Observational Study

Radiofrequency Treatment of Iliac and Paravertebral Cluneal Nerves for Low Back Pain

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Background: Paravertebral cluneal nerves are constrained within a tunnel consisting of the thoracolumbar fascia and the iliac crest's superior rim as they pass over the iliac crest. Their involvement in low back pain has not been presented previously.

Objective: To develop a diagnostic and therapeutic protocol for radiofrequency ablation of paravertebral and iliac cluneal trigger points.

Study Design: In a prospective observational cohort study, clinically painful trigger points were anatomically defined with diagnostic local anesthetic injections containing a steroid. Validated trigger points were ablated and the resolution of low back pain was monitored and analyzed.

Setting: The Spinal Foundation, The Weymouth Hospital, London, United Kingdom.

Methods: Injections at painful trigger points were considered diagnostic if patients reported 50% or more low back pain relief sustained for 10 days or more. These patients were treated with aware state radiofrequency ablation of the trigger points if the back or referred pain remained refractory despite 3 months of core correction physiotherapy. Clinical outcomes were assessed with the visual analog scale (VAS) and Oswestry Disability Index (ODI) scores for low back pain at a minimum follow-up of 2 years.

Results: This prospective feasibility study included 52 patients with an average age of 56.9 ± 14.9 years ranging from 29 to 83. The mean follow-up was 38.33 months ranging from 25 to 66 months. The average symptom duration before the first consultation was 54.8 months. Many patients had multiple failed chronic pain management interventions, including failed epidural steroid injections (28/52, 53.8%); failed facet injections (45/52, 86.5%); failed facet rhizotomies (20/52, 38.5%); and failed sacroiliac joint ablations (34/52, 65/4%). The majority had had spine surgery before presenting with persistent low back or radiating pain. The surgeries were microdiscectomy (38.5%), laminectomy (11.5%), laminotomy (3.8%), endoscopic transforaminal decompression (9.6%), foraminoplasty (1.9%), sacroiliac joint fusion (11.5%), total disc replacement (13.5%), and lumbar fusion (34.6%). Chief concerns were low back (69.2%), buttock pain (71.2%), groin pain (40.4%), trochanteric pain (28.8%), abdominal or flank pain (5.8%), anterior thigh pain (32.7%), and symptoms mimicking sciatica (19.2%). Validated painful trigger points were the lateral (5.7%), superior (48.1%), medial (23.1%), or a combination of 2 (23.1%). The VAS reduction was from 7.25 ± 1.79 to 1.11 ± 0.98 ($P < 0.0001$). The ODI reduction was from 51.23 ± 9.58 to 7.11 ± 6.69 ($P < 0.001$). The Prolo score was reduced from 3.59 ± 0.72 to 1.35 ± 0.59. Symptoms resolved completely in 34 (65.4%) patients but persisted slightly in 9 (17.3%) and mildly in another 8 (15.4%). There were no cases of infection, dysesthesia, numbness, or paralysis.

Limitations: Our study suffers from low patient numbers and the absence of another diagnostic test definitively confirming the presence of painful cluneal nerve involvement.

Conclusion: Cluneal trigger points should be considered in the differential diagnosis of pain in the lower back, flank, lower abdominal, buttock, trochanteric, groin, and thigh area. It is one form of so-called "pseudo-sciatica." The authors' diagnostic injection protocol suggests that most patients with cluneal trigger points may successfully be treated with percutaneous radiofrequency ablation.

Key words: Cluneal nerve trigger points, low back pain, radiofrequency ablation

Pain Physician 2022: 25:E1129-E1136

In 1989, Maigne et al (1) described the presence of lateral cutaneous branches of the dorsal rami of nerves at the thoracolumbar junction, and in 1998 Lu et al (2) described the anatomic relationship of the cluneal nerves to the posterior iliac crest and the thoracolumbar fascia. Both studies found that the superior cluneal nerves were constrained within a tunnel consisting of the thoracolumbar fascia and the iliac crest's superior rim as they pass over the iliac crest, with the remainder piercing an orifice or fissure in the thoracolumbar fascia. Anatomical terminology for this region has varied (3-9), with superior cluneal nerves loosely classified as originating from L1 – L3 (10,11), and the medial cluneal cutaneous nerves arising at L4 – S1 and passing over the posterior pelvic rim or perforating the sacrotuberous and long posterior sacroiliac ligament (3,12). The role of the paravertebral cluneal nerves in low back pain has not been presented previously.

