Article

Not peer-reviewed version

Recalcitrant Pelvic Pain: Evaluating the Effectiveness of Radiofrequency Ablation for Pudendal, Genitofemoral, and Ilioinguinal Neuropathy

Zuhair Zaidi , Sarah Attia , Muaz Wahid , Yin Xi , Hareena Sangha , Kelly Scott , Rupali Kumar , Flavio Duarte Silva , Avneesh Chhabra *

Posted Date: 5 September 2025

doi: 10.20944/preprints202509.0527.v1

Keywords: pelvic neuropathy; pudendal neuralgia; ilioinguinal neuralgia; genitofemoral neuralgia; pulsed radiofrequency ablation; continuous radiofrequency ablation; chronic pelvic pain; minimally invasive pain treatment; CT-guided intervention

Article

Recalcitrant Pelvic Pain: Evaluating the Effectiveness of Radiofrequency Ablation for Pudendal, Genitofemoral, and Ilioinguinal Neuropathy

Zuhair Zaidi [1], Sarah Attia [1], Muaz Wahid [1], Yin Xi [2], Hareena Sangha [1], Kelly Scott [3], Rupali Kumar [3], Flavio Duarte Silva [2] and Avneesh Chhabra [2,4]

1. UT Southwestern Medical School, Dallas, Texas 75390
2. UT Southwestern Department of Radiology, Dallas, Texas 75390
3. UT Southwestern Department of Physical Medicine and Rehabilitation Dallas, Texas 75390
4. UT Southwestern Department of Orthopedic Surgery, Dallas, Texas 75390

* Correspondence: avneesh.chhabra@utsouthwestern.edu

Simple Summary

Chronic pelvic neuropathies of the pudendal, ilioinguinal, and genitofemoral nerves often persist despite medications or steroid injections, which provide only short-lived relief and leave surgery as a higher-risk option. This study evaluated pulsed radiofrequency ablation (pRFA) for pudendal neuralgia and continuous radiofrequency ablation (cRFA) for ilioinguinal and genitofemoral neuropathies, tracking pain, quality of life, and analgesic use. Both techniques provided significantly longer-lasting relief, improved function, and reduced medication dependence compared to steroid injections, with no major complications. These findings support radiofrequency ablation as a safe, effective treatment for refractory pelvic nerve pain.

Abstract

Chronic pelvic neuropathies involving the pudendal, ilioinguinal, and genitofemoral nerves are a major source of refractory pain and disability, yet conventional steroid injections typically provide only short-lived benefit. We retrospectively analyzed 78 patients: 49 with pudendal neuralgia treated by pulsed radiofrequency ablation (pRFA) and 29 with ilioinguinal (n = 15) or genitofemoral (n = 14) neuropathies treated by continuous RFA (cRFA). For pudendal neuropathy, pRFA provided mean pain relief of 9.48 ± 9.52 weeks versus 3.98 ± 3.56 weeks after the first steroid injection and 3.32 ± 3.21 weeks after the most recent ($p < 0.0001$ for both). Quality-of-life scores improved significantly through 3 months, and analgesic use declined during this period. No correlation was found between symptom duration and treatment response. For ilioinguinal and genitofemoral neuropathies, cRFA extended pain relief to 21.76 and 17.68 weeks, respectively. Mean VAS scores improved from 6.87 to 1.73 for ilioinguinal ($p < 0.0001$) and from 6.36 to 2.36 for genitofemoral ($p = 0.0007$). Quality-of-life scores improved through 3 months, with trends toward baseline by 6 months, while analgesic use decreased initially before returning to baseline. Across all nerves, no major complications occurred. RFA offers safe, longer-lasting relief than steroid injections for refractory pelvic neuropathies.

Keywords: pelvic neuropathy; pudendal neuralgia; ilioinguinal neuralgia; genitofemoral neuralgia; pulsed radiofrequency ablation; continuous radiofrequency ablation; chronic pelvic pain; minimally invasive pain treatment; CT-guided intervention

1. Introduction

Chronic pelvic pain syndrome (CPPS), defined as non-malignant, non-cyclical pelvic pain lasting at least six months, is a prevalent and disabling condition that affects both men and women, often accompanied by cognitive, behavioral, or social challenges [1–3]. Women are

 doi:10.20944/preprints202509.0527.v1

disproportionately affected, with prevalence estimates reaching 26–27% globally and roughly 15% in the United States [1,4–6]. The wide spectrum of causes necessitates multidisciplinary care involving gynecology, urology, colorectal surgery, and pain management, yet the absence of universally accepted diagnostic criteria complicates both diagnosis and treatment, often resulting in delayed recognition and worsened chronicity [7].

One major neuropathic contributor to CPPS is pudendal neuropathy, characterized by genital, rectal, and perineal pain, with prevalence estimated at 1% in the general population and up to 20% in women [7]. The pudendal nerve, arising from sacral roots S2–S4, supplies sensory and motor innervation to the perineal region [8]. Pudendal neuralgia may result from iatrogenic injuries such as pelvic organ prolapse repair, childbirth, repetitive trauma (e.g., cycling), or systemic conditions including diabetes, multiple sclerosis, and viral infections [9–14]. Treatment strategies range from pharmacologic and physical therapies to perineural steroid injections [15–18]. Nevertheless, repeated injections often lose efficacy, while decompression surgery risks further nerve damage and scarring [13,19]. Pulsed radiofrequency ablation (pRFA) has emerged as a minimally invasive alternative, delivering high-intensity current in short bursts to modulate aberrant signaling without thermal injury [20–24]. Case reports, pilot studies, and a randomized trial suggest pRFA provides superior and more durable pain relief compared to steroid injections [25–28].

Neuropathic pain also arises from entrapment of the ilioinguinal and genitofemoral nerves, which originate from the lumbar plexus and are vulnerable to trauma during pelvic or hernia surgery, as well as repetitive strain [29–31]. Such neuralgias are frequently underdiagnosed, with symptoms that mimic other pelvic conditions, adding to the complexity of CPP. First-line approaches include medications, physical therapy, and image-guided corticosteroid injections [1,6,32,33]. While nerve blocks can provide diagnostic clarity and short-term relief, their benefits diminish with repeated use. Neurectomy may be considered in refractory cases but is invasive, not widely available, and subject to recurrence [34–36]. In this context, continuous radiofrequency ablation (cRFA) has gained interest, with early case series and small randomized trials showing prolonged analgesia in ilioinguinal neuralgia [37–39]. Nevertheless, evidence for genitofemoral nerve ablation remains limited to isolated case reports and small cohorts [30,40].

Together, these observations underscore the need for minimally invasive, durable interventions for pelvic neuropathies. This study evaluates CT-guided pRFA for pudendal neuralgia and cRFA for ilioinguinal and genitofemoral neuralgias, comparing outcomes in pain scores, analgesic use, quality of life, and safety, with the aim of advancing treatment strategies for refractory chronic pelvic pain.

2. Materials and Methods

2.1. Study Design

This retrospective cohort study, approved by the Institutional Review Board (IRB) with a waiver of informed consent, analyzed a consecutive cohort of patients who underwent pudendal nerve pRFA at a single tertiary care hospital, based on electronic health record chart reviews from April 2016 to August 2024. Patients were referred by physical medicine and rehabilitation physicians from a pelvic pain clinic, and the diagnoses were based on multiple criteria, including clinical findings of pudendal neuralgia, previous response to pelvic floor therapy and perineural steroid injection. All participants had previously received medical therapy and magnetic resonance neurography (MRN) of the lumbosacral plexus.

