

Under-recognized Cause of Buttock Pain; Superior Cluneal Neuropathy and Diagnostic Utility of Combined Ultrasonography and Neurostimulation Guidance: Case Series

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Abstract

Background: Superior cluneal neuropathy (SCN) is an under-recognized source of unilateral low back and buttock pain, representing approximately 14% of lower back pain cases. The condition is caused by entrapment or irritation of the superior cluneal nerves. Diagnosis is challenging due to symptom overlap with other spinal and pelvic conditions and the absence of gold-standard diagnostic criteria.

Objective: This case series evaluates the utility of ultrasound (US) guidance combined with nerve stimulation for diagnosing and treating SCN, particularly in patients with complex pain histories and overlapping differential diagnoses.

Methods: Three patients with unilateral lower back, iliac crest, and buttock pain underwent US-guided superior cluneal nerve injections supplemented by nerve stimulator confirmation. Pain characteristics, physical examination findings, and procedural outcomes were recorded. SCN was identified as hyperechoic structures on US with a honeycomb appearance. Nerve stimulation reproduced patients' symptoms, followed by therapeutic injection of local anesthetic and corticosteroid.

Results: All three patients reported greater than 60% pain relief immediately following the injection. During the follow up evaluations at two and four weeks, excellent pain relief was reported in two patients and moderate relief in one.

Conclusion: SCN should be considered in cases of lower back and buttock pain resistant to conventional treatments. This approach of combining US and nerve stimulation improves diagnostic accuracy and therapeutic efficacy, representing a significant advancement in the management of SCN.

Keywords: Chronic pain, Cluneal neuropathy, Ultrasound-guided injections

Introduction

Superior cluneal neuropathy (SCN) is one of the more under-recognized causes of unilateral low back and buttock pain. Comprising about 14% of cases of lower back pain, SCN represents a relatively rare yet significant portion of patients presenting with lower back pain [1]. The cluneal nerves are

susceptible to compromise due to entrapment neuropathy as a result of direct or indirect compression or irritation [2].

Originating from the L1, L2, and L3 nerve roots, the superior cluneal nerves pass through significant musculature including the iliocostalis and erector spinae muscles and can lie between the iliocostalis lumborum and longissimus muscles

[3]. The medial branch of the SCN remains within a tunnel that consists of the thoracolumbar fascia and superior rim of the iliac crest as it passes over the iliac crest. The intermediate and lateral branches of the SCN enter the thoracolumbar fascia or pass through an orifice in the fascia [12]. The superior cluneal nerve often extends distally to the greater trochanter [4]. With this anatomy in mind, there are many various risk factors for SCN due its proximity to surrounding structures. These include history of lumbar or pelvic procedures, particularly spinal fusion or sacroiliac screw placement [5]. Posterior iliac bone harvest procedures have also been well documented in the literature as compromising cluneal nerve integrity [4]. Other procedures including decubitus ulcer debridement and muscle flap surgeries place patients at risk as well [5]. Females and elderly have traditionally been at higher risk [6], however younger populations such as soldiers may be at risk as well [7]. Parkinson's disease has also rarely been associated with SCN due to mechanical compression of the cluneal nerves secondary to increased muscle tone and rigidity in paravertebral and gluteal muscles, causing abnormal posture [6]. SCN has also been reported secondary to entrapment at an osseofibrous orifice formed by the thoracolumbar fascia [8].

There is no established gold standard criteria for diagnosis of SCN. However, diagnostic block is a useful tool, therefore underscoring the importance of achieving accurate identification of the SCN prior to block. Although there is no study comparing the clinical efficacy of ultrasound-guided SCN block versus landmark-based (blind) technique, there have been multiple human and cadaveric studies revealing the accuracy of ultrasound-guidance in identifying the superior cluneal nerve by using cadavers to optimize the technique for delivering ultrasound-guided injections [9,10], and various landmark-guided studies showing inconsistent targets [11-13].