Cluneal nerve irritation may arise from focal entrapment in the thoracolumbar fascia paravertebrally or at the iliac crest. It may also arise from irritation of the nerve root in the epidural space or foramen and is commonly present in patients who underwent open surgery or bone graft harvesting. The long posterior sacroiliac ligament (LPSL) has a close anatomical relationship with the erector spinae muscle, sacrotuberous ligament, and superficial thoracolumbar fascia layers. It is under tension during sacroiliac joint counternutation (posterior rotation) and slack during nutation (12).

Counternutation may arise in flat back postures or scoliosis, causing entrapment irritation of the medial cluneal trigger points (TPs) over the LPSL or posterior iliac crest (3). Anterior nutation is frequently associated with obesity-related protrusion of the abdominal wall and contents, inadequately rehabilitated abdominal wall surgery, spinal surgery with poor sagittal balance, or iliac bone graft harvesting (4). This results in repetitive strain or trauma to the thoracolumbar fascia and irritation of any or all of the paravertebral or iliac crest cluneal TPs. Once the irritation causes swelling of the nerve, it becomes a self-perpetuating entrapment syndrome with irritation in the osseofibrous sheath or soft tissues and persistent swelling of the nerves and encompassing tissues above or below the sheath. The irritation leads to pain arising from the nerve's surface and changes in the axon plasma flow. Nerves are innervated by nervi nervorum, and impingement may reactively release both substance P and calcitonin gene-related peptide (CGRP), thereby amplifying C nerve fiber nociception (13,14).

On clinical grounds, we classified iliac rim trigger points (TPs) related to the cluneal nerves' leashes into 3 groups (Fig. 1). This grouping excludes the inferior (infrapelvic) cluneal nerves. Some of the superior cluneal nerves pass over the iliac crest in 2 leashes around a landmark lipoma forming the superior cluneal TPs. The more lateral elements of the superior cluneal nerves produce lateral cluneal nerve TPs located above, on, or below the iliac crest, lateral to the iliac crest tubercle, and are variable in position (Fig. 2).

The medial cluneal nerves cross the posterior iliac crest or perforate the LPSL or the sacrotuberous ligament to form the medial cluneal nerve trunk closely approximating the sacroiliac joint (3). Paravertebral TPs occur along the lateral border of the erector spinae as they emerge from the muscle and thoracolumbar fascia, lateral to the line of the facet joints.

While patients may experience pain in the midline or facet joint structures during anteroposterior displacement, the critical feature is the focal tenderness over one or more of the cluneal nerve TPs. The provocation replicates some or all of the predominant presenting symptoms. Buttock pain is often a principal feature. Pain and paresthesia in the paravertebral region, flank, or over the pelvic rim or groin or proximal anterior thigh may arise from the paravertebral TPs. The superior and lateral leashes of the iliac cluneal nerves can produce pain and paresthesia radiating through the buttock, trochanteric region and along the anterolateral thigh to the knee and, on rarer occasions, the symptoms pass into the shin and the foot, mimicking sciatica. In comparison, the medial iliac cluneal nerve TPs can produce deep buttock, deep medial groin, posterior thigh, calf, and foot pain, and sacral–pudendal pain which may be misdiagnosed as pain arising from the sacroiliac joint.

In this study, we present our clinical outcomes with radiofrequency treatment in patients suffering from low back pain and other associated symptoms attributable to cluneal nerve TP irritation. We present our diagnostic protocol to work up patients with suspected painful cluneal trigger points and discuss its use in the differential diagnosis of other unexplained pain in the lower back and extremity.

Methods

Study Design
Patients were enrolled prospectively in an observational sequential cohort study. From June 2014 through December 2018, patients with clinical signs of cluneal

nerve TP tenderness were treated using a step-wise protocol (described below) to determine whether the cluneal nerve TPs were a relevant contributory factor causing the patient's symptoms. Patients were reassessed 6 weeks and 12 weeks after their initial consultation and diagnostic injection for suspected cluneal nerve TPs or selected computed tomography (CT)-guided nerve root blocks for suspected radicular symptoms. During this period, patients were prescribed a supervised muscle balance physiotherapy course with core stabilization and postural spine and pelvis corrective realignment. They were encouraged to incorporate this as a lifestyle change.

