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Peripheral Nerve Stimulation Implant for Chronic Posttraumatic Hip and Pelvic Pain: A Case Report

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Background: Chronic hip and pelvic pain following trauma can be challenging to treat, particularly when pain originates from multiple nerve distributions. Traditional treatments often provide limited relief; peripheral nerve stimulation is a minimally invasive alternative.

Case Report: A 68-year-old woman with persistent pelvic and hip pain following a right iliac wing fracture reported minimal response to medications and injections. Diagnostic nerve blocks targeting the obturator nerve, femoral sensory branches, and middle cluneal nerve, provided significant but short-term pain relief. A peripheral nerve stimulation trial targeting the middle cluneal, obturator, and femoral nerves resulted in a 75% reduction in pain. Following permanent implantation, a revision was required due to lead migration. Post revision, pain levels stabilized at 3-4/10 across both anterior and posterior pain distributions, with sustained improvement at 12 months.

Conclusion: This case demonstrates the feasibility and sustained benefit of externally powered peripheral nerve stimulation for chronic posttraumatic hip and pelvic pain.

Key words: Peripheral nerve stimulation, chronic pelvic pain syndrome, middle cluneal nerve, sensory branches of femoral and obturator nerves

BACKGROUND

Chronic Pelvic Pain Syndrome is a prevalent condition worldwide, occurring twice as frequently in women as in men in the United States (1). Notably, approximately 80% of pelvic pain in women originates from non-gynecologic causes (2). Chronic pain following pelvic fractures affects nearly half of patients (48.4%), and is associated with a substantial impairment in quality of life and physical functioning (3).

Managing chronic pelvic pain requires a multidisciplinary approach, including physical therapy; pharmacologic and nonpharmacologic therapies; interventional procedures; and surgical options. However, due to the complex neural anatomy of the pelvic and hip regions, employing nerve blocks or neuromodulation techniques presents unique challenges. Trauma-related factors, such as joint misalignment or unhealed fractures, can further exacerbate pain arising from the hip joint and sacral areas.

Peripheral nerve stimulation (PNS) is a minimally invasive and targeted neuromodulation strategy for managing chronic pain syndromes, particularly when conventional treatments have proven inadequate. By selectively modulating the activity of peripheral nerves,

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PNS may offer sustained pain relief with fewer systemic side effects. Its growing application for various neuropathic and musculoskeletal pain conditions supports its consideration for challenging pain presentations, including chronic posttraumatic pelvic and hip pain (4).

The pelvis receives innervation from the lumbar, sacral, cluneal, and coccygeal plexuses. The femoral and obturator nerves provide innervation to the anterior hip joint (5).

Middle cluneal nerve (MCN) entrapment has been identified as a potential source of lower back and leg pain symptoms (6,7). MCNs are purely sensory cutaneous nerves originating from the dorsal rami of the S1–S4 sacral nerve roots. Their lateral branches traverse the long posterior sacroiliac ligament, where they can become entrapped near the iliac crest, resulting in symptoms that mimic sacroiliac joint pain (6,8).

To our knowledge, peripheral PNS targeting the obturator, femoral articular branches, and middle cluneal nerves has not been previously reported for treating chronic posttraumatic hip and pelvic pain. Our case report highlights the potential of this approach for managing pain within regions characterized by complex neural distributions.

CASE PRESENTATION

A 68-year-old woman presented with persistent pelvic and hip pain 9 months after sustaining a right iliac wing fracture due to a mechanical fall. X-rays revealed a hypertrophic nonunion fracture with displacement of the pubic symphysis and right sacroiliac joint. She described her pain as constant and excruciating, rating it 8 out of 10 on the 11-point Numeric Rating Scale. Her pain radiated to the lateral buttock and groin, worsening with walking, movement, transitioning from sitting to standing, climbing stairs, and getting in and out of a vehicle.

She provided written informed consent to use her clinical information and imaging in this case report.

The patient managed her pain with tramadol (50 mg 3 times daily), gabapentin (600 mg twice daily), and baclofen (10 mg at bedtime). Right sacroiliac joint and hip intra-articular steroid injections provided short-term relief. Diagnostic nerve blocks targeting the right obturator and femoral articular nerve branches resulted in a 75% pain reduction in pain, decreasing from 8/10 to 2/10 for 2 days. After repeat injections, her symptoms improved by 50%, with the pain rating going from 8/10 to 4/10 for one week. Additionally, an MCN steroid and local anesthetic injection achieved 100% pain relief on day one, reducing her pain from 8/10 to 0/10. This relief was sustained for approximately one week, with the pain slowly returning to 3/10 by the end of that week.