The inclusion criteria were adult patients (≥ 18 years) of all genders, clinically diagnosed with pelvic neuralgia, having received medical therapy and at least one injection before their first RFA. Exclusion criteria included patients who did not undergo initial medical therapy, patients with less than six months of follow-up post-procedure, and those with incomplete electronic health records. Selection methodology can be illustrated in **Figure 1.**

 doi:10.20944/preprints202509.0527.v1

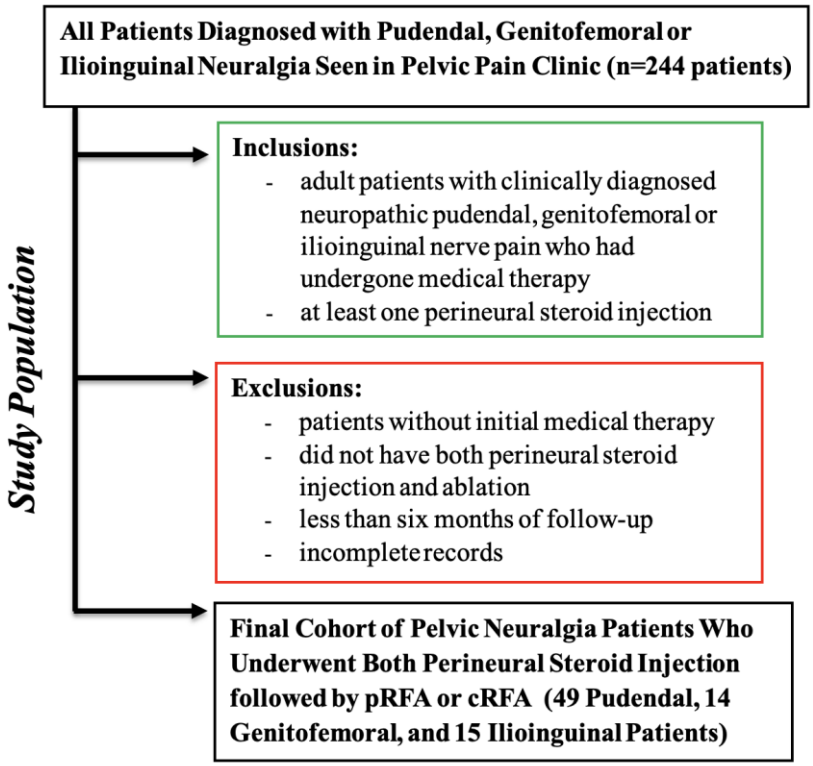


Figure 1. Flowchart Depicting Selection of Participants.

2.2. CT-Guided Procedures

All ablation procedures followed a standardized process. Patients were brought to the CT suite by a procedural nurse, placed on cardiac and oxygen monitoring, positioned prone, and a pre-procedural timeout was performed. Procedures were performed under CT fluoroscopy guidance with conscious sedation. Sedation typically included fentanyl (average 81–83 ± 43–58 μg) and midazolam (1.2–1.3 ± 0.65–0.76 mg), titrated for patient comfort, with two patients in each cohort opting to forego sedation.

Superficial anesthesia was provided with 1% lidocaine before needle placement. Using radiopaque markers and intermittent CT guidance, a 22 G coaxial needle was advanced to the target nerve. For pudendal procedures, the needle was positioned adjacent to the pudendal nerve in Alcock's canal, identified as the most posterior structure in the pudendal neurovascular bundle beneath the sacrotuberous ligament, with fascicular architecture and intermediate density confirming its location. For ilioinguinal procedures, the needle was advanced to the fascial plane between the internal oblique and transversus abdominis muscles near the anterior superior iliac spine. For genitofemoral procedures, the target was the anterior surface of the psoas major, lateral to the external iliac artery, with CT confirming fascicular structure and density. Needle placement was confirmed in all cases by injection of 1 ml of dilute water-soluble iodinated contrast (Isovue 180 or 200).

Ablation probes were advanced through the needles, followed by sensory and motor stimulation at 2–3 V. For pudendal procedures, pulsed RFA (pRFA) was performed at 42–43°C for 120 seconds, followed by injection of 5 ml of anesthetic-steroid mixture (2 ml 1% lidocaine, 2 ml 0.5% bupivacaine, 1 ml dexamethasone 4 mg/ml). For ilioinguinal and genitofemoral procedures, continuous RFA (cRFA) was performed at 79–80°C for 90 seconds, followed by the same anesthetic-steroid injectate. The choice of technique reflected anatomical and functional considerations: the pudendal nerve is a mixed sensory–motor nerve in close proximity to sphincteric structures, making pRFA preferable to avoid permanent injury, whereas the ilioinguinal and genitofemoral nerves are primarily sensory and more superficial, allowing safe thermal lesioning with cRFA for longer-lasting relief.

 doi:10.20944/preprints202509.0527.v1

Procedure duration averaged 94 ± 46 minutes for pudendal cases and 49 ± 39 minutes for ilioinguinal/genitofemoral cases, including setup, sedation, and time-out protocols. Needle insertion-to-removal time ranged 5–10 minutes for pudendal and 5–20 minutes for ilioinguinal/genitofemoral cases. Technical success was achieved in all patients, defined as accurate needle placement confirmed with contrast injection and attainment of target ablation parameters. No immediate complications were observed. Demographic data, clinically relevant history, imaging studies, and details of medical and surgical therapy were abstracted from patients' medical records. Ablation of respective pudendal nerves can be seen in **Figure 2.** Ablation of respective ilioinguinal and genitofemoral nerves can be seen in **Figures 3 and 4.**

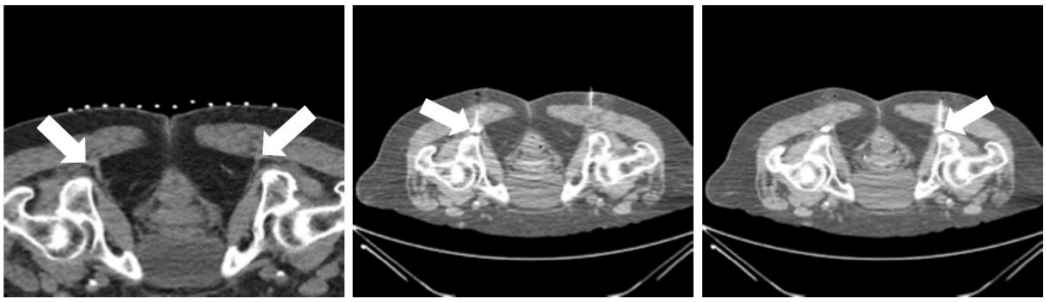


Figure 2. CT Acquisitions Portraying Pulsed Radiofrequency Ablation of the Pudendal Nerve. (a) Planning CT image demonstrates the isodense right pudendal nerve located posterior to an adjacent blood vessel; (b) Axial CT shows ablative changes following probe placement within Alcock's canal targeting the left pudendal nerve; (c) Axial CT shows similar ablative changes with the probe introduced into Alcock's canal targeting the right pudendal nerve.