Further to our knowledge, there are no studies evaluating nerve stimulation supplementary to ultrasound-guidance involving SCN patients. In particular, ultrasound guidance and nerve stimulation may be increasingly beneficial in patients presenting with complex history of other potential nearby pain generators.

Considering the significant overlap of presenting symptoms, nearby anatomical structures, and lack of specific physical examination maneuvers, SCN remains a challenging diagnosis and condition to properly treat. This case series aims to aid in successful SCN diagnosis through ultrasound visualization and nerve stimulator confirmation. We used a musculoskeletal US to identify the superior cluneal nerve and guide a needle to block the superior cluneal nerve supplementary to a nerve stimulator to confirm the visualized structure as pain generator by reproducing the patient's symptoms. To our knowledge, this is the first report of such a novel approach to SCN.

Cases

Case 1

A 73 year-old female presented with a 4-year history of stabbing pain primarily localized to the right iliac crest and buttock. The pain was described as radiating to the right greater trochanter. Her pain intensity was rated as 9 out of 10 and constant. On physical exam, there was no tenderness over the sacroiliac joint, or posterior superior iliac spine (PSIS), or greater trochanter. Special tests including Flexion Abduction External Rotation (FABER) test, Gillet test and Gaenslen's test with lumbar facet loading were positive for pain. Following an injection to the superior cluneal nerve, her pain intensity decreased to 0 out of 10, however, recurred to 3 out of 10 after two weeks and remained at that intensity after one month.

Case 2

A 52-year-old female presented with a 5-year history of constant pain described as pins-and-needles in the left iliac crest and buttock, radiating to the left greater trochanter, posteromedial thigh, and calf. She also reported bilateral lower extremity pain and numbness, worse on the left side with the left calf being most affected by numbness. Her symptoms were aggravated by standing up from a seated position or during bowel movements. Her pain was alleviated by diclofenac. She denied bowel or bladder incontinence and saddle anesthesia. A prior EMG suggested possible superior cluneal nerve entrapment. On physical examination, there was tenderness over the sacroiliac joint and PSIS, with positive FABER and Gillet tests. However, there was no lumbar facet or greater trochanter tenderness. Palpation over the left iliac crest approximately 6.5 cm from the midline at L5 reproduced her paresthesia over the left calf. Following an injection to the superior cluneal nerve, her pain intensity improved to 3 out of ten and subsequently resolved after two weeks but recurred at the one month follow up to an intensity of 6 out of 10 level of pain.

Case 3

A 77-year-old female presented with a 1-year history of pain in the right hip and buttock. She described her pain as constant pins and needles which radiated to the right hip. The intensity of the pain was initially an 8 out of 10. On physical exam, there was sacroiliac joint and PSIS tenderness with a positive Gaenslen's test, but negative FABER, Gillet and lumbar facet loading, and straight leg raising test. Following an injection to the superior cluneal nerve, her pain resolved completely to 0 out of 10 and remained pain free at both two weeks and one month follow up visits.

Demographic data and pain characteristics of patients are described in **Table 1**. All three patients experienced severe unilateral low back, iliac crest and buttock area pain. Patient

1 and 2 developed the pain gradually without any preceding injury or trauma. Patient 3 developed the pain gradually after a mole removal surgery on the buttock. Patient 1 and 2 had “trigger point” localized over the posterior iliac crest approximately 6-8 cm from the midline and patient 3 had “trigger point” on the surgical scar, inferior to the iliac crest. Palpation of “trigger point” reproduced the presenting symptoms of ipsilateral lower back and buttock pain with severe tenderness with radiating pain to the ipsilateral greater trochanteric area. Patient 2 and 3 reported a pain below the buttock as well. Pain is reported to be worse on forward flexion of back in all 3 subjects. **Table 2** summarizes the physical examination findings. Neurological examinations of lower extremities including motor strength, sensory examination, and deep tendon reflex were normal. Patient 1 underwent a vertebroplasty for T12 for compression fracture as well as decompression and instrumentation at L4-S1 for spinal stenosis which didn’t improve her pain significantly. Patient 2 and 3 had an X-ray which revealed a mild facet arthropathy at lower lumbar spine levels.

