Clinical anatomy of the superior cluneal nerve in relation to easily identifiable bony landmarks

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Background: Lower back pain (LBP) remains a common ailment among adult populations and a superior cluneal nerve (SCN) entrapment accounts for 10% of reported LBP cases. The diagnostic criteria for SCN entrapment include anaesthesia of the area supplied by the SCN after performing a nerve block. Several surgical reports describe the anatomy of the SCN but purely anatomical studies of the course of the SCN are rare. This study aimed to describe the location of the SCN in relation to easily identifiable bony landmarks.

Methods: The SCN was identified as it pierced the thoracolumbar fascia and crossed over the posterior part of the iliac crest on both sides of 27 adult cadavers. A sliding dial caliper was used to measure the distance from the posterior superior iliac spine (PSIS) to the SCN and from the midline lumbar spinous processes to the nerve.

Results: The PSIS to SCN measurement was found to be 69.6 ± 15.0 mm (mean ± SD) while the midline to SCN measurement was 72.1 ± 10.2 mm.

Discussion: This study showed clear gender differences in the PSIS to SCN measurement, due to the sexual dimorphism of the bony pelvis. There was also found to be a positive correlation between the height of the sample and the distances of the SCN from both the midline and PSIS. This study provides a clear anatomical description of the course of the SCN as it crosses the iliac crest, which will allow for the successful identification of the SCN.

Keywords: bone harvesting, entrapment syndrome, lower back pain, regional nerve block, superior cluneal nerve

Introduction

Lower back pain (LBP) is estimated to have a prevalence of 85–90%. There are many aetiological factors for LBP but even with the use of new imaging techniques no obvious cause can be found in approximately 50% of these cases. One of the many missed causes of LBP is entrapment of the medial branch of the superior cluneal nerve (SCN), which accounts for approximately 10% of all reported LBP cases. SCN entrapment syndrome is often confused with a facet syndrome, lower lumbar disc problems or an iliolumbar syndrome as it entrapment syndrome is often confused with a facet syndrome, presents with the same clinical features.1

The SCN originates from the dorsal rami of the L1–L3 spinal nerve roots and provides sensory innervation over the posterior aspect of the iliac crest and upper middle buttock. Within its course, the SCN pierces the psoas major muscle and paraspinal muscles, runs posterior to the quadratus lumborum muscle and pierces the thoracolumbar fascia as it crosses over the posterior part of the iliac crest. Lu et al. described the anatomical relationships of the SCN and the posterior part of the iliac crest. In their study they dissected 15 cadavers and found that the SCN passes over the iliac crest within an osteofibrous tunnel approximately 7–8 cm lateral to the midline.1 This tunnel is formed by the iliac crest posteriorly and the thoracolumbar fascia anteriorly. The position of the SCN therefore makes it particularly vulnerable to entrapment. As it crosses over the iliac crest it may become entrapped within this osteofibrous tunnel. This may be exacerbated by continuous stretching or flexion of the hip joint that may cause tissue oedema, irritation and inflammation.4

The posterior iliac crest is also an excellent site for autogenous bone procurement for osteoinduction, osteoconduction and osteogenesis as it affords the ability to yield a large amount of corticocancellous bone with multiple applications.2 Many patients have reported chronic pain at the donor site after the procurement procedure and it was found that SCN entrapment syndrome was a complication of bone procurement from the posterior iliac crest. However, Trescot reported that SCN neuralgia was mostly due to a spontaneous entrapment of the nerve and less commonly due to nerve injury during bone harvesting.3 Although there are many studies that investigate the possibility of damaging the SCN during bone procurement, there are not many that investigate the anatomical course of these nerves to ascertain their position and other possible causes of SCN entrapment syndrome.