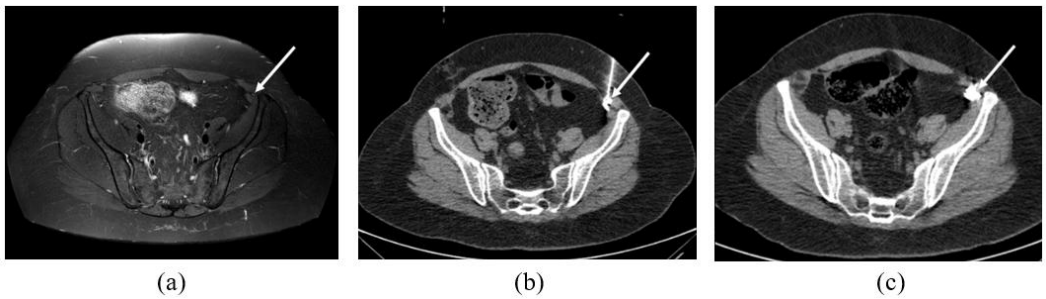
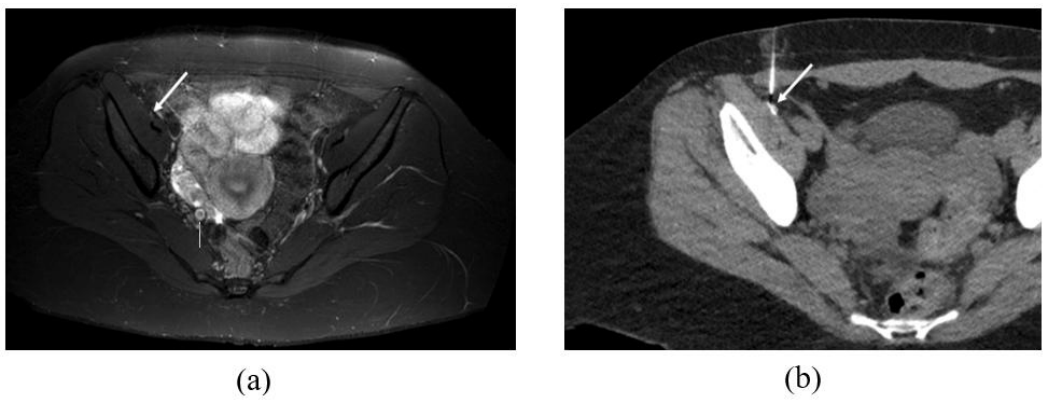


Figure 3. MRN and CT Images Depicting Continuous Radiofrequency Ablation of the Left Ilioinguinal Nerve. (a) Axial T2 DIXON water-only 3T-MRN image demonstrates a high signal within the left ilioinguinal nerve targeted for ablation (white arrow); (b) Axial CT shows needle placement within the perineural space of the left ilioinguinal nerve adjacent to the anterior superior iliac spine (white arrow); (c) Post-ablation image reveals expected changes in the perineural space without immediate complications (white arrow).



 doi:10.20944/preprints202509.0527.v1

Figure 4. CT Acquisitions During Pulsed Radiofrequency Ablation of the Genitofemoral Nerve. (a) Axial T2 DIXON water-only 3T-MRN image shows a slightly thickened right genitofemoral nerve proximal to the inguinal canal (white arrow); (b) Axial CT demonstrates accurate needle placement along the genitofemoral nerve path, confirmed by its location adjacent to the psoas major muscle (white arrow).

2.3. Follow-Ups

Clinical outcomes for all patients were evaluated using retrospective chart reviews and prospective telephone questionnaires. Pain severity was assessed with the validated 10-point Visual Analog Scale (VAS) at 4 weeks, 6 weeks, 3 months, and 6 months following ablation. Duration of pain relief was defined as the time from the procedure to the recurrence of pain, with the lowest reported VAS score during each interval also recorded. For patients undergoing multiple ablation procedures, outcomes were analyzed chronologically by procedure date. Data on analgesic use and patient-reported quality-of-life changes were collected at the same intervals to capture broader treatment effects.

2.4. Statistics

All statistical analyses were conducted by a faculty statistician. Pain relief durations and lowest pain scores were compared across steroid injections, pRFA, and cRFA using a linear mixed model that accounted for within-patient clustering, with log (duration + 1) transformation applied to address skewness. Ad-hoc multiple comparisons were performed with Tukey adjustment. Pearson correlation coefficients examined the relationship between symptom duration and treatment outcomes. A significance threshold of $p < 0.05$ was used. Additional analyses, including ANOVA, chi-square tests, and Student's t-tests, were conducted using Prism GraphPad software.

3. Results

3.1. Patient Characteristics and Demographics

A total of 49 patients with pudendal neuropathy, 15 with ilioinguinal neuropathy, and 14 with genitofemoral neuropathy met inclusion criteria, forming the final combined cohort of 78 patients for analysis. Among the 49 patients with pudendal neuralgia, 186 procedures were performed over an average follow-up of 8.82 ± 2.39 months. The mean age was 61.7 ± 14.1 years with a BMI of 26.3 ± 4.9; 30 were female and 19 male. Thirty-one underwent one ablation, 13 had two, 6 received three, and 2 patients underwent four procedures for recalcitrant pain. The most recent pain exacerbation prior to pRFA had persisted for 8.12 ± 1.34 months. All patients received at least one prior CT-guided perineural injection (mean 2.10 ± 1.65, range 1–8).

In the ilioinguinal group (n = 15), the mean age was 57.3 ± 14.1 years, with a BMI of 28.8 ± 7.0; 9 were female and 6 male. A total of 47 procedures were performed (8 left, 5 right, 2 bilateral), with an average pain duration prior to cRFA of 7.21 ± 1.12 months.In the genitofemoral group (n = 14), the mean age was 59.7 ± 18.5 years, with a BMI of 29.9 ± 9.2; 8 were female and 6 male. Forty-nine procedures were performed (4 left, 6 right, 4 bilateral), with pain duration averaging 7.47 ± 0.93 months prior to cRFA.

3.2. MRN Findings

Pre-procedural MR neurography was available for all patients. Among pudendal cases (n = 49), 51.0% (n = 25) demonstrated no abnormalities; 16.3% (n = 8) showed nerve thickening/asymmetry; 12.2% (n = 6) demonstrated T2 hyperintensity; 18.4% (n = 9) showed perineural scarring/fibrosis at Alcock's canal; and 26.5% (n = 13) displayed pelvic muscle atrophy.

For ilioinguinal patients (n = 15), 46.7% (n = 7) had no abnormalities; 20.0% (n = 3) showed nerve thickening; 13.3% (n = 2) demonstrated T2 hyperintensity; 20.0% (n = 3) had perineural fibrosis near the inguinal canal; and 26.7% (n = 4) exhibited adjacent abdominal wall muscle atrophy. For genitofemoral patients (n = 14), 50.0% (n = 7) had no abnormalities; 14.3% (n = 2) showed nerve

 doi:10.20944/preprints202509.0527.v1

thickening; 14.3% (n = 2) demonstrated T2 hyperintensity; 21.4% (n = 3) had perineural scarring near the psoas tunnel; and 28.6% (n = 4) showed iliopsoas muscle atrophy. **Tables 1–3** provide detailed demographic, procedural, and imaging characteristics.

Table 1. Table Depicting Baseline Patient Demographics.