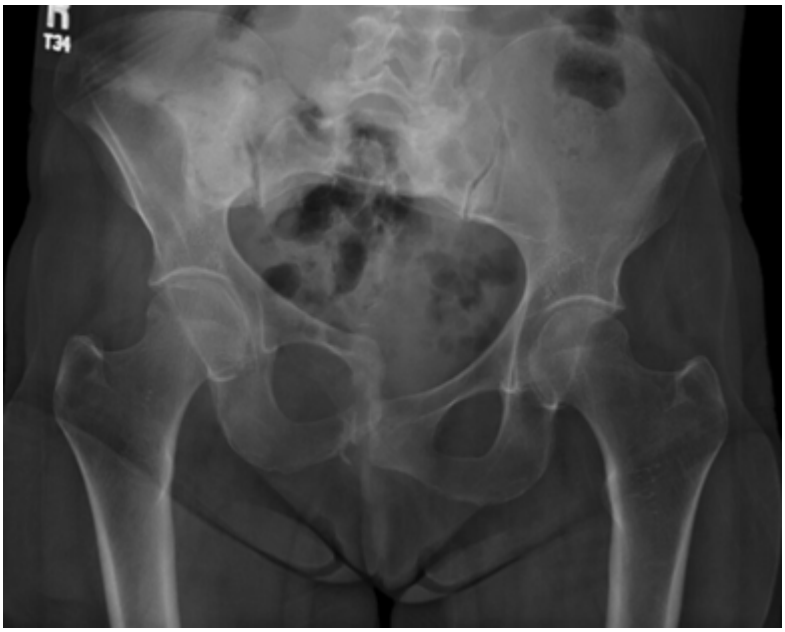

Fig. 1. X-ray pelvis: inlet and outlet views. This image shows diastasis of the pubic symphysis with approximately 3–4 cm posterior displacement of the right pubis relative to the left. Asymmetric widening of the right sacroiliac joint and a slightly displaced right parasymphyseal fracture are seen. No femoral or acetabular fractures are seen.

Due to the transient relief from these interventions and her inability to undergo surgery, we evaluated her for PNS. After a psychological evaluation, she became an appropriate candidate for a PNS trial using the Freedom® Peripheral Nerve Stimulator System (Curonix LLC). This device has an external, wireless, rechargeable transmitter assembly using high-frequency electromagnetic coupling (9).

During the trial, 8-contact nontined electrode arrays were placed adjacent to the right MCN, obturator nerve, and femoral articular nerve branches. Over the course of one week, the patient reported significant improvement in her activities of daily living and a 75% reduction in pain, from a baseline pain

score of 8/10 to 2/10 on the Numeric Rating Scale. Based on these results, she underwent permanent implantation with 4-contact tined electrode arrays connected to separate receivers.

At one-month postimplantation, she reported inadequate pain relief. Imaging identified neurostimulator migration; the middle cluneal neurostimulator had displaced cranially and the femoral and obturator neurostimulators had displaced caudally. Revision surgery occurred 2 months after the initial implantation.

At the one-month postrevision follow-up, she reported good pain relief in both the anterior and posterior distributions, with a 50%–70% improvement in the posterior region (from a baseline pain level of 8/10 to 3–4/10) and a 30%–50% improvement in the anterior region (from a baseline pain level of 7/10 to 4–5/10). This pain relief continued at the 3-month follow-up. She reported that her pain would recur within 2 hours if the stimulator was turned off.

By the 6-month follow-up, pain control remained consistent, with a 50%–70% improvement in both anterior and posterior distributions (posterior pain decreased from 8/10 to 3–4/10, and anterior pain decreased from 7/10 to 3–-4/10). Imaging confirmed stable placement of the system.

At the 9- and 12-month follow-ups, she continued to have 50% pain relief in both the anterior and posterior distributions (posterior pain remained at 4/10, and anterior pain remained at 3–4/10). However, she reported worsening thigh and lateral leg pain, with a 50% increase in pain intensity (pain increased from 4/10 to 6/10) when walking or standing. Lumbar magnetic resonance imaging revealed stenosis due to ligamentum flavum thickening, which was treated with a lumbar epidural steroid injection, which provided a 33% reduction in pain (from 6/10 to 4/10).

