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Review Article

Pelvic Nerve Stimulation for Chronic Pelvic Pain Disorder in Women: A Clinical Review

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Abstract

Chronic pelvic pain (CPP) in women is multifactorial and often refractory to conventional therapies. Neuromodulation-targeting sacral roots, the pudendal nerve, and, more recently, the dorsal root ganglion (DRG)-has emerged as a useful option for carefully selected patients. Evidence supports sacral neuromodulation (SNM) for refractory pelvic pain syndromes (including bladder pain syndrome), growing-though still heterogeneous-support for pudendal peripheral nerve stimulation (PNS), and promising but low-to-moderate quality data for DRG stimulation in neuropathic pelvic pain. This review synthesizes current mechanisms, patient selection, procedural approaches, outcomes, safety, and a practical algorithm for clinical use.

Keywords: *Chronic Pelvic Pain (CPP); Neuromodulation (NM); Dorsal Root Ganglion (DRG); Sacral Nerve Stimulation (SNS); Sacral Neuromodulation (SNM); Peripheral Nerve Stimulation (PNS)*

Introduction

Chronic pelvic pain (CPP) affects 15 - 20% of women worldwide and carries a significant physical, psychological, and socioeconomic burden. It is defined as noncyclic pelvic pain lasting at least 6 months and is commonly associated with conditions such as endometriosis, bladder pain syndrome, pudendal neuralgia, and post-surgical neuropathic pain [1,4].

The pathophysiology involves central sensitization, altered nociceptive signaling, and autonomic dysregulation, making treatment complex. Traditional management-such as medications, physiotherapy, and nerve blocks-often provides incomplete relief. Neuromodulation has emerged as a minimally invasive, reversible option that directly targets aberrant neural pathways [2,5].

A literature review was conducted using PubMed, Cochrane, and guideline repositories from 2020-2025. Search terms included “chronic pelvic pain”, “sacral neuromodulation”, “pudendal nerve stimulation” and “dorsal root ganglion stimulation”. We included randomized trials, systematic reviews, meta-analyses, and high-quality observational studies [3,4].

Neuromodulation modalities and evidence

Sacral nerve stimulation (SNS)

Mechanism: SNS involves electrical stimulation of sacral nerve roots (typically S3), modulating afferent and efferent signaling within spinal and supraspinal circuits. Originally approved for overactive bladder, SNM has been repurposed for refractory CPP to alter dysfunctional neural pain processing [1].

Clinical evidence:

- A systematic review of 26 studies involving 853 CPP patients demonstrated significant pain reductions (mean decrease in pain scores ~4.6/10) and improved quality of life sustained over long-term follow-up (~42.5 months).
- Prospective cohort and RCT evidence, though limited, suggests durable analgesic effects and reduced analgesic use following SNM implantation.

Advantages:

- Produces sustained pain reduction and improvement in functional quality of life.
- Suitable for refractory cases when conservative measures fail.

Limitations:

- Invasive procedure requiring trial stimulation and potential permanent implantation.
- Complications include lead migration, infection, and the need for reoperation.

Percutaneous tibial nerve stimulation (PTNS)

Mechanism: PTNS stimulates the posterior tibial nerve, engaging mixed sensory-motor fibers originating from L4-S3 that modulate sacral spinal cord activity indirectly influencing pelvic structures [2].

Clinical evidence:

- Prospective studies indicate significant reductions in pain intensity and pain frequency, improvement in sexual pain and quality of life after weekly PTNS sessions.
- Case series show clinically meaningful pain relief (≥ 50% VAS reduction) and improved daily functioning.

Advantages:

- Minimally invasive, typically outpatient, with favorable safety profile.
- May benefit women intolerant of more invasive neuromodulation.

Limitations:

- Evidence is predominantly small case series; long-term outcomes and standardized protocols are lacking.

Transcutaneous electrical nerve stimulation (TENS)

Mechanism: TENS applies surface electrical stimulation to dermatomes corresponding to pelvic innervation, activating large-fiber afferents to inhibit nociceptive transmission via gate-control mechanisms [3].

Clinical evidence:

- Systematic reviews report modest pain reduction in women with CPP, with effectiveness depending on frequency, duration, and intensity parameters.
- Data supports better outcomes with high-frequency stimulation at tolerable intensities.