Nerve	*Pudendal*	*Ilioinguinal*	*Genitofemoral*
Total Patients Per Nerve	*49*	*15*	*14*
Age (years)	*61.7 ± 14.1*	*57.3 ± 14.1*	*59.7 ± 18.4*
Males	*19*	*6*	*6*
Females	*30*	*9*	*8*
Body Mass Index	*26.3 ± 4.90*	*28.8 ± 7.0*	*29.9 ± 9.2*
Total Number of Procedures	*186*	*47*	*49*
		Laterality	
Left	*15*	*8*	*4*
Right	*10*	*5*	*6*
Bilateral	*24*	*2*	*4*

Table 2. Reported Causes of Pelvic Neuralgia in Patients Undergoing pRFA.

Etiology	*Pudendal*	*Ilioinguinal*	*Genitofemoral*
Idiopathic/Unspecified	*11*	*1*	*3*
Trauma	*8*	*2*	*1*
Childbirth	*8*	*1*	*0*
Chronic Constipation	*1*	*0*	*0*
Pelvic Tumor/Mass	*2*	*3*	*2*
***Repetitive Stress Injury (long car drive, mountain biking, sedentary desk job,* etc.)**	*12*	*4*	*5*
Post-Surgical	*7*	*3*	*3*

Table 3. Total Number of Perineural Injections and Ablations Per Patient.

Number of Injections	*Pudendal*	*Ilioinguinal*	*Genitofemoral*	*Number of Ablations*	*Pudendal*	*Ilioinguinal*	*Genitofemoral*
One Injection	*24*	*7*	*6*	***One Ablation***	*31*	*11*	*10*
Two Injections	*13*	*5*	*3*	***Two Ablations***	*13*	*4*	*5*
Three Injections	*9*	*1*	*3*	***Three Ablations***	*6*	*0*	*0*
Four Injections	*3*	*2*	*2*	***Four Ablations***	*2*	*0*	*0*
Five Injections	*0*	*0*	*0*				
Six Injections	*1*	*0*	*0*				
Seven Injections	*0*	*0*	*0*				
Eight Injections	*1*	*0*	*0*				

3.3. Pain Response

For pudendal neuropathy, initial baseline pain before intervention averaged 5.92 ± 2.78 amongst the cohort. The lowest post-procedure pain scores were 1.85 ± 3.54 following the first steroid injection,

 doi:10.20944/preprints202509.0527.v1

1.64 ± 1.73 after the most recent injection, and 1.75 ± 2.21 after pRFA. All interventions yielded significant pain reductions compared to baseline ($p < 0.0001$). However, differences between pRFA and steroid injections did not reach statistical significance ($p = 0.992$ vs. first injection; $p = 0.995$ vs. most recent injection).

For ilioinguinal neuropathy, mean baseline pain was 6.87 ± 1.25. After the first steroid injection, pain decreased to 2.23 ± 1.92 ($p < 0.0001$) but increased to 3.80 ± 1.70 after the most recent injection ($p < 0.0001$ vs. baseline). Following the first cRFA, scores improved further to 1.73 ± 1.28 ($p < 0.0001$), representing the most effective intervention. The second cRFA produced a score of 3.33 ± 1.21, which was not significantly different from the first ablation ($p = 0.2585$).

For genitofemoral neuropathy, baseline pain was 6.36 ± 1.34. Scores decreased to 2.57 ± 1.70 following the first steroid injection ($p < 0.0001$) and rose to 3.43 ± 1.16 after the most recent injection ($p < 0.0001$ vs. baseline). After the first cRFA, pain decreased further to 2.36 ± 1.08 ($p = 0.0007$ vs. most recent injection). The second cRFA yielded a score of 3.43 ± 0.98, which was not significantly different compared to the first ablation ($p = 0.5608$).

3.4. Duration of Pain Relief

The duration of pain relief was evaluated over a minimum 6-month follow-up for all patients (Figure 5). Among those with pudendal neuropathy, mean duration of improvement following pRFA was 9.48 ± 9.52 weeks, significantly longer than the 3.98 ± 3.56 weeks observed after the first steroid injection and 3.32 ± 3.21 weeks after the most recent injection ($p < 0.0001$ for both comparisons).

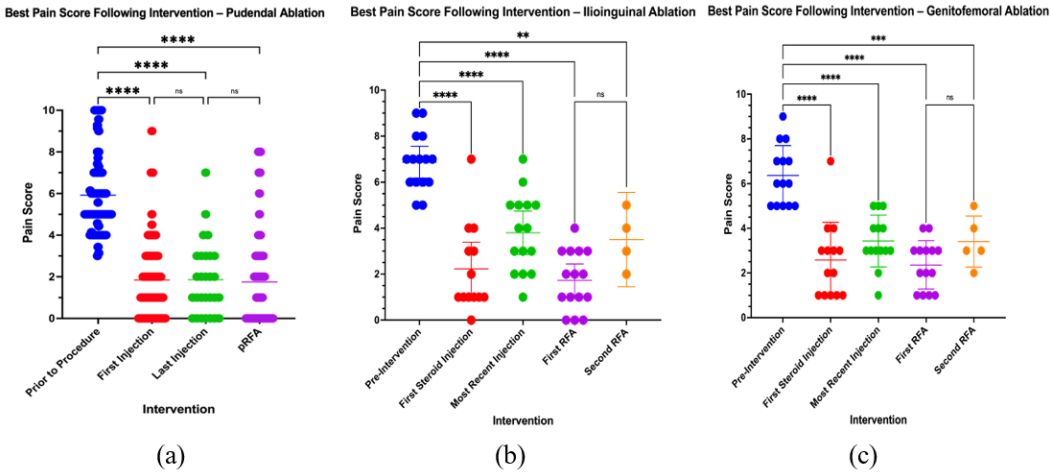


Figure 5. Best Pain Score Following Steroid Injection and RFA by Nerve Ablated. (a) Pudendal ablation; (b) Ilioinguinal ablation; (c) Genitofemoral ablation.

For the ilioinguinal group, mean duration of benefit following the first steroid injection was 2.71 ± 1.20 weeks, decreasing slightly to 2.43 ± 0.85 weeks after the most recent injection ($p > 0.9999$). Following the first cRFA, duration of relief increased markedly to 21.76 ± 19.04 weeks ($p = 0.0002$ vs. most recent injection). A second cRFA produced a shorter duration of 10.75 ± 3.43 weeks, though this was not significantly different from the first ablation ($p = 0.3600$).

For the genitofemoral group, mean duration of improvement was 2.80 ± 0.94 weeks after the first steroid injection and 2.87 ± 1.19 weeks after the most recent injection ($p > 0.9999$). Following the first cRFA, duration extended significantly to 17.68 ± 12.98 weeks ($p < 0.0001$ vs. most recent injection). The second cRFA averaged 8.25 ± 2.63 weeks, which again was not significantly different compared to the first ablation ($p = 0.1488$).

 doi:10.20944/preprints202509.0527.v1

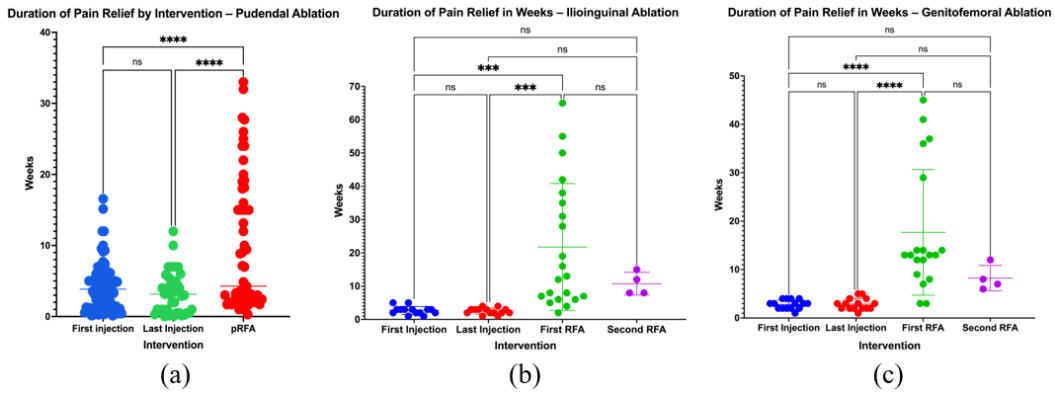


Figure 6. Duration of Pain Relief in Weeks Following Steroid Injection and RFA by Nerve Ablated. (a) Pudendal ablation; (b) Ilioinguinal ablation; (c) Genitofemoral ablation.