METHODS

Middle Cluneal Nerve Trial Implantation

- The patient was positioned prone and prepped and draped using sterile technique.
- Using fluoroscopy and ultrasound, a 13G Coudé needle was advanced from the lower L4 area, lateral to the transverse process, until it gently contacted the posterior surface of the sacrum, lateral to the S1 dorsal foramen, superficial to the posterior sacral crest, and medial to the sacroiliac joint. The needle was then advanced until its tip reached the area lateral to the S3 foramen within the posterior thoracolumbar fascia. Proper placement was confirmed using fluoroscopy in both anteroposterior and lateral views, along with ultrasound. An 8-contact, nontined electrode was then advanced through the needle. The steering stylet was removed, and the electrode array was connected to a separate receiver. Subsequently, the needle was removed, intraoperative testing was performed, and appropriate positioning was confirmed. The patient reported paresthesia around the sacroiliac joint. Finally, the neurostimulator was sutured at the skin level and covered with an adhesive dressing (Fig. 2A).

Femoral and Obturator Sensory Branches Trial Implantation

- The patient was then positioned supine, and the abdomen and groin were prepped and draped. High-frequency ultrasound was used to visualize the femoral artery and bowel, while fluoroscopy was used to align the obturator foramen.
- A 13G Coudé needle was guided medially and superiorly in order to target the sensory branches of the femoral and obturator nerves, with the intent of covering both nerve distributions. The femoral sensory branches were targeted at the superolateral aspect of the hip capsule at the middle third of the iliopectineal line. The obturator sensory branches were targeted lateral to the obturator foramen, inferior to the acetabulum, at the teardrop shadow (medial inferior aspect of the incisura acetabuli).
- Placement was confirmed with fluoroscopy. Electrode positioning deep to the femoral vessels and iliopsoas tendon was confirmed with ultrasound. An 8-contact, nontined electrode array was advanced through the needle. The steering stylet was removed, and the electrode array was connected to a separate receiver. The needle was then removed, intraoperative testing was performed, and appropriate positioning was confirmed, with the patient reporting paresthesia in the distribution of her groin pain. The neurostimulator was sutured in place, and an adhesive dressing was applied.
- Pain distribution was assessed following trial stimulation and programming adjustments.

The distal 4 contacts, targeting the obturator sensory branches, provided greater relief of her anteromedial hip pain compared with the proximal 4 contacts. Both neurostimulators were programmed to an amplitude of 3, a pulse rate of 1499 Hz, and a pulse width of 30 μs (Fig. 2B).

Middle Cluneal Nerve Permanent Implantation

- The patient was positioned prone. Following sterile preparation, the patient received 2 grams of cefazolin intravenously. Local anesthetic was infiltrated, and an incision was made lateral to the L4 transverse process.
- A 13G blunt introducer was inserted, and a 2-0 nonabsorbable suture was placed around the introducer. The introducer was advanced under ultrasound and fluoroscopic guidance in the anteroposterior view. The tip was tracked with ultrasound until it was superficial to the posterior sacral crest, medial to the sacroiliac joint, and lateral to the sacral foramen within the posterior thoracolumbar fascia. It was then advanced to a position lateral to the S3 dorsal foramen. Proper placement was confirmed using fluoroscopy in anteroposterior and lateral views. A 4-contact, tined Freedom electrode array was advanced through the introducer. The steering stylet was removed, and the electrode array was connected to the separate receiver. The needle was removed, intraoperative testing was performed, and positioning was confirmed.
- A second incision was made to create a receiver coil pocket in the lower thoracic paraspinal region. A tunneled blunt introducer was used to subcutaneously tunnel the neurostimulator from the initial incision site to the receiver pocket. The distal end of the neurostimulator was coiled and secured to the deep fascia using 2-0 nonabsorbable sutures.