US evaluation of the buttock was performed using LOGIQ e (GE medical, Inc) portable ultrasound with 10-12 MHz linear array transducer (**Figure 1**). With the patient on lateral recumbent fetal position with hip and knee flexed, US identified the branches of superior cluneal nerve as hyperechoic oval structures with ‘honey comb’ appearances within the surrounding hypoechoic fat tissue slightly distal to the iliac crest and superficial to fascial plane of gluteus maximus (**Figure 2**). Then, the course of nerve was confirmed proximally and distally in relation to iliac crest. After the area was cleaned in a sterile fashion, a nerve stimulator needle (Ambu Neuroline Inoject 3” x 24 gauge) was introduced to the superior cluneal nerve with in-plane approach under ultrasound guidance (**Figure 3**). The size of the superior cluneal nerve was measured as 1-2 mm in diameter, which correlated with the previous reported value from the cadaveric specimen [4]. Nerve stimulation at the level of 0.5 milliampere (mA) reproduced the pain on the buttock area in all 3 patients and the specific referral pattern in each patient to greater trochanter in all 3 patients, lower extremity in patient

Table 1. Patient characteristics.

	Case 1	Case 2	Case 3
Age (years)/Sex	73/Female	52/Female	77/Female
Location of pain	Right iliac crest/buttock	Left iliac crest/buttock	Right iliac crest/buttock
Duration of pain	4 years	5 years	1 year
Quality of pain	Stabbing	Pins and needle	Pins and needle
Frequency of pain	Constant	Constant	Constant
Pain intensity *	9	9	8
Radiating pain	Right greater trochanter	Left greater trochanter, posteromedial thigh, and calf	Right greater trochanter
Post injection *	0	3	0
After 2 weeks *	3	0	0
After 1 month *	3	6	0

*: Pain intensity was measured with numeric pain rating scale.

Table 2. Physical examination findings.

	Case 1	Case 2	Case 3
Sacroiliac joint tenderness	-	+	+
Flexion Abduction and External Rotation	+	+	-
Gillet test	+	+	-
Gaenslen’s test	+	-	+
PSIS tenderness	-	+	+
Straight leg raising	-	-	-
Lumbar facet loading	+	-	-
GT tenderness	-	-	-

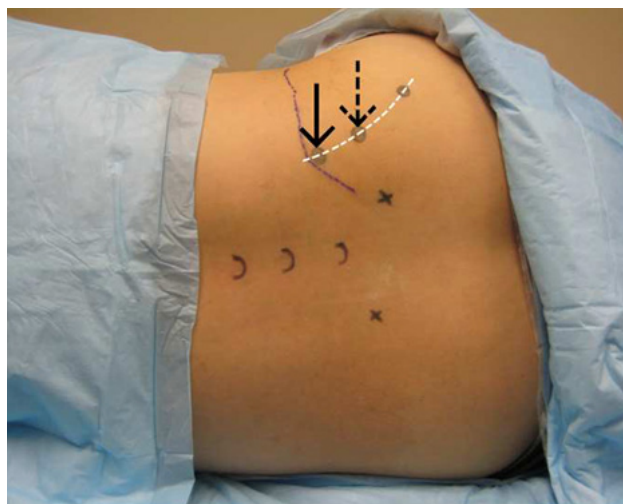


Figure 1. The patient is placed in lateral recumbent position. Iliac crest, posterior superior iliac spine and lumbar spinous process were marked as well as the course of the superficial cluneal nerve (dotted white line). Arrows (solid and broken) indicate the corresponding level of transverse US imaging of Figure 2A and 2B.