3.5. Quality of Life

For pudendal neuropathy, 36 patients had documented quality-of-life (QoL) scores following pRFA, measured with 10-point Likert scales where 10 indicated maximum improvement in function, pain tolerance, and comfort. Significant improvements were observed at 4 weeks ($p = 0.0001$), 6 weeks ($p = 0.0003$), and 3 months ($p = 0.0016$), while a non-significant benefit persisted at 6 months ($p = 0.0726$).

For ilioinguinal neuropathy, QoL scores were available for 24 patients. Baseline mean QoL was 3.89 ± 1.59, which improved significantly to 6.32 ± 1.11 at 4 weeks ($p < 0.0001$) and 6.21 ± 1.18 at 6 weeks ($p < 0.0001$). At 3 months, scores declined slightly to 5.79 ± 1.40 but remained significantly higher than baseline ($p = 0.0023$). By 6 months, scores further decreased to 4.84 ± 0.96, showing no significant difference compared to baseline ($p = 0.124$).

For genitofemoral neuropathy, baseline QoL was 3.21 ± 1.13. Scores improved significantly at 4 weeks (5.32 ± 1.20, $p < 0.0001$) and 6 weeks (5.26 ± 0.93, $p < 0.0001$), with a modest decline by 3 months (4.89 ± 0.88, $p = 0.0017$). At 6 months, scores decreased further to 3.74 ± 1.10, with no significant difference from pre-intervention levels ($p = 0.112$).

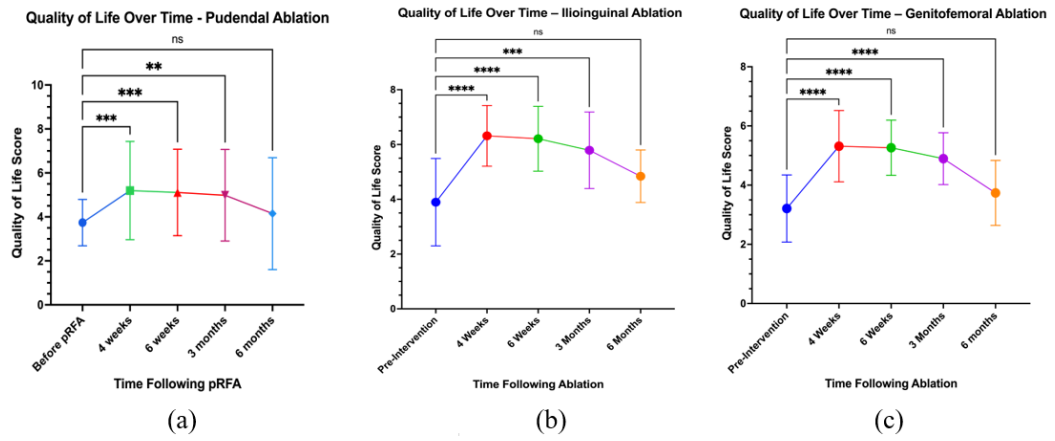


Figure 7. Quality of Life Scores Following cRFA by Nerve Ablated. (a) Pudendal ablation; (b) Ilioinguinal ablation; (c) Genitofemoral ablation.

3.6. Analgesic Use

For pudendal neuropathy, 33 patients had documented analgesic use tracked for up to six months following pRFA. Patients rated their use of oral pain medications and topical analgesics on a 0–2 Likert scale, where 0 indicated no need for analgesics, 1 represented continuation of the pre-procedure regimen, and 2 indicated doubling of analgesic need. Significant reductions in analgesic

 doi:10.20944/preprints202509.0527.v1

use were reported at 4 weeks (p = 0.0014), 6 weeks (p = 0.0045), and 3 months (p = 0.0110), with a non-significant decrease persisting at 6 months (p = 0.1683).

For ilioinguinal neuropathy, cRFA produced significant short-term reductions in analgesic use compared to baseline (100%). At 4 weeks, usage decreased to 86.67% ± 8.16% (p < 0.0001) and remained low at 87.33% ± 9.61% at 6 weeks (p < 0.0001). By 3 months, use began to rise toward baseline at 90.67% ± 7.04% (p = 0.0049), and at 6 months it reached 94.67% ± 6.40%, showing no significant difference compared to pre-procedure levels (p = 0.2458).

For genitofemoral neuropathy, baseline analgesic use was also 100%. After cRFA, usage decreased to 86.43% ± 7.45% at 4 weeks (p < 0.0001) and 90.00% ± 6.79% at 6 weeks (p = 0.0002). By 3 months, usage rose to 92.14% ± 5.79% (p = 0.0045), and by 6 months, returned to 95.71% ± 5.14%, which was not significantly different from baseline (p = 0.2800).

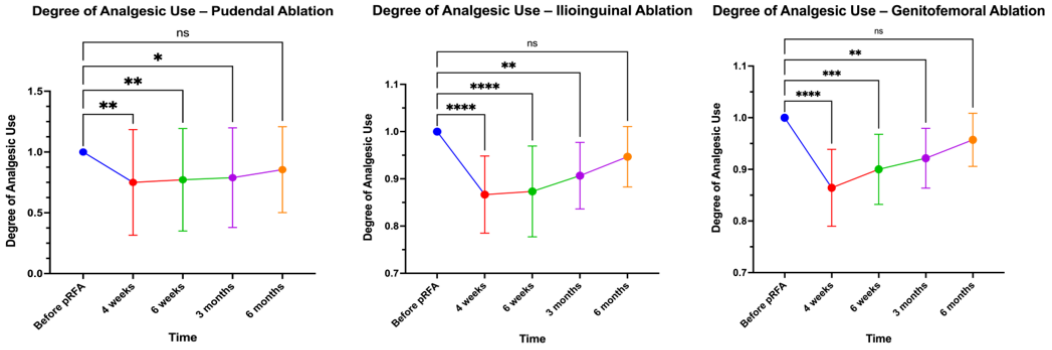


Figure 8. Reported Analgesic Use Over Time Following Ablation by Nerve Type. (a) Pudendal ablation; (b) Ilioinguinal ablation; (c) Genitofemoral ablation.

3.7. Correlations

Across all three nerve groups, there was no significant correlation between treatment timing and outcomes. In pudendal neuropathy, neither symptom duration nor interval from last injection to pRFA correlated with post-procedure pain scores or duration of relief. Similarly, for ilioinguinal and genitofemoral neuropathies, no associations were observed between symptom duration or timing of prior injections and cRFA outcomes. These findings collectively suggest that the timing of intervention does not significantly influence the efficacy of radiofrequency ablation.