Advantages:

- Non-invasive, low cost, and generally well tolerated.

Limitations:

- Effect size is mild compared with invasive methods.
- Protocol heterogeneity and variable patient adherence limit strong conclusions.

Pudendal nerve stimulation (PNS)

Mechanism: Direct stimulation of the pudendal nerve (S2-S4 fibers) targets somatic pathways associated with pelvic floor and perineal sensory innervation, potentially modulating pain via interrupting nociceptive signalling [5].

Clinical evidence:

- Early trials and retrospective analyses suggest PNS can yield significant pain reductions, sometimes outperforming SNM in select cohorts.
- Case series in pudendal neuralgia demonstrated substantial ≥ 50% pain improvement following leads placed at the pudendal nerve.

Advantages:

- Targeted approach for neuralgic pain syndromes.
- Useful when SNM fails or for peripheral nerve-dominant CPP.

Limitations:

- Technically more challenging implantation.
- Limited large-scale, long-term RCT evidence.

Emerging and adjunctive techniques

Dorsal root ganglion (DRG) and spinal cord stimulation

Although evidence is currently limited, DRG stimulation and conventional spinal cord stimulation have been applied in refractory CPP with promising preliminary outcomes, particularly for neuropathic components [4].

Integration with pelvic floor rehabilitation

Combining neuromodulation with pelvic floor physical therapy, psychological support, and multimodal pain management may enhance outcomes given the multifactorial etiology of CPP. Evidence from related pelvic pain domains supports multidisciplinary care [4].

Discussion

CPP's heterogeneity complicates direct comparisons across stimulation modalities. Sacral neuromodulation currently has the most robust evidence, particularly for pain associated with bladder-centric syndromes (IC/BPS). However, PTNS and pudendal stimulation

show promising results, especially for musculoskeletal and peripheral neural pain. Non-invasive TENS remains a reasonable adjunct or first-line for mild to moderate pain. Across modalities, limitations include small sample sizes, lack of large RCTs, and inconsistent outcome measures.

Future research should prioritize head-to-head RCTs, standardized stimulation protocols, and mechanistic exploration of neural modulation in CPP pathophysiology. Multimodal approaches that combine neuromodulation with physical and psychological therapies may further optimize clinical outcomes.

Technique	Indications	Success Rate	Key Risks
Sacral Neuromodulation (SNM)	IC/BPS, CPP with LUTS, mixed visceral pain	50 - 70% long-term pain relief	Lead migration, infection, pain at implant site
Pudendal PNS	Pudendal neuralgia, vulvodynia, focal pelvic neuropathic pain	40 - 60% (heterogeneous evidence)	Lead migration, neuritis, infection
DRG Stimulation	Neuropathic CPP, post-surgical pain, focal dermatomal pain	50 - 80% (small series)	Lead fracture, infection, programming complexity

Table 1: *Comparison of different neuromodulation techniques on chronic pelvic pain syndrome and their success rate and risks factors.*

Conclusion

Pelvic nerve stimulation represents a growing therapeutic frontier for chronic pelvic pain in women. Sacral neuromodulation offers substantial evidence for meaningful pain reduction and quality of life improvement, while PTNS, TENS, and pudendal stimulation provide alternatives tailored to specific pain phenotypes. Limited high-quality evidence and heterogeneous methodologies underscore the need for rigorous comparative trials. Nonetheless, neuromodulation should be considered a valuable element in the comprehensive management of refractory CPP. Below we made a comparative analysis table based on current evidenced based neuromodulation treatments and available success rates and key risks factors.

Conflict of Interest

We declare that there is no conflict of interest.

Bibliography

1. SNM and long-term CPP outcomes: Sacral neuromodulation shows significant pain reduction and quality of life improvements in women with chronic pelvic pain, with effects maintained over long follow-up.
2. PTNS evidence: PTNS reduces pain intensity and improves quality of life and sexual pain in women with CPP.
3. TENS systematic review: TENS provides mild pain relief in CPP, with effectiveness varying by stimulation parameters.
4. Neuromodulation systematic review: Peripheral nerve stimulation appears promising; SNM and PTNS exhibit evidence of pain improvement, with PNS less studied.
5. PNS applications: Pudendal stimulation may outperform SNM in some refractory pain settings, with targeted relief.

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