Patient Selection

Patients were evaluated for clinical history, clinical (physical) examination, visual assessment of posture, and the effect of correcting the standing posture on the symptoms, standing x-rays, and lumbar 3 Tesla magnetic resonance imaging (3T MRI) scans. Physical examination was focused on distinguishing between facet joint pain versus focal tenderness over one or more of the paravertebral or iliac cluneal nerve TPs, where applied pressure should replicate the patient's predominant presenting symptoms.

Patients were included in the study if they presented with continuous back, flank, and buttock pain and elements of trochanteric, groin, or thigh pain, or "sciatica" with or without prior back surgery or chronic pain management. Symptoms were required to be present for 6 months or more before the consultation, despite 3 months of physiotherapy and pain medication. Patients were only included in this study if they had at least a 50% reduction in pain sustained for 10 days or more with the diagnostic injection protocol outlined below.

Patients with objective radicular sensory or motor deficits were excluded from this study. However, in broader practice, concurrent radicular and cluneal TP symptoms are not uncommon. Patients were also excluded if they had facet joint cysts, severe bony axial or foraminal stenosis, cauda equina syndrome, systemic neuropathy or spinal tumours, blood dyscrasia, allergies, mental handicaps, or psychiatric conditions precluding adequate communication or language problems. Disc degeneration or protrusion, spondylolisthesis, and pregnancy were not exclusion factors.

Diagnostic Protocol

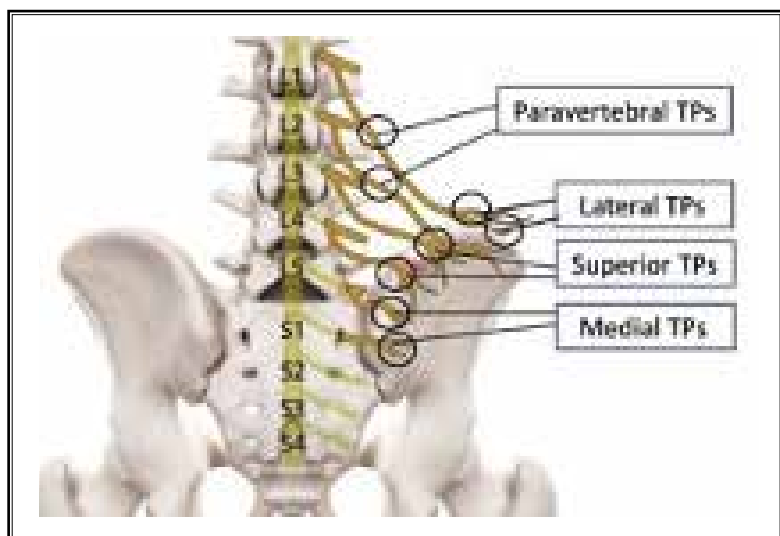In order to determine the relative contribution to the predominant presenting symptoms of low back

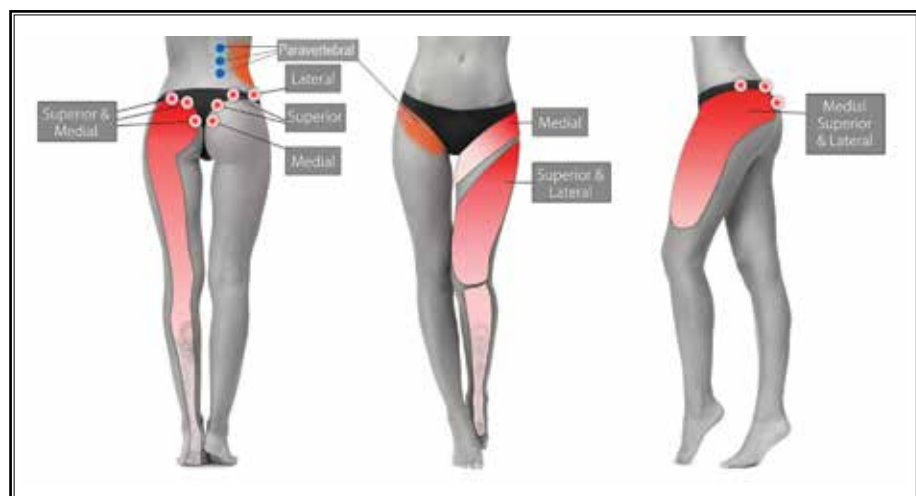Fig. 1. *Anatomy and classification of the cluneal nerves.*