3.8. Complications

Across all procedures, complications were generally mild and self-limiting, with no patient requiring further intervention. In the pudendal group (n = 49), nine patients developed transient symptoms: three experienced mild perineal numbness resolving in 3–4 days, four reported injection site soreness subsiding within 3–5 days, and two noted transient bowel or bladder urgency/difficulty that resolved within one week. In the ilioinguinal cohort, three patients developed temporary groin numbness that resolved within 2–3 weeks, two experienced small hematomas at the needle site resolving in one week, and one reported transient shooting pain in the inguinal region lasting 10 days, attributed to temporary nerve irritation. In the genitofemoral cohort, two patients reported mild erythema at the insertion site resolving within 48 hours, and one experienced brief upper thigh hypersensitivity lasting one week. All complications resolved spontaneously with conservative management, and no major or permanent adverse effects were observed.

4. Discussion

Our study demonstrates that pRFA is an effective therapeutic option for chronic pudendal neuralgia, providing a mean pain relief duration of 9.48 ± 9.52 weeks. This was substantially longer

 doi:10.20944/preprints202509.0527.v1

than the relief observed after the first (3.98 ± 3.56 weeks, $p < 0.0001$) and most recent perineural steroid injections (3.32 ± 3.21 weeks, $p < 0.0001$). Patients also experienced significant improvements in quality of life at 4 weeks ($p = 0.0014$), 6 weeks ($p = 0.0045$), and 3 months ($p = 0.0110$), with a corresponding reduction in analgesic use, independent of baseline symptom severity or duration.

Building on these findings, we incorporated continuous radiofrequency ablation with CT guidance in the treatment of ilioinguinal and genitofemoral neuropathies. Pain scores decreased significantly from 6.87 ± 1.25 to 1.73 ± 1.28 for ilioinguinal neuropathy ($p < 0.0001$) and from 6.36 ± 1.34 to 2.36 ± 1.08 for genitofemoral neuropathy ($p = 0.0007$). Relief was durable, lasting an average of 21.76 ± 19.04 weeks for ilioinguinal and 17.68 ± 12.98 weeks for genitofemoral neuropathy.

Perineural steroid injections and nerve blocks have long been used as first-line therapies for pelvic neuropathy, but their benefits diminish with repeated use and may even worsen long-term outcomes [41]. pRFA has emerged as a durable option, with several studies showing benefit versus steroid injections; direct head-to-head comparisons with cRFA remain limited and heterogeneous [42]. Advances in CT guidance have further improved precision and yielded nearly 100% technical success, reinforcing its utility as a preferred intervention [27].

Our findings build on this evidence by demonstrating the superiority of pRFA over steroid injections in extending pain relief duration. Collard et al. reported that pRFA significantly prolonged pain relief compared to the most recent injection ($p = 0.0195$) but not the initial one ($p = 0.64$), while pain scores trended lower but without statistical significance ($p = 0.1094$ and $p = 0.7539$) [27]. In a long-term follow-up by Krinjen, 79% of patients described their condition as “much better” at 3 months, with durable improvement maintained across 430 pRFA treatments over four years, yielding an 89% long-term success rate [25]. Similarly, Fang et al. found a 92.1% clinical effective rate at 3 months in patients receiving pRFA plus pudendal nerve block versus 35.9% in those receiving block alone [43]. Taken together, these results reinforce the sustained efficacy of pRFA for pudendal neuralgia and are consistent with our cohort’s outcomes.

Evidence also supports ablation techniques for ilioinguinal and genitofemoral neuropathies. In a randomized trial of 70 patients with post-surgical orchialgia, pulsed RFA produced >50% pain reduction in 80% of patients compared to 23% in the sham group, with 50% discontinuing analgesics versus 3.3% in controls ($p = 0.001$) [44]. A study of 42 patients with ilioinguinal neuralgia similarly found microwave ablation provided 12.5 months of relief versus only 1.6 months with local infiltration, while a smaller series of 10 patients achieved an 83% success rate and ~70% mean pain reduction [39,45]. Case-based reports also highlight benefit, such as RFN at the L1 origin yielding 4–5 months of relief and individual cases maintaining improvement for at least 3 months [39]. Despite these encouraging results, limitations such as small cohorts, lack of imaging guidance, and short follow-up have restricted generalizability. These gaps are addressed by our study with CT-guided continuous RFA and extended follow-up.

While our study offers important insights, several limitations should be acknowledged. The repeated-measures design without a control group and reliance on subjective, patient-reported outcomes introduce potential bias, particularly in the absence of objective pain assessment tools. The influence of a placebo effect also cannot be excluded. Furthermore, the six-month follow-up period limits conclusions about long-term efficacy and durability. These factors restrict generalizability across broader populations and extended timelines. Future research should adopt larger, multicenter designs incorporating objective outcome measures and longer follow-up to strengthen external validity.

5. Conclusions

In conclusion, our study supports radiofrequency ablation as an effective treatment for pudendal, ilioinguinal, and genitofemoral neuropathic pain. Patients experienced meaningful improvements in pain, quality of life, and reduced analgesic use, with consistent outcomes across symptom severities. By using CT guidance and evaluating multiple nerves, we provide a comprehensive perspective on its role in managing pelvic and groin neuropathies. These findings

 doi:10.20944/preprints202509.0527.v1

reinforce radiofrequency ablation as a valuable option, while underscoring the need for larger studies with extended follow-up to confirm long-term efficacy.

Author Contributions: Conceptualization, A.C., F.D.S., R.K., and K.S.; methodology, Z.Z., Y.X., and A.C.; software, Y.X. and Z.Z.; validation, Y.X., Z.Z., S.A., and M.W.; formal analysis, Y.X. Z.Z.; investigation, Z.Z., S.A., M.W., and H.S.; resources, A.C.; data curation, Z.Z., S.A., and H.S.; writing—original draft preparation, Z.Z., A.C., S.A.; writing—review and editing, Z.Z., A.C., M.W., K.S., and R.K.; visualization, Z.Z.; supervision, A.C., K.S., and R.K.; project administration, Z.Z. and A.C. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of the University of Texas Southwestern Medical Center (protocol code STU-2022-0281, approved on March 21, 2022). Ethical review and approval included a waiver of informed consent due to the retrospective nature of the study and minimal risk to participants.

Informed Consent Statement: Patient consent was waived due to the retrospective nature of the study, minimal risk to participants, and the use of de-identified data, as approved by the Institutional Review Board. Written informed consent was not required for publication as no identifiable patient information is presented.

Data Availability Statement: The data supporting the findings of this study are not publicly available due to privacy and ethical restrictions but may be provided by the corresponding author upon reasonable request and with Institutional Review Board approval.

Acknowledgments: The authors would like to acknowledge the administrative and technical support provided by the Department of Radiology and the Department of Physical Medicine and Rehabilitation at UT Southwestern Medical Center.

Conflicts of Interest: A.C. reports the following disclosures: Consultant for ICON Medical and TREACE Medical Concepts Inc.; book royalties from Jaypee and Wolters; speaker for TMC Academy; medical advisor for IBL, Inc.; and research grants from IBL, Inc. and Qure-AI. The remaining authors declare no conflicts of interests.

