Emerging Applications of Spinal Cord Stimulation in Movement Disorders Beyond Parkinson's Disease and Dystonia

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Abstract

Introduction: Movement disorders, such as essential tremor, spasticity, and other less prevalent conditions, significantly impact motor function and quality of life in many patients. Consequently, effective therapeutic alternatives are essential to improve clinical management. Spinal cord stimulation (SCS), traditionally used for chronic pain, has emerged as a promising therapeutic option in this context. This study aims to review the effectiveness of SCS in treating movement disorders, identifying its benefits, limitations, and future perspectives.

Method: This systematic review followed the PRISMA protocol. A comprehensive search was performed in PubMed, Embase, Scopus, Web of Science, BVS (including LILACS), and Cochrane. The strategy included keywords such as "Spinal Cord Stimulation," "Movement Disorders," and "Essential Tremor." Inclusion criteria encompassed articles, case reports, and books discussing SCS in movement disorders, focusing on publications from the last 20 years.

Results: A total of 31 studies were included: 19 case reports, 11 case series, and 1 case-control study. SCS demonstrated promising results across various disorders. In refractory essential tremor, cervical SCS (C2) in burst mode led to sustained improvement for up to 23 months. In post-cervical fusion disorders, implants in C5–C6 and C7–T1, with frequencies of 39–52 Hz and pulse widths of 450–470 µs, eliminated symptoms immediately. In orthostatic tremor, thoracic SCS (T11–T12) reduced tremors by 30%–60% and improved postural stability. For spinocerebellar ataxia type 7, thoracic implantation (T11) with 130 Hz, 5 V, and pulse widths of 60–450 µs showed slight gait improvement. In patients with spasticity, SCS applied to the C2–C5, T9–T12, and L1 regions led to reduced muscle tone, pain relief, and functional improvement. In cases of spasticity due to cerebral palsy or spinal cord injury, muscle tone reduction was observed in all patients with spinal spasticity. In cerebral spasticity, the greatest benefits were seen in lower spastic paraparesis. The most effective parameters included frequencies of 40–130 Hz, pulse widths > 450 µs, and amplitudes up to 5 V.

Discussion: SCS has shown potential in treating essential tremor and spasticity, particularly in refractory cases, likely due to modulation of motor circuits. It also presents a low rate of adverse effects. However, variability in stimulation parameters and implantation sites (cervical, thoracic, lumbar) challenges standardization. The lack of randomized trials and possible placebo effects, influenced by paresthesias, limit scientific validation. Although less invasive, broader clinical use of SCS in movement disorders requires controlled studies to optimize protocols and confirm its benefits.

Conclusions: SCS is a promising therapy for movement disorders, especially essential tremor and spasticity. Nonetheless, technical and accessibility challenges demand further research to support its validation and wider clinical application.

References

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