Fig. 2. *Cluneal nerve trigger point symptom distribution.*

pain and buttock pain from axial spinal, paravertebral, or iliac cluneal pain sources, we adopted the diagnostic, therapeutic pathway shown in Fig. 3. Depending on the MRI findings of protrusion, extrusion, sequestration, foraminal axial stenosis, or degenerative/spondylolysis or spondylolisthesis, suspected painful spinal pathology was worked up with diagnostic injections (described in more detail below) to determine the source of the predominant presenting symptoms.

A CT-guided facet joint or nerve root block was performed if a pain source was suspected to stem from the facet joint or the nerve root in a stenotic foramen. A TP injection was considered if these injections failed to relieve a patient's pain, or if the patient presented with tenderness over a TP, reproducing the predominant presenting symptoms. Consequently, patients were stratified for either facet joint ablations (15), a transforaminal endoscopic lumbar decompression and foraminoplasty, or cluneal nerve radiofrequency ablation if symptoms recurred after the initial cluneal nerve TP injection had significantly reduced their symptoms (16). A TP ablation was only performed if the injection produced a reduction of the predominant presenting symptom for 7 – 10 days and if the patient had completed a 6-week physiotherapy program with concurrent use of nonsteroidal anti-inflammatories.

Outpatient Cluneal Nerve Injections

The points of maximal tenderness reproducing the predominant presenting symptoms were marked on the skin at the sites of the paravertebral, lateral, superior, or medial cluneal nerve TPs. The skin was sterilized.

Fig. 3. *The treatment protocol.*

A 22G needle was inserted at the evocative TPs, and patients were injected with aliquots of a mix of 5 mL of 0.5% levobupivacaine, 40 mg of methylprednisolone (2 mL) and 40 mg of triamcinolone acetonide (2 mL) delivered in divided aliquots at each TP or leash of nerves in 2 mL divided doses after which a dry dressing(s) were applied. Triamcinolone acetonide was added to the methylprednisolone to cover the occasional initial irritant effect of the methylprednisolone and thus achieve more effective relief.

We dispensed with image intensification and relied upon the patient to guide us to the TP. However, an image intensifier may be used in the posteroanterior plane to mark out the location of the TP in relationship to the iliac crest.
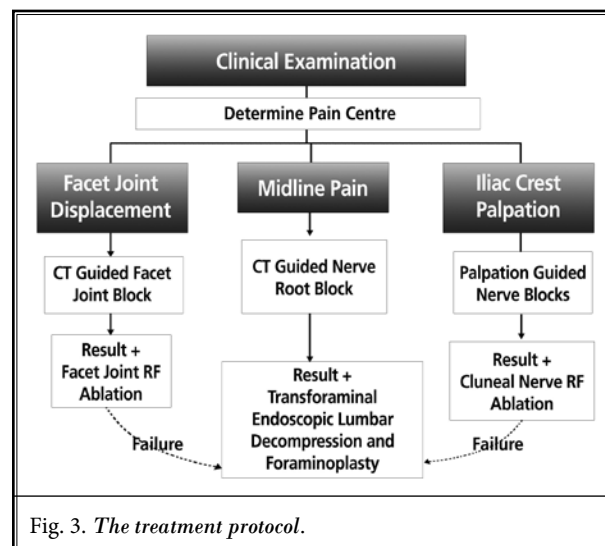
The patient was mobilized and completed a pain diary 3 times a day until review at 6 weeks. During this period, the patient participated in muscle balance physiotherapy and postural alignment retraining. If sustained improvement was achieved, then a further course of muscle balance physiotherapy was recommended to consolidate the benefit; progress was then rechecked at 3 months.

Cluneal Nerve Radiofrequency Ablation

Prior to the procedure the points of maximal tenderness were marked out on the patients skin with the patient in slight flexion. The patient was placed prone on a Knight Sheffield radiolucent table (Royal Hallamshire Hospital Bioengineering Department) which flexes the patient at the hips by 20°.