Abbreviations

The following abbreviations are used in this manuscript:

cRFA	Continuous Radiofrequency Ablation
pRFA	Pulsed Radiofrequency Ablation
VAS	Visual Analog Scale
MRN	Magnetic Resonance Neurography
CT	Computed Tomography
RFA	Radiofrequency Ablation
IRB	Institutional Review Board
HIPAA	Health Insurance Portability and Accountability Act
BMI	Body Mass Index
QoL	Quality of Life
ANOVA	Analysis of Variance
PRF	Pulsed Radiofrequency
RFN	Radiofrequency Neurotomy

References

1. Lamvu, G.; Carrillo, J.; Ouyang, C.; Rapkin, A. Chronic Pelvic Pain in Women: A Review. *JAMA* **2021**, *325*, 2381, doi:10.1001/jama.2021.2631.

 doi:10.20944/preprints202509.0527.v1

2. Doggweiler, R.; Whitmore, K.E.; Meijlink, J.M.; Drake, M.J.; Frawley, H.; Nordling, J.; Hanno, P.; Fraser, M.O.; Homma, Y.; Garrido, G.; et al. A Standard for Terminology in Chronic Pelvic Pain Syndromes: A Report from the Chronic Pelvic Pain Working Group of the International Continence Society. *Neurourol Urodyn* **2017**, *36*, 984–1008, doi:10.1002/nau.23072.
3. Kothari, S. Neuromodulatory Approaches to Chronic Pelvic Pain and Coccygodynia. In *Operative Neuromodulation*; Sakas, D.E., Simpson, B.A., Krames, E.S., Eds.; Acta Neurochirurgica Supplements; Springer Vienna: Vienna, 2006; Vol. 97/1, pp. 365–371 ISBN 978-3-211-33078-4.
4. Latthe, P.; Latthe, M.; Say, L.; Gülmezoglu, M.; Khan, K.S. WHO Systematic Review of Prevalence of Chronic Pelvic Pain: A Neglected Reproductive Health Morbidity. *BMC Public Health* **2006**, *6*, 177, doi:10.1186/1471-2458-6-177.
5. Ahangari, A. Prevalence of Chronic Pelvic Pain among Women: An Updated Review. *Pain Physician* **2014**, *17*, E141-147.
6. Meisenheimer, E.S.; Carnevale, A.M. Chronic Pelvic Pain in Women: Evaluation and Treatment. *Am Fam Physician* **2025**, *111*, 218–229.
7. Hunter, C.W.; Stovall, B.; Chen, G.; Carlson, J.; Levy, R. Anatomy, Pathophysiology and Interventional Therapies for Chronic Pelvic Pain: A Review. *Pain Physician* **2018**, *21*, 147–167.
8. Shafik, A.; El-Sherif, M.; Youssef, A.; Olfat, E. Surgical Anatomy of the Pudendal Nerve and Its Clinical Implications. *Clinical Anatomy* **1995**, *8*, 110–115, doi:10.1002/ca.980080205.
9. Kaur, J.; Leslie, S.W.; Singh, P. Pudendal Nerve Entrapment Syndrome. In *StatPearls*; StatPearls Publishing: Treasure Island (FL), 2025.
10. Robert, R.; Prat-Pradal, D.; Labat, J.J.; Bensignor, M.; Raoul, S.; Rebai, R.; Leborgne, J.; Lardoux, M.C.; Thiodet, J. Anatomic Basis of Chronic Perineal Pain: Role of the Pudendal Nerve. *Surg Radiol Anat* **1998**, *20*, 93–98, doi:10.1007/BF01628908.
11. Leibovitch, I.; Mor, Y. The Vicious Cycling: Bicycling Related Urogenital Disorders. *Eur Urol* **2005**, *47*, 277–286; discussion 286-287, doi:10.1016/j.eururo.2004.10.024.
12. Lien, K.-C.; Morgan, D.M.; Delancey, J.O.L.; Ashton-Miller, J.A. Pudendal Nerve Stretch during Vaginal Birth: A 3D Computer Simulation. *American Journal of Obstetrics and Gynecology* **2005**, *192*, 1669–1676, doi:10.1016/j.ajog.2005.01.032.
13. Leslie, S.W.; Antolak, S.; Feloney, M.P.; Soon-Sutton, T.L. Pudendal Neuralgia. In *StatPearls*; StatPearls Publishing: Treasure Island (FL), 2025.
14. Ramsden, C.E.; McDaniel, M.C.; Harmon, R.L.; Renney, K.M.; Faure, A. Pudendal Nerve Entrapment as Source of Intractable Perineal Pain. *Am J Phys Med Rehabil* **2003**, *82*, 479–484.
15. *Neuropathic Pain in Adults: Pharmacological Management in Non-Specialist Settings*; National Institute for Health and Care Excellence: Guidelines; National Institute for Health and Care Excellence (NICE): London, 2020; ISBN 978-1-4731-0328-3.
16. Finnerup, N.B.; Attal, N.; Haroutounian, S.; McNicol, E.; Baron, R.; Dworkin, R.H.; Gilron, I.; Haanpää, M.; Hansson, P.; Jensen, T.S.; et al. Pharmacotherapy for Neuropathic Pain in Adults: A Systematic Review and Meta-Analysis. *Lancet Neurol* **2015**, *14*, 162–173, doi:10.1016/S1474-4422(14)70251-0.
17. Levesque, A.; Bautrant, E.; Quistrebert, V.; Valancogne, G.; Riant, T.; Beer Gabel, M.; Leroi, A.; Jottard, K.; Bruyninx, L.; Amarenco, G.; et al. Recommendations on the Management of Pudendal Nerve Entrapment Syndrome: A Formalised Expert Consensus. *European Journal of Pain* **2022**, *26*, 7–17, doi:10.1002/ejp.1861.
18. Basol, G.; Kale, A.; Gurbuz, H.; Gundogdu, E.C.; Baydilli, K.N.; Usta, T. Transvaginal Pudendal Nerve Blocks in Patients with Pudendal Neuralgia: 2-Year Follow-up Results. *Arch Gynecol Obstet* **2022**, *306*, 1107–1116, doi:10.1007/s00404-022-06621-1.
19. Charlotte, W.; Sebastian, D.; Viviane, T.; Luc, B. Selection Criteria for Surgical Treatment of Pudendal Neuralgia. *Neurourology and Urodynamics* **2017**, *36*, 663–666, doi:10.1002/nau.22988.
20. Wray, J.K.; Dixon, B.; Przkora, R. Radiofrequency Ablation. In *StatPearls*; StatPearls Publishing: Treasure Island (FL), 2025.
21. Hoang Roberts, L.; Vollstedt, A.; Gilleran, J.; Peters, K.M. Bladder Dysfunction and Pelvic Pain: The Role of Sacral, Tibial, and Pudendal Neuromodulation. In *Female Genitourinary and Pelvic Floor Reconstruction*;

 doi:10.20944/preprints202509.0527.v1

Martins, F.E., Holm, H.V., Sandhu, J.S., McCammon, K.A., Eds.; Springer International Publishing: Cham, 2023; pp. 255–273 ISBN 978-3-031-19597-6.