Femoral and Obturator Sensory Branches Permanent Implantation

- The patient was positioned supine. Additional local anesthetic was infiltrated at the needle entry site in the right lower abdominal quadrant, followed by the initial incision. Subcutaneous tissue was dissected until the fascia was visualized and palpated. A 13G blunt introducer was inserted, and a 2-0 nonabsorbable suture was placed around the introducer. The introducer was advanced under combined ultrasound and fluoroscopic guidance in the anteroposterior view. The introducer tip was tracked to the predetermined target for the 4-contact tined electrode array covering the obturator sensory branches, as defined during the trial phase. The target was identified lateral to the obturator foramen, inferior to the acetabulum, at the teardrop (medial inferior aspect of the incisura acetabuli). The steering stylet was removed, and the electrode array was connected to a separate receiver. The needle was removed, intraoperative testing was performed, and appropriate positioning was confirmed.

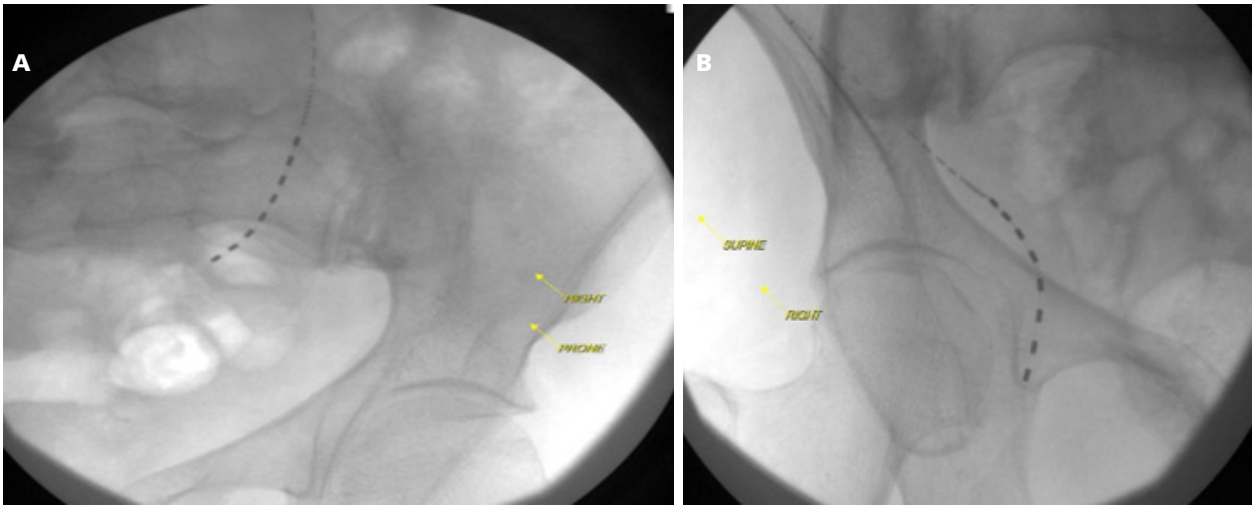

Fig. 2. A. Fluoroscopic image of the middle cluneal nerve 8-lead trial. B. 8-contact lead for both the femoral and obturator sensory branches.

- Following additional local anesthetic infiltration, a second incision was made to create a receiver coil pocket in the lateral midabdominal region along the midaxillary line. A tunneled blunt introducer was used to subcutaneously tunnel the neurostimulator from the initial incision site to the receiver pocket. The distal end of the neurostimulator was coiled and secured to the deep fascia using 2-0 nonabsorbable sutures.
- For the revision procedure performed due to stimulator migration, the same procedural steps were repeated following explantation of both systems (Fig. 3).

DISCUSSION

Clinical Rationale and Overview

PNS is an emerging treatment that offers a long-term option for managing chronic hip and sacroiliac pain. For patients with chronic pain in specific nerve distributions, percutaneous PNS placement can be a viable treatment option. However, hip and pelvic pain present challenges for PNS because the nerve supply originates from both the lumbar and sacral plexuses, making it difficult to target a specific nerve for complete coverage (9). In our patient's case, we successfully targeted the middle cluneal nerve, as well as the obturator and femoral sensory articular terminal branches, in order to treat chronic posttraumatic hip and pelvic pain. To our knowledge, this represents the first reported case using PNS of the obturator and middle cluneal nerves for this indication.

Device Characteristics and Practical Considerations

We utilized the Freedom Peripheral Nerve Stimulator System. This device features an externally powered pulse transmitter worn over the skin that wirelessly powers the implanted receiver. This design allows for a minimally invasive procedure without a bulky implantable battery; the design reduces operative time and surgical burden. However, the need for an external transmitter introduces practical considerations related to mobility and comfort.