The proposed criteria for SCN entrapment are if the pain presents itself as unilateral and localised projecting from the iliac crest to the upper buttock, a myofascial trigger point may be palpated and relief is found by a nerve block. There should also not be any pathological signs on lumbosacral radiography, computerised tomography and magnetic resonance imaging. SCN entrapments should be considered as a cause of LBP when all other causes have been ruled out.3 The most widely accepted and first-line treatment for SCN entrapment syndrome is by injecting over the iliac crest with local anaesthetic solution. Tu et al. described a technique using fluoroscopic guidance to localise the SCN over the iliac crest. Seven to eight centimetres lateral to the midline at the level of...
lumbar vertebrae 5 (L5), the superficial tissues and the thora-
columbar fascia over the iliac crest were infiltrated with 20 ml of
0.5% bupivacaine and 80 mg of triamcinolone solution. This was
found to give complete pain relief. 7 Akbas et al. also used fluor-
osscopic guidance to identify the position of the SCN over the
iliac crest but there are discrepancies in the level of the lumbar
vertebrae targeted. Akbas et al. described the procedure using
the L4 vertebra. They used 3 ml of 0.2% ropivacaine with 20 ml of
triamcinolone as a local anaesthetic and also reported complete
pain relief. 5 There was little difference between using ropiva-
caine and bupivacaine. They both showed the same extent of
local anaesthesia but time of onset differed slightly between the
two. There was no difference in the side effects experienced
between the two different local anaesthetic agents. 8

The success of this procedure depends on the anatomical
knowledge of the anaesthesiologist as well as clear descriptions
of the course and location of the target nerve. This study
therefore aimed to investigate the course of the SCN on an
anatomical basis and to provide clear descriptions of the location
of the SCN in relation to bony landmarks that can be easily palpated.

Methods
The left and right SCN of 27 (17 male and 10 female) adult cadavers
were dissected. Only cadavers with a body mass index (BMI) of less
than 29.9 kg/m² were included in the study. This is because the area
to be dissected is the typical ‘love handle’ area and therefore may
be affected by a larger BMI due to the fatty deposits in this area.
Cadavers were further excluded from the study if the SCN was seen
to be damaged or disturbed and if any skeletal changes or deform-
ities of the vertebrae or os coxae, e.g. scoliosis or previous surgery
in the area, were seen. Ethical clearance was obtained from the
Research Ethics Committee at the University of Pretoria (76/2014).

The lower lumbar area, from L1 to the gluteal region, of each
cadaver was dissected. A midline incision was made along the
spinous processes of the lumbar vertebrae and the skin was
reflected laterally to expose the thoracolumbar fascia, posterior
center of the iliac crests and PSIS. Tracing the iliac crests, the medial
branch of the SCN was exposed and marked with a pin (point A).

A second pin was placed in the centre of the PSIS (point B), and a
third pin at a point where a horizontal line, traced from the point
where the SCN crossed over the iliac crest, crossed the midline of
the cadaver (point C). The midline in this study was defined as a
vertical line along the spinous processes of the lumbar vertebrae.

The first measurement taken was the linear distance from point A
to point B on both left and right sides. The second measurement
taken was the linear horizontal distance from point A to point C
(Figure 1). All measurements were taken with a sliding dial cali-
pper (accuracy: 0.01 mm) and recorded on a data sheet.

Descriptive statistics were done on the data to delineate the loca-
tion of the SCN. A paired t-test was used to compare the measure-
ments of left versus right sides as well as males versus females. To
determine the strength of the relationship between the measure-
ments taken (dependent variable) and the height, weight and
BMI of the sample (independent variables), Pearson’s correlation
test was used. Measurements were captured in a Microsoft Excel
worksheet and Statistix version 8.0 (Analytical Software, Tallahas-
see, FL, USA) was used for all the statistical analyses.

Results
The results of this study were divided into two parts: measure-
ments from the PSIS to the SCN and measurements from the mid-
line to the SCN.

For the PSIS to SCN measurement, no statistically significant dif-
ference was found in the position of the medial branch of the SCN
between left and right sides (p = 0.2666). This allowed the combi-
nation of both sides to give a sample size of n = 38 after exclu-
sions. The Pearson’s correlation test revealed a positive correla-
tion between the PSIS to SCN measurement and the height of the
population. However, no correlation was found between the PSIS
to SCN measurement and the BMI and weight of the sample. Table 1
summarises the results obtained for the PSIS to SCN measure-
ment.

It was found that gender does play a role in PSIS to SCN measure-
ment as there was a statistically significant difference between
males and females (p = 0.039). In males, the PSIS to SCN distance
was significantly longer (74.8 mm ± 11.6 mm) compared with the
much shorter distance in females (63.9 mm ± 17.6 mm).