22. Costigan, M.; Scholz, J.; Woolf, C.J. Neuropathic Pain: A Maladaptive Response of the Nervous System to Damage. *Annu Rev Neurosci* **2009**, *32*, 1–32, doi:10.1146/annurev.neuro.051508.135531.
23. Wu, H.; Zhou, J.; Chen, J.; Gu, Y.; Shi, L.; Ni, H. Therapeutic Efficacy and Safety of Radiofrequency Ablation for the Treatment of Trigeminal Neuralgia: A Systematic Review and Meta-Analysis. *JPR* **2019**, *Volume 12*, 423–441, doi:10.2147/JPR.S176960.
24. Xie, E.; Garzon-Muvdi, T.; Bender, M.; Doshi, T.; Carson, B.; Lim, M.; Bettegowda, C. Association Between Radiofrequency Rhizotomy Parameters and Duration of Pain Relief in Trigeminal Neuralgia Patients with Recurrent Pain. *World Neurosurg* **2019**, *129*, e128–e133, doi:10.1016/j.wneu.2019.05.059.
25. Krijnen, E.A.; Schweitzer, K.J.; Van Wijck, A.J.M.; Withagen, M.I.J. Pulsed Radiofrequency of Pudendal Nerve for Treatment in Patients with Pudendal Neuralgia. A Case Series with Long-Term Follow-Up. *Pain Practice* **2021**, *21*, 703–707, doi:10.1111/papr.12999.
26. Petrov-Kondratov, V.; Chhabra, A.; Jones, S. Pulsed Radiofrequency Ablation of Pudendal Nerve for Treatment of a Case of Refractory Pelvic Pain. *Pain Physician* **2017**, *20*, E451–E454.
27. Collard, M.D.; Xi, Y.; Patel, A.A.; Scott, K.M.; Jones, S.; Chhabra, A. Initial Experience of CT-Guided Pulsed Radiofrequency Ablation of the Pudendal Nerve for Chronic Recalcitrant Pelvic Pain. *Clin Radiol* **2019**, *74*, 897.e17-897.e23, doi:10.1016/j.crad.2019.06.028.
28. Wang, C.-L.; Song, T. The Clinical Efficacy of High-Voltage Long-Duration Pulsed Radiofrequency Treatment in Pudendal Neuralgia: A Retrospective Study. *Neuromodulation* **2022**, *25*, 1372–1377, doi:10.1111/ner.13401.
29. Wadhwa, V.; Scott, K.M.; Rozen, S.; Starr, A.J.; Chhabra, A. CT-Guided Perineural Injections for Chronic Pelvic Pain. *RadioGraphics* **2016**, *36*, 1408–1425, doi:10.1148/rg.2016150263.
30. Cesmebasi, A.; Yadav, A.; Gielecki, J.; Tubbs, R.S.; Loukas, M. Genitofemoral Neuralgia: A Review. *Clinical Anatomy* **2015**, *28*, 128–135, doi:10.1002/ca.22481.
31. Zuckerbraun, B.S.; Cyr, A.R.; Mauro, C.S. Groin Pain Syndrome Known as Sports Hernia: A Review. *JAMA Surg* **2020**, *155*, 340, doi:10.1001/jamasurg.2019.5863.
32. Urits, I.; Schwartz, R.; Herman, J.; Berger, A.A.; Lee, D.; Lee, C.; Zamarripa, A.M.; Slovek, A.; Habib, K.; Manchikanti, L.; et al. A Comprehensive Update of the Superior Hypogastric Block for the Management of Chronic Pelvic Pain. *Curr Pain Headache Rep* **2021**, *25*, 13, doi:10.1007/s11916-020-00933-0.
33. Starzec-Proserpio, M.; Frawley, H.; Bø, K.; Morin, M. Effectiveness of Nonpharmacological Conservative Therapies for Chronic Pelvic Pain in Women: A Systematic Review and Meta-Analysis. *American Journal of Obstetrics and Gynecology* **2025**, *232*, 42–71, doi:10.1016/j.ajog.2024.08.006.
34. Patil, A.S.; Gupta, M.; Knezevic, N.N.; Oehlermarx, W.; Diwan, S.; Abdallah, R.T.; Sanapati, M.; Soin, A.; Abd-Elsayed, A.A. A Comprehensive Review of Treatment Approaches to Ilioinguinal Neuralgia. *Pain Physician* **2025**, *28*, 197–205.
35. Gangopadhyay, N.; Pothula, A.; Yao, A.; Geraghty, P.J.; Mackinnon, S.E. Retroperitoneal Approach for Ilioinguinal, Iliohypogastric, and Genitofemoral Neurectomies in the Treatment of Refractory Groin Pain After Inguinal Hernia Repair. *Ann Plast Surg* **2020**, *84*, 431–435, doi:10.1097/SAP.0000000000002226.
36. Chen, D.C.; Hiatt, J.R.; Amid, P.K. Operative Management of Refractory Neuropathic Inguinodynia by a Laparoscopic Retroperitoneal Approach. *JAMA Surg* **2013**, *148*, 962, doi:10.1001/jamasurg.2013.3189.
37. Kastler, A.; Aubry, S.; Barbier-Brion, B.; Jehl, J.; Kastler, B. Radiofrequency Neurolysis in the Management of Inguinal Neuralgia: Preliminary Study. *Radiology* **2012**, *262*, 701–707, doi:10.1148/radiol.11110727.
38. Makharita, M.Y.; Amr, Y.M. Pulsed Radiofrequency for Chronic Inguinal Neuralgia. *Pain Physician* **2015**, *18*, E147-155.
39. Kastler, A.; Aubry, S.; Piccand, V.; Hadjidekov, G.; Tiberghien, F.; Kastler, B. Radiofrequency Neurolysis versus Local Nerve Infiltration in 42 Patients with Refractory Chronic Inguinal Neuralgia. *Pain Physician* **2012**, *15*, 237–244.
40. Parris, D.; Fischbein, N.; Mackey, S.; Carroll, I. A Novel CT-Guided Transpsoas Approach to Diagnostic Genitofemoral Nerve Block and Ablation. *Pain Med* **2010**, *11*, 785–789, doi:10.1111/j.1526-4637.2010.00835.x.

 doi:10.20944/preprints202509.0527.v1

41. Sondekoppam, R.V.; Tsui, B.C.H. Factors Associated With Risk of Neurologic Complications After Peripheral Nerve Blocks: A Systematic Review. *Anesth Analg* **2017**, *124*, 645–660, doi:10.1213/ANE.0000000000001804.
42. Sayed, D.; Grider, J.; Strand, N.; Hagedorn, J.M.; Falowski, S.; Lam, C.M.; Tieppo Francio, V.; Beall, D.P.; Tomycz, N.D.; Davanzo, J.R.; et al. The American Society of Pain and Neuroscience (ASPN) Evidence-Based Clinical Guideline of Interventional Treatments for Low Back Pain. *JPR* **2022**, *Volume 15*, 3729–3832, doi:10.2147/JPR.S386879.
43. Fang, H.; Zhang, J.; Yang, Y.; Ye, L.; Wang, X. Clinical Effect and Safety of Pulsed Radiofrequency Treatment for Pudendal Neuralgia: A Prospective, Randomized Controlled Clinical Trial. *JPR* **2018**, *Volume 11*, 2367–2374, doi:10.2147/JPR.S167866.
44. Hetta, D.F.; Mahran, A.M.; Kamal, E.E. Pulsed Radiofrequency Treatment for Chronic Post-Surgical Orchialgia: A Double-Blind, Sham-Controlled, Randomized Trial: Three-Month Results. *Pain Physician* **2018**, *21*, 199–205.
45. Lee, K.S.; Sin, J.M.; Patil, P.P.; Hanna, A.S.; Greenberg, J.A.; Zea, R.D.; Brace, C.L. Ultrasound-Guided Microwave Ablation for the Management of Inguinal Neuralgia: A Preliminary Study with 1-Year Follow-Up. *J Vasc Interv Radiol* **2019**, *30*, 242–248, doi:10.1016/j.jvir.2018.10.031.