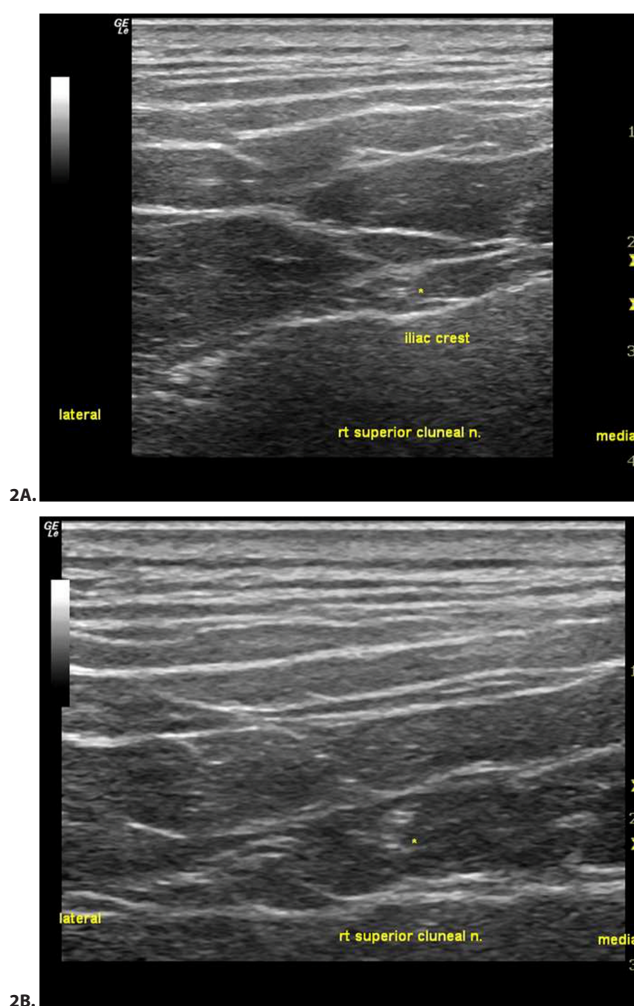


Figure 2. Transverse ultrasound images showing the superior cluneal nerve (asterisk) on the iliac crest (A) and distal to the level of iliac crest (B).

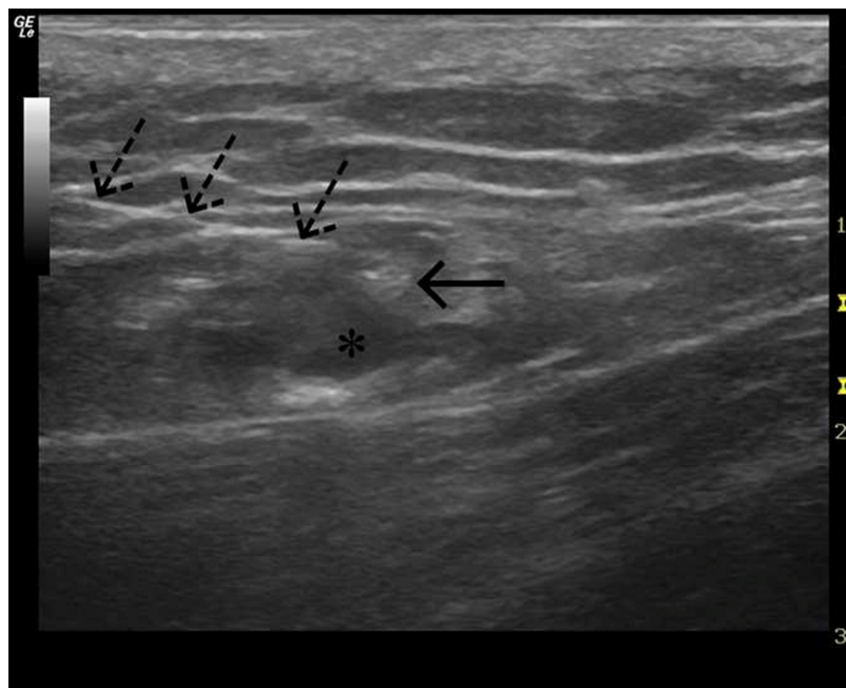


Figure 3. Superior cluneal nerve injection. The broken arrows outline the shadow of the needle shaft. The needle is right above the superficial cluneal nerve (the solid arrow) above the gluteus maximus muscle. After injection, SCN is surrounded by pool of hypoechoic local anesthetic (*) surrounding the nerve.