The midline to SCN distance also revealed no statistically signifi-
cant difference between the left and right sides (p = 0.2076) or
between males and females (p = 0.5923). This allowed the combi-
nation of both sides to give a sample size of n = 32 after exclu-
sions. No correlation was found between the midline to SCN
measurement and the height, BMI or weight of the sample. Table 2
summarises the results obtained for the midline to SCN measure-
ment.

Although there were no statistically significant gender differen-
tences, the midline to SCN measurement in males was still slightly larger
(73.2 mm ± 10.9 mm) than in females (70.8 mm ± 7.8 mm).

Discussion
Pain experienced over the posterior aspect of the iliac crest may
present as an iliolumbar syndrome, facet syndrome or as a lower
lumbar disc problem. The insertion of the iliolumbar ligament
responds to the area in which LBP is experienced in an iliolum-
bar syndrome. 9 However, the insertion of this ligament is on the
ventral aspect of the posterior iliac crest and is therefore protected
by the iliac crest. 9 This makes the insertion point of the ligament

Figure 1: Line diagram of back and posterior iliac crest with the point
where the SCN crosses the iliac crest (Point A), the PSIS (Point B) and
the midline of the cadaver (Point C) indicated.
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difficult to palpate and may not correspond to the area where the trigger point is experienced. Facet syndromes have been described as originating from the cutaneous dorsal rami from the thoracolumbar junction and radiographic abnormalities have led to the incorrect diagnosis of LBP. These three diagnoses do not account for all LBP cases. Pain and tenderness experienced over the posterior iliac crest may also correspond to the position of the medial branch of the SCN over the iliac crest as it passes through the osteofibrous tunnel.

The lower lumbar region is covered by a posterior aponeurosis that is attached to the posterior iliac crest and is formed by the thick fibres of latissimus dorsi and the posterior layer of the thoracolumbar fascia. Constant contraction of the latissimus dorsi muscle and flexion and extension of the hip joint showed an influence on the tension of the fibres of the thoracolumbar fascia. As the medial branch of the SCN passes through these fibres to reach the cutaneous area of sensory innervation over the medial part of the central buttock, the increased tension in these fibres may lead to a subsequent entrapment of this branch. In the current study, only one out of 54 cadavers showed an entrapment of the medial branch of the SCN compared with 2 out of 10 found in the study done by Lu et al.

Autogenous bone, harvested from the posterior iliac crest, is used for multiple applications such as the repair of long bone reconstruction, fracture non-union, spinal fusion, arthrodesis in various joints and facial and cranial reconstructions. However, many patients have reported chronic pain at the donor site after the procurement procedure and it was found that entrapment of the SCN was a complication of bone procurement from this site. Anatomical studies revealed that the bone-harvesting technique being used placed the SCN in a vulnerable position of being damaged. The current study revealed that the medial branch of the SCN emerged between 68.5 mm to 75.6 mm (mean: 72 mm) lateral from the midline and 64.8 mm to 74.3 mm (mean: 69 mm) from the PSIS. If surgeons were to perform skin incisions and procurement techniques within a zone no more than 64 mm lateral to the PSIS, nerve injury and postoperative complications would be kept to a minimum. This measurement is in agreement with the study done by Lu et al. in which they report the safe zone as 60 mm lateral to the PSIS. Unfortunately, this will not completely avoid the SCN in all cases. In one case the nerve was found to be 35 mm from the right PSIS and 42 mm from the left. This was in a 1.52 m female cadaver and therefore the stature of the patient should always be taken into account when targeting the SCN. When trying to avoid the SCN, physicians should stay more medial in patients of a shorter stature.

The most commonly used treatment method for an SCN entrapment is to inject the area approximately 7–8 cm lateral to the midline with a local anaesthetic agent. According to the literature, this should provide complete relief from the LBP experienced as a result of the entrapped SCN as well as confirm the diagnosis of an SCN entrapment. Table 3 shows a comparison of the results from the current study with the only two previous studies that looked at similar measurements. These two studies were done by Lu et al. on a Chinese cadaver population and Kuniya et al. on a Japanese cadaver population. The current study revealed similar measurements for the midline to SCN measurement when compared with the study done by Kuniya et al. However, Kuniya et al. reported measurements almost 20 mm shorter than those reported in the current study and by Lu et al.