The procedure was conducted under various levels of total intravenous analgesia (17) with the patient in an aware state. An anesthesiologist provided sedation with a continuous injection of intravenous remifentanil and propofol to ensure sedation levels. The skin was sterilized and draped. Each validated TP site was injected only subdermally, with 1% lignocaine given both locally and horizontally along the pelvic rim or margin of the erector spinae. Local anesthesia was not inserted around the targets.

An image intensifier (Ziehm Vision, 23 cm Vision 4713 model) was used in the posteroanterior plane to ensure an oblique entry trajectory to the previously validated points of maximal tenderness. This oblique line of entry allowed the radiofrequency probe to trace along the line of the erector spinae margin or iliac crest, offering ablation at several points of irritation (lateral and medial to the erector spinae portals, above/below /medial to the iliac crest, over the crest, and at the pre-

sumed point where the nerve entered and exited the fascial tunnel or area of soft tissue tethering).

A 10-cm 22G radiofrequency cannula with a curved 10 mm active tip and its radiofrequency electrode (Neurotherm, Morgan automation LTD, Medipoint GmbH) were advanced to bring the tip into the relevant TP. In the case of paravertebral TPs, the curved tip of the probe addressed the cluneal nerve within the erector spinae fascia and externally in the thoracolumbar fascial layers. The fascia may bifurcate at this margin. The probe tip positioning was optimized by detecting tissue impedance of 350 - 800 Ω, which indicated that the probe was adjacent to the nerve(s). Sensory stimulation at 50 Hz up to one V was used to identify the nerve position further using patient feedback whenever feasible under total intravenous analgesia (Fig. 4). During ablation, our anesthesiologist increased the analgesia and sedation for each 60-second lesioning episode at 80°C, as this can produce an intense sense of burning. This procedure was repeated along the leashes line within the TP until the required cluneal TPs were no longer painful upon provocative pressure (Fig. 5).

Clinical Outcome Measures

Patient pain and functionality were assessed using the visual analog pain scale (VAS) for back pain (18), Oswestry Disability Index (ODI) (19,20), and the Prolo activity score (21) during the first 6 – 12 weeks following each phase of treatment and at final follow-up, which ranged from 25 to 66 months. Additionally, patients' outcomes were also rated by categorizing symptom resolution as follows: a) resolved, b) slight persistent symptoms, c) mild persistent symptoms, and d) severe symptoms requiring additional intervention including repeat radiofrequency ablation.

Results

From June 2014 through December 2018, 52 patients met the inclusion criteria and were prospectively included in this feasibility study. The average age was 56.9 ± 14.9 years ranging from 29 to 83. Twenty-four (46.2%) patients were men, and 28 (53.8%) patients were women. The mean follow-up was 38.33 months ranging from 25 to 66 months. Thirty-five (67.3%) patients were working, and the remaining 17 (32.7%) patients were retired.

The average symptom duration before the first consultation was 54.8 months, ranging from 14 to 144 months. Many patients had multiple failed chronic pain management interventions, including failed epidural steroid injections (28/52, 53.8%); failed facet injections (45/52, 86.5%); failed facet rhizotomies (20/52, 38.5%); and failed sacroiliac joint ablations (34/52, 65/4%). Many patients had more than one prior spine surgery, including microdiscectomy (20/52, 38.5%); laminectomy (6/52, 11.5%); laminotomy (2/52, 3.8%), endoscopic transforaminal decompression (5/52, 9.6%); foraminoplasty (1/52, 1.9%); sacroiliac joint fusion (6/52, 11.5%); total disc replacement (7/52, 13.5%); and lumbar fusion (18/52, 34.6%).

The predominant symptoms were low back (36/52, 69.2%) and buttock (37/52, 71.2%) pain. Additional concerns listed by patients were groin pain (21/52, 40.4%), trochanteric pain (15/52, 28.8%), abdominal or flank pain (3/52, 5.8%), anterior thigh pain (17/52, 32.7%), and symptoms mimicking sciatica (10/52, 19.2%). Nine patients (17.3%) had one symptom, 15 patients had 2 (28.8%), 14 patients (26.9%) had 3, and 13 patients (25%) had 4. Only one (1.9%) patient had 5 of the listed symptoms. Only 2 patients were found to have true sciatica from a symptomatic L3 and L5
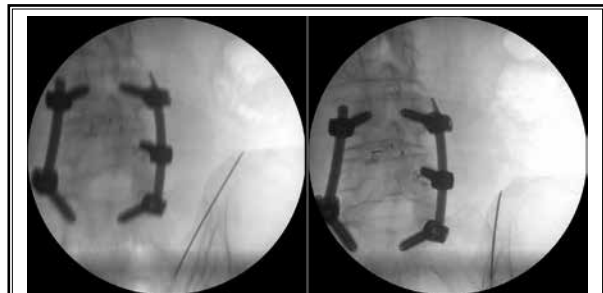