Externally powered systems tend to be more affordable upfront compared to fully implantable alternatives, because they do not have internal pulse generators. However, they may incur ongoing costs due to the maintenance or replacement of external components (10). In terms of mobility, proper transmitter alignment is essential in order to ensure continuous stimulation. Misalignment during movement, especially in high-motion anatomical areas, can interrupt therapy. Nonetheless, prior studies have reported that most patients tolerate the system well and often experience improved function and quality of life, suggesting that the clinical benefits outweigh these limitations (11).

Additionally, both patients and providers must receive adequate training in order to optimize outcomes. This includes education on transmitter placement, charging, and troubleshooting potential device-related issues (12).

Imaging and Outcomes

In our patient's case, postprocedural imaging played a critical role in confirming appropriate lead placement adjacent to the targeted peripheral nerves. Fluoroscopy was used intraoperatively to verify trajectory and final position, while follow-up imaging ensured the absence of lead migration or other complications (13). Imaging findings throughout the follow-up period correlated with our patient's sustained pain relief and functional

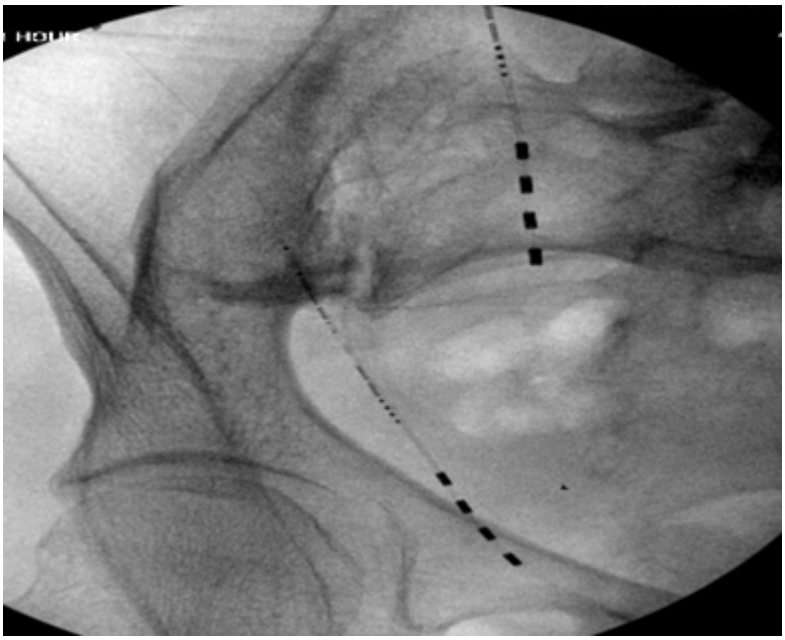

Fig. 3. Post revision 4-contact lead for the middle cluneal and obturator sensory branches.

improvement. Previous studies have shown that consistent lead positioning is essential for long-term efficacy in patients undergoing PNS (12,14).

Anatomical Rationale and Technical Approach

The anterior branch of the obturator nerve runs between the pectineus and adductor brevis muscles, then between the adductor longus, adductor brevis, and gracilis muscles. It innervates these muscles but rarely supplies the pectineus. The posterior branch travels between the adductor brevis and adductor magnus muscles, providing innervation to them. The obturator nerve also has articular branches around the hip and knee joints. The anteromedial hip joint receives innervation from the common obturator nerve (anterior and posterior branches after exiting the obturator canal), which we targeted below the inferior junction of the symphysis pubis tubercle and ischium, based on the patient's reports of groin, pelvic, and medial thigh pain (15-17) . Branches of the obturator nerve lie adjacent to the obturator foramen, just beneath the acetabulum. This location corresponds with the "teardrop shadow" seen on radiographs, that is produced by the dense cortical bone at the base of the acetabulum (5).

The anterior hip joint is supplied by the femoral articular nerve branches, which arise from the posterior division of the femoral nerve (L2-L3-L4 nerve roots in the lumbar plexus). We targeted the femoral articular branch below and medial to the anterior superior iliac spine at the anterolateral aspect of the hip. The articular nerve branches at the hip supply the joint capsule, ligaments, synovial membranes, and the rectus femoris (18)

The most common technique used to approach the obturator articular branches for injection and radiofrequency ablation involves targeting the anteromedial junction of the pubis and ischium at the incisura acetabuli (19). The typical approach for targeting the femoral articular sensory branches involves targeting the anterolateral side of the extra-articular hip joint underneath the anterior inferior iliac spine.