| Table 1: Summary of results obtained for PSIS to SCN measurement |
|-----------------|----------------|----------------|----------------|
| **Age (years)** | **Height (m)** | **Weight (kg)** | **BMI (kg/m²)** |
| Mean            | 65             | 1.7            | 59.1           |
| Standard deviation | 18             | 0.1            | 13.6           |
| Minimum         | 22             | 1.5            | 39.2           |
| Maximum         | 87             | 1.9            | 90.0           |
| Range (95% confidence interval) | 64.3–74.3 |

| Table 2: Summary of the results obtained for the midline to SCN measurement |
|-----------------|----------------|----------------|----------------|
| **Age (years)** | **Height (m)** | **Weight (kg)** | **BMI (kg/m²)** |
| Mean            | 69             | 1.7            | 61.7           |
| Standard deviation | 12             | 0.1            | 15.2           |
| Minimum         | 49             | 1.5            | 40.6           |
| Maximum         | 87             | 1.9            | 90.0           |
| Range (95% confidence interval) | 68.5–75.6 |

| Table 3: Comparison of the measurements from the current study with a by Lu et al. and Kuniya et al. |
|-----------------|----------------|----------------|
| Population      | South African (current study) | Chinese¹ | Japanese² |
| Midline to SCN  | 72.1 mm         | 81.0 mm       | 71.0 mm     |
| PSIS to SCN     | 69.0 mm         | 64.7 mm       | 45.7 mm     |
The differences seen between males and females can be attributed to the high degree of sexual dimorphism of the bony pelvis. The male pelvis, when viewed from the posterior aspect, has more vertical and upright iliac crests when compared with the female pelvis that has flattened and more laterally projecting iliac crests. As a result, males will have a longer PSIS to SCN measurement compared with females with a similar BMI.

In conclusion, this study showed that the SCN crosses the posterior aspect of the iliac crest an average of 72 mm from the midline and 70 mm from the PSIS. The differences seen between the different populations and between genders should be taken into account when the SCN is the target of the procedure or when trying to avoid nerve injury during a bone graft. The measurements that were found in this South African population also differed from both a Chinese and Japanese population, examined in previous studies, which may indicate a correlation between the measurements and height of the population.

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References
1. Ermis MN, Yildirim D, Durakbasa MO, et al. Medial superior cluneal nerve entrapment neuropathy in military personnel; diagnosis and etiologic factors. J Back Musculoskelet Rehabil. 2011;24(3):137–44.
2. Sittitavornwong S, Falconer DS, Shah R, et al. Anatomic considerations for posterior iliac crest bone procurement. J Oral Maxillofac Surg. 2013;71(10):1777–88. http://dx.doi.org/10.1016/j.joms.2013.03.008
3. Lu J, Ebraheim NA, Huntoon M, et al. Anatomic considerations of superior cluneal nerve at posterior iliac crest region. Clin Orthop Relat Res. 1998;347:224–8.
4. Trescot AM. Cryoanalgesia in interventional pain management. Pain Physician. 2003;6:345–60.
5. Akbas M, Yegin A, Karsli B. Superior cluneal nerve entrapment eight years after decubitus surgery. Pain Pract. 2005;5(4):364–6. http://dx.doi.org/10.1111/j.1533-2500.2005.00543.x
6. Herring A, Price DD, Nagdev A, et al. Superior cluneal nerve block for treatment of buttock abscesses in the emergency department. J Emerg Med. 2010;39(1):83–5. http://dx.doi.org/10.1016/j.jemermed.2009.08.033
7. Talu GK, Özyalçin S, Talu U. Superior cluneal nerve entrapment. Reg Anesth Pain Med. 2000;25(6):648–50. http://dx.doi.org/10.1097/00115550-200011000-00018
8. Zaric D, Nydahl P, Philipson L, et al. The effect of continuous lumbar epidural infusion of ropivacaine (0.1%, 0.2%, and 0.3%) and 0.25% bupivacaine on sensory and motor block in volunteers: a double-blind study. Reg Anesth Pain Med. 1996;21(1):187–9.
9. Moore KL, Dalley AF, Agur AMR. Clinically oriented anatomy. 7th ed. Baltimore, MD: Lippincott Williams & Wilkins; 2014. p. 330–2.
10. Kuniya H, Aota Y, Saito T, et al. Anatomical study of superior cluneal nerve entrapment. J Neurosurg Spine. 2013;19(1):76–80. http://dx.doi.org/10.3171/2013.4.SPINE12683

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