2. A mixture of 0.5 milliliter (ml) of 40 mg/ml Kenalog and 2.5 ml of 1% Lidocaine was injected after negative aspiration. Immediately following the injection, all patients reported greater than 60% of pain relief (**Table 1**). During the follow up evaluations at two and four weeks, excellent pain relief was reported in two patients and moderate relief in one.

Discussion

These cases illustrate successful management of SCN MSK US and nerve stimulation with greater than 60% pain relief directly after the injection. As discussed above, the superior cluneal nerve, which innervates the area of posterior iliac crest and the upper buttock, can be further specified into medial, intermediate, and lateral nerves which originate from dorsal rami of L1, L2, and L3 spinal nerves [4]. The superior cluneal nerve becomes superficial by passing through the thoracolumbar fascia at iliac crest level; medial branch $81 \text{ mm} \pm 9.2 \text{ mm}$ from the midline, $5.8 \pm 1.8 \text{ mm}$ inferiorly and lateral branch $12 \pm 4.4 \text{ mm}$ superiorly [12]. The medial superior cluneal nerve can be confined within a tunnel consisting of the thoracolumbar fascia and the superior rim of the iliac crest as it passes over the iliac crest [12, 14]. The diagnosis of SCN is challenging since there are no specific clinical examinations or imaging studies available. Therefore, diagnosis is often made after exclusion of other more valid disorders of the spine/buttock (i.e. lumbar radiculopathy, facet arthropathy, SI joint dysfunction).

Superior cluneal nerves are purely sensory terminal branches of dorsal rami of the L1, L2, and L3 roots, passing through the thoracolumbar fascia at iliac crest level, and innervating the buttock area below the iliac crest [12]. As such, clinical presentation typically involves pain in the lower back or superior gluteal region [5]. Dysesthesia may also be the primary symptom [15]. However, if motor weakness is reported, this is less likely purely SCN given its purely sensory function, thus a more proximal nerve injury may be present. Notably, SCN can cause leg symptoms in 47-84% of patients [5].

Physical examination is an important element of SCN workup given the variety of overlapping symptoms with other etiologies of lower back pain. While no physical examination maneuver has been deemed sensitive or specific for SCN, there are tests that have proven useful. Tinel-like palpation over the iliac crest where the superior cluneal nerve passes through the osteofibrous tunnel (about 6.6 cm lateral from midline over the iliac crest) can produce pain in the distribution of the SCN [16]. This includes pain in the lower back radiating to the gluteal region, posterior thigh as stated above. One study also suggested that complete flexion of the ipsilateral hip and knee reproduces symptoms [15]. It is important to perform a complete and thorough neurologic examination, as SCN typically remains a diagnosis of exclusion in patients presenting with lower back pain.

It is also important to rule out similar differential diagnoses

including thoracic and lumbar facet arthropathy, lumbar stenosis, lumbar radiculopathy, discogenic pathology, sacroiliac joint dysfunction, sciatica, obturator neuritis, posterior femoral cutaneous neuritis, myofascial pain syndrome or trigger points, piriformis syndrome, or pelvic pain syndromes [6,15].

Isu *et al.* defined five diagnostic criteria for SCN: low back pain with involvement of the iliac crest and gluteal region, worsening pain with movement of the lumbar spine, tenderness over the posterior iliac crest at the location of nerve entrapment, reproduction of pain and/or numbness with compression at site of nerve entrapment, and symptom relief with a diagnostic block [6]. Lastly, the management of SCN should emphasize addressing the myofascial structures. This can be achieved through pharmacological and non-pharmacological treatment options which include exercise, massage, ultrasound, electrotherapy and dry needling [17].