Fig. 4. *Images of a cluneal nerve ablation probe positioned at points on either side of the "guideline" lipoma, around which the superior cluneal nerves pass.*

Fig. 5. *Radiofrequency ablation probes bilaterally stimulating the medial cluneal nerves.*

radiculopathy. The most common location of validated painful TPs was the lateral (3/52, 5.7%); superior (25/52, 48.1%); medial (12/52, 23.1%); or a combination of 2 locations or overlapping paravertebral TPs (12/52, 23.1%, Table 1).

There were statistically significant reductions from the mean preoperative VAS of 7.25 ± 1.79 to postoperative VAS of 1.11 ± 0.98 ($P < 0.0001$). The ODI score reduced from preoperative 51.23 ± 9.58 to postoperative 7.11 ± 6.69 ($P < 0.001$). The Prolo score reduced from preoperative 3.59 ± 0.72 to postoperative 1.35 ± 0.59 ($P < 0.001$; Table 2). Thirty-four (65.4%) of the 52 patients had complete symptom resolution. Nine (17.3%) patients had near complete and another 8 (15.4%) patients had mild persistent residual symptoms — only one patient had continuing severe symptoms after radiofrequency ablation (Table 3). None of the prior surgery types associated with failed back surgery syndrome were statistically significantly correlated with the extent of symptoms; the VAS, ODI, Prolo score reductions; or the extent of symptom resolution after radiofrequency ablation. There were no cases of infection, dysesthesia, numbness, or paralysis.

Discussion

The cluneal nerve TPs can produce pain ranging from discrete low back and buttock pain to widespread symptoms. The most intense pain is usually located at the TPs. It radiates diffusely over the flank or buttock, often accompanied by a less severe aching felt in the lower anterior abdomen, trochanteric region, groin, or anterior, lateral, or posterior thigh. More rarely, less intrusive paraesthesia may be felt below the knee and mimic sciatica. Clinically, patients with these conditions may complain that the pain increases when sitting or getting out of a chair (often interpreted as "spinal instability") or is aggravated by walking, turning in bed, or arching or rotating the lumbar spine. Usually, the patient may stand with a hand on the iliac crest and have difficulty standing upright. This posture is often considered to denote pain arising from a disc, facet joint, or sacroiliac joint rather than arising from a painful cluneal nerve TP. Consequently, many patients undergo surgery of the lumbar spine that may be ineffective. In some cases, unrecognized cluneal nerve irritation is the cause for failed sacroiliac joint ablations. The high percentage of patients with previous spine surgery classified as failed back surgery syndrome with persistent symptoms corroborates this.

Patients with symptomatic cluneal TPs may present with altered posture and increased pelvic anteversion or flat back postures. Intervertebral anterolisthesis or retrolisthesis may also be present on plain film studies in patients with cluneal nerve TP pain and could confuse the diagnosis. Concomitant trochanteric bursa irritation may also be a common associated finding on physical examination. The medial cluneal nerve TPs are located close to the iliac crest and may be misdiagnosed as sacroiliac joint pain. A more serious consequence of this could be ill-conceived and ineffective sacroiliac joint fusion procedures.

Buttock pain is a common feature located along the iliac crest and radiating into the buttock and may be misdiagnosed as Piriformis syndrome. The patient often describes the pain as diffuse until the examiner palpates the TP. If cluneal TPs are suspected, conservative treatment with a supervised muscle balance physiotherapy and Pilates program aimed at correcting core strength and spinal posture has been recommended. It has been stipulated that cluneal nerve irritation or impingement leads to pain from within the nerve's surface and changes in the axon plasma flow resulting in the release both substance-P and calcitonin gene-related peptide (CGRP), thereby amplifying C nerve fiber nociception (13,14).

