of pain signals from sensory nerves to the central nervous system, and modulating pain perception through targeted neuromodulation Recent advancements in device technology position PNS as a viable option for patients ineligible for or wishing to postpone surgery. This review evaluates the efficacy of PNS in reducing pain, opioid use, and improving functionality.

Methods:
This review followed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which provide a framework for ensuring methodological rigor and transparency in systematic reviews. A comprehensive search strategy was conducted across PubMed, Cochrane, Embase, and Scopus databases using terms such as "Peripheral nerve stimulation," "knee pain," "genicular nerve stimulation," and "neuromodulation." Studies published after 2010, involving patients aged 18 years or older, and reporting outcomes such as pain relief, functional improvements, or opioid reduction were included. Study designs considered were randomized controlled trials (RCTs), case series, and prospective or retrospective studies. Excluded studies focused on non-knee-related PNS, were published before 2010, or lacked full-text access. Data extraction included patient demographics, nerves targeted, device settings, pain scores, opioid use, functional outcomes, and adverse events.

Results:
Across all studies, PNS demonstrated notable trends in pain reduction, with most patients experiencing significant improvements within six months of intervention. Pain relief during motion and rest was consistent, underscoring its efficacy in managing both static and dynamic discomfort. Opioid consumption decreased significantly in patients receiving PNS, with many transitioning to lower doses or achieving complete cessation. Functional improvements, such as enhanced mobility and activities of daily living, were also commonly reported, reflecting meaningful gains in quality of life. Adverse events were rare and generally mild, including minor cramping or lead dislodgement, further supporting PNS as a safe intervention for chronic knee pain.

Conclusion:
Peripheral nerve stimulation (PNS) is a minimally invasive and effective treatment for chronic knee pain, providing significant pain relief, reduced opioid use, and improved mobility and quality of life. However, the current evidence base is limited by small sample sizes, inconsistent methodologies, and short follow-up periods. Future research should prioritize large-scale, standardized trials to validate these findings, with a focus on incorporating long-term patient-reported outcomes (PROs). These steps are crucial to establishing PNS as a reliable standard of care in chronic pain management.