All 3 patients in this case series reported radiating pain to the buttock and greater trochanter on palpation of “trigger point”, however, none of them showed any point tenderness on the greater trochanteric region. SI joint dysfunction is one of the most important differential diagnoses to consider in patients with upper buttock pain. Interestingly, all 3 patients showed positive findings in ≥ 3 out of 5 SI joint maneuvers [18, 19]. Although physical examinations for SIJ are often poorly specific [20,21], we acknowledge the possibility of concurrent SI joint pathologies/dysfunction as well as facet arthropathy in these patients. However, reproducibility of symptoms by palpation of “trigger point” on the middle posterior iliac crest in patient 1 and 2 and surgical scar in patient 3 with referred pain rather than SI joint line led us to believe that the primary etiology was SCN. Absence of lower lumbar paraspinal rigidity or tenderness, maximum pain localized in the buttock area below L5 and iliac crest level with none to minimal intermittent radiating symptoms, and negative provocative test made lumbar radiculopathy less likely. More importantly, reproduction of patients’ exact symptoms with the nerve stimulation and subsequent pain relief from SCN block further confirms the diagnosis of SCN over other disorders.

Using the diagnostic criteria described above by Isu *et al.* in 2018, case 1 meets four out of five criteria (does not have tenderness over the posterior iliac crest at the location of nerve entrapment). Case 2 meets all criteria, and case 3 meets all criteria however one criteria (worsening pain with movement of the lumbar spine) was not assessed. Thus, if using diagnostic criteria in the literature, not all three cases described here would be diagnosed with SCN. However, the accuracy with which US and nerve stimulation identified the superior cluneal nerve, and the improvement seen in all three patients after injection, points to the usefulness of US and nerve stimulation in aiding in diagnosis.

The fact that the same radiating pain to lateral thigh was

reproduced with nerve stimulation of superior cluneal nerve can be attributed to extension of the lateral branch of superior cluneal nerve to greater trochanter of the femur [4]. Interestingly, palpation of “trigger point” produced referred pain beyond buttock down to the posterior thigh and calf in patient 2 and 3. This may be attributed to the central hypersensitivity at the proximal level of pain pathway (at the spinal or supraspinal level), or anastomosis of medial superior cluneal nerve with middle cluneal nerve from S1-3 which could cause referred pain in S1-3 dermatomal distribution [4]. Alternatively, myofascial pain syndrome may be considered pain produced with palpation of the “trigger point”. Myofascial pain syndrome can present as painful restricted range of motion, stiffness, and referred pain patterns. Diagnosis is primarily based off physical exam by identifying trigger points through palpation. Treatment is multimodal and involves physical therapy, different medication modalities such as anti-inflammatory medications and trigger point injections [22].

Although all three patients initially experienced pain relief, only patient 3 had sustained relief 1 month out. Patient 1 and 2 both had experienced neuropathic pain for several years, whereas patient 3 experienced pain for 1 year. The difference in response may be attributable for the length of neuropathic pain each patient experienced. An additional reason may be the mechanism of SCN. Both patients 1 and 2 had no preceding events or trauma that led to their pain, and developed it more gradually. Patient 3 developed pain after a mole removal surgery. This may have caused very direct and localized trauma to the superior cluneal nerve, whereas the other two patients may have had a larger area of nerve entrapment cause more severe damage, in addition to possible other surrounding structures contributing to the pain that may not have been targeted with the dual approach. An initial positive response indicates high probability of reaching the correct target, however both patients had several years of pain prior to the injection, which may require repeat injections in order to further decrease their pain and break the pain cycle. Additionally, pain management often calls for a multimodal approach, involving other types of injections such as trigger points, medication management and physical therapy.