The favorable clinical outcome with cluneal TP radiofrequency ablation observed in our patients, many of whom had multiple previous surgeries, highlights the importance of considering pain from the cluneal TPs in the differential diagnosis when assessing patients suspected of having pain from the disc, painful nerves in stenotic foraminiina, diseased facet joints, and sacro-

Table 1. *Clinical presentation of patients with tender iliac trigger points.*

	Frequency	Valid Percent	Cumulative Percent
Lateral & superior iliac trigger point	1	1.9	1.9
Medial & lateral iliac trigger point	1	1.9	3.8
Medial & superior iliac trigger point	12	23.1	26.9
Medial iliac trigger point	12	23.1	50.0
Medial, lateral & superior iliac trigger point	1	1.9	51.9
Superior iliac trigger point	25	48.1	100.0
Total	52	100.0	

iliac joint. The clinical workup requires a conventional appraisal of clinical history, weight-bearing x-rays, and MRI scans with physical examination and attention to the patient's standing and sitting posture. When the paravertebral or iliac crest cluneal nerve TPs are considered prime sources of tenderness, they are injected with steroids, observed as described, and the patient is enrolled in a core stabilization and postural correction program. When transient but significant amelioration of pain is achieved with the diagnostic injection, then cluneal nerve TP radiofrequency ablation is indicated.

This prospective study represents the 2-year follow-up data of an evaluation of initial outcomes of the radiofrequency-based treatment technique and protocol for iliac TPs (22). Our findings are corroborated by Maigne and Doursounian (23) who reported on open surgical decompression of the iliac crest cluneal nerves in 19 patients with unilateral low back pain projecting in the territory of the medial cluneal nerve TPs. With a 2-year or longer follow-up, excellent results were reported by these authors in 13 cases (7 of which had suffered from severe compression), and unsatisfactory in 6 cases (including 4 cases in whom no compression could be demonstrated, suggesting an incorrect diagnosis) (23). Alternative treatments include prolotherapy, (24) CT-guided, (25) or ultrasound-guided injections (26) (or for the inferior cluneal nerve, endoscopic neurolysis). While our study results on 52 patients suggest that treatment of cluneal nerve TPs may be beneficial in patients with low back if all else fails, our study suffers limitations, including low patient numbers and the absence of another diagnostic modality definitively confirming the presence of painful cluneal TPs.

Conclusions

Cluneal cutaneous nerves can develop entrapment TPs along the lateral margin of the erector spinae or iliac crest. Referred symptoms present as combinations of low back pain; flank, lower abdominal, buttock, trochanteric, groin, and thigh pain; or as "sciatica." Cluneal nerve TP irritation may arise from degenerative spine disease and malposture affecting the cluneal nerves as they pass over through the thoracolumbar fascia at the border of the erector spinae or the iliac crests. Spinal surgery may aggravate cluneal nerve irritation, especially if the nerves are injured during the surgical

Table 2. *Paired t testing of pre- and postoperative ODI, VAS, Prolo scores*

	Mean	Std. Deviation	Std. Error Mean
Preoperative ODI	51.2308	9.58065	1.32860
Postoperative ODI	7.1154	6.69109	.92789
Preoperative VAS	7.2500	1.79187	.24849
Postoperative VAS	1.1154	.98327	.13635
Preoperative Prolo Score	3.5962	.72110	.10000
Postoperative Prolo Score	1.3462	.59027	.08186

Paired Differences	Mean	95% CI of the Difference		Sig. (2-tailed)
		Lower	Upper	
Preoperative ODI - Postoperative ODI	44.11538	40.93793	47.29284	< .0001
Preoperative VAS - Postoperative VAS	6.13462	5.61442	6.65481	< .0001
Preoperative Prolo Score - Postoperative Prolo Score	2.25000	2.03034	2.46966	< .0001

ODI = Oswestry Disability Index; VAS = Visual Analog Scale

Table 3. *Patients' rating of symptom resolution*

	Frequency	Valid Percent	Cumulative Percent
Mild residual symptoms	8	15.4	15.4
Severe residual symptoms	1	1.9	17.3
Slight residual symptoms	9	17.3	34.6
Symptoms resolved	34	65.4	100.0
Total	52	100.0	

exposure. This study shows that diagnostic injections of cluneal nerve TPs should be considered to aid in the differential diagnosis of persistent low back pain, particularly after previous surgery. Radiofrequency ablation of the cluneal TPs should be considered in those patients who failed nonoperative care with physiotherapy and nonsteroidal anti-inflammatory drugs.

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