When the posterior pelvic ring is involved, the sacroiliac joint is often affected, potentially leading to MCN entrapment and subsequent neuropathic pain. The MCN, composed of sensory branches from the dorsal rami of S1 to the S4 foramina, travels below the posterior superior iliac spine to supply the skin overlying the posteromedial area of the buttock. MCN entrapment under or within the long posterior sacroiliac ligament can be a potential cause of low back and pelvic pain (20).

Due to the distribution of pain, MCN entrapment may be misdiagnosed as sacroiliac joint pain. A comparison of the effects of intra-articular versus peri-articular sacroiliac joint injections showed better pain relief for patients receiving peri-articular injections. This suggests that sacroiliac joint pain can be mediated by the MCN (21,22).

Comparison to Radiofrequency Ablation and Lead Strategy

Our patient had previously undergone a right sacroiliac joint injection and right hip intra-articular steroid injection, which initially provided some relief. However, the relief was short-lived. Radiofrequency ablation (RFA) of branches of the femoral and obturator articular nerves is an accepted treatment for chronic hip pain, though evidence supporting its use is limited to case reports and series (23,24). Additionally, RFA has many limitations. For widespread pain and anatomical variations in the location of the articular nerves around the hip joint, a large-sized lesion would be necessary, and the analgesic effects tend to be of limited duration.

Multiple bony anatomical landmarks can serve as RFA targets; these same targets can be used for PNS, which can provide wider coverage than RFA. One advantage of a PNS trial for anterior hip pain is that it allows for determining whether the femoral or obturator sensory branches are contributing more to the patient's pain before permanent implantation. Even if both sensory branches contribute equally, PNS remains an option. Two 4-contact neurostimulators can be staggered for the femoral branches, with one placed for the obturator branches, since it is difficult to cover both with a single system.

Other neuromodulation strategies, including dorsal root ganglion stimulation and spinal cord stimulation, were considered but not selected in our patient's case. These treatments are generally more appropriate for diffuse, dermatomal, or centrally mediated pain patterns. In contrast, this patient's symptoms demonstrated a focal distribution corresponding to discrete peripheral sensory branches. Given the ability to selectively target and trial the involved nerves while minimizing unnecessary central neuromodulation, we decided percutaneous PNS to be the most anatomically precise and least invasive option for our patient.

Novelty and Clinical Implications

This case report contributes to the expanding literature on PNS for posttraumatic and postsurgical pain. While prior studies have reported successful outcomes targeting nerves such as the femoral, superior cluneal, sciatic, and lateral femoral cutaneous, (3,7,25-28), stimulation of the obturator and middle cluneal nerves remains largely unreported. To our knowledge, this is the first documented case of successful PNS implantation involving the middle cluneal, obturator, and femoral sensory branches.

Limitation

A limitation of an externally powered system is that patients must wear an external source of energy, transmitted via radiofrequency, to the neurostimulator. One common complication with PNS, as seen with our patient, is the neurostimulators' migration risk despite using tined electrode arrays. When this happened to our patient, we performed a revision; her outcome was then satisfactory for at least one year.

The technique we used offers a promising alternative for patients with challenging-to-treat hip and pelvic pain. Further validation could be achieved through prospective studies and larger case series evaluating pain reduction, functional outcomes, and complication rates, as well as randomized controlled trials comparing percutaneous neurostimulation with conventional interventional therapies. Such studies would help establish standardized implantation protocols and clarify long-term efficacy and safety. Importantly, future research should also focus on developing and refining implantation techniques aimed at reducing the lead migration risk, which remains a crucial procedural limitation. Our experience suggests that percutaneous neurostimulation may represent a valuable addition to the therapeutic armamentarium for chronic pain management in this patient population.

CONCLUSION

Our case report highlights the role of a minimally invasive, externally powered peripheral nerve stimulator for managing posttraumatic chronic hip and pelvic pain. By targeting the MCN along with the obturator and femoral sensory branches, this technique may offer a therapeutic option for patients with complex and refractory pain in these regions.

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