Although nerve stimulation technique has been traditionally used for accurate needle placement, accuracy of electrical localization has been challenged recently [23-25]. Superior accuracy, reproducibility, and safety have been reported using combined US and nerve stimulation guidance in some nerves block [24,25]. Traditional palpation guided injection with large volume can be used as an alternative technique [26]. However, this technique can decrease the diagnostic specificity of nerve block around the iliac crest due to nearby pain generators and may increase local anesthetic toxicity. A study published in 2019 by Nielsen *et al.* showed US-guided nerve block accurately targeted the superior cluneal nerve with 90% success [27]. It was also found that an injectate volume of 10 ml was optimal for superior cluneal nerve

block efficacy, avoiding spread to nearby structures such as the sacroiliac joint and thus complicating diagnosis [27]. Contrarily, landmark based techniques recommend needle entry above the trigger point (nerve compression region) located on the posterior iliac crest, however this location is documented inconsistently throughout the literature. Lu *et al.* suggested the distance from the medial branch of the superior cluneal nerve to the posterior superior iliac crest midline is 70 to 80 mm [12], while Kuniya *et al.* suggested 45 mm due to body habitus differences in smaller Japanese cadavers [13]. Body habitus has also been reported to be a limitation with ultrasound only approach. Saranteas *et al.* presented a case report on two patients admitted to the ICU who received peripheral nerve blocks. One patient had significant edema and obesity which presented as a limitation for the procedure. These factors made ultrasound imaging difficult, and it was found when combining it with nerve stimulation it led to a successful block [28].

It has also been shown that sex differences play a role due to the anatomical differences in male versus female pelvic shape [11]. Considering these findings utilizing cadaveric studies suggesting blind injection does not ensure accurate localization, this case series demonstrates the accuracy and efficacy of ultrasound-guided injection with supplementary nerve stimulator confirmation. Nerve stimulation for superior cluneal nerve interventions, particularly for its multiple branches after piercing the thoracolumbar fascia and transitioning into cutaneous branches, can provide valuable confirmation of each branch's distribution. This is especially useful in targeting the branch responsible for the patient's pain pattern. While nerve stimulation alone has been shown to have low sensitivity for nerve localization, its use in conjunction with ultrasound adds an extra layer of precision and safety.

Nerve stimulation serves as a highly specific monitor for needle-nerve contact, offering a strong rationale for its concomitant use with ultrasound guidance. This combination is particularly effective in warning against accidental needle-nerve contact, which may not always be evident with ultrasound alone [29]. Furthermore, a retrospective registry analysis by Bomberg *et al.* demonstrated that combining ultrasound with nerve stimulation significantly reduced the odds of unintended paresthesia [30]. This evidence underscores the utility of integrating these modalities for both efficacy and safety in interventional pain management.

Therefore, authors recommend the US scanning of superior cluneal nerve from "trigger point" usually located 7-9 cm from the midline on the iliac crest then distally toward the origin site of gluteus maximus muscle along the course of the nerve as depicted in the **Figure 2**, with confirmation utilizing nerve stimulation.

There have been some adverse effects reported with dual

approach which should be kept in mind when using this method. A retrospective analysis by Bomberg *et al.* discusses some risks with dual approach, noting an increased odds of multiple punctures when using the dual approach method with ultrasound and nerve stimulation guidance. The odds ratio reported for multiple skin punctures was 1.5 (95% CI, 1.2-1.9; P = 0.001) [30]. Despite this, the overall incidence of significant adverse effects remains very low.

A rare, but possible adverse effect with dual approach is nerve injury. In a case report by Reiss *et al.*, a severe brachial plexus injury was reported after combined ultrasound and nerve-stimulator guided plexus block [31]. However, such cases are exceptionally uncommon and should be considered in the context of the technique's overall safety and efficacy. The benefits of combining these modalities, particularly in reducing unintended paresthesia, may outweigh the low risk of adverse effects.

Conclusion

In summary, the superior cluneal entrapment neuropathy should be included in the differential diagnosis of low back, buttock, and greater trochanteric pain. Combined US and nerve stimulation guidance can be useful in the diagnostic and therapeutic injection of this condition.

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