Short title: Fascia iliaca compartment block

Fascia iliaca compartment block

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Key points

- The hip is supplied by nerves arising from both lumbar and sacral plexuses.
- Fascia iliaca compartment block (FICB) may be performed using a landmark or ultrasound-guided approach.
- FICB is recommended for preoperative analgesia in patients with hip fracture.
- FICB is opioid-sparing but does not provide complete analgesia for hip surgery.
- As with any regional anaesthetic block, appropriate monitoring is needed to ensure safety.

Learning objectives

By reading this article, you should be able to:

- Describe and identify the pertinent anatomy for performing FICB.
- Explain the anatomical and ultrasound guided approaches to the FICB.
- Discuss which patient groups would potentially benefit from a FICB.
- Define the safe performance of a FICB and the recommended requirements for monitoring.

The fascia iliaca compartment block (FICB) was first described by Dalens and colleagues[1] in 1989 and remains a popular regional anaesthetic technique for surgical procedures involving the hip joint and femur. The FICB may be thought of as an anterior approach to the lumbar plexus where local anaesthetic (LA) is injected proximally beneath the fascia iliaca, with the aim of blocking the femoral nerve (FN), obturator nerve (ON), and lateral cutaneous nerve of thigh (LCNT) simultaneously. Unlike the FN block, the needle is not directed to lie adjacent to the FN, thus reducing the risk of neuropraxia. In clinical practice, the FICB provides a safe and relatively simple alternative to femoral and lumbar plexus blocks.

Anatomy

Hip joint

The hip joint consists of a ball (femoral head) and socket (acetabulum) with the femoral head, neck, and greater and lesser trochanters comprising the proximal end of the femur. The psoas major muscle originates from the vertebral bodies of T12–L4 and costal processes of the L1–L5 vertebrae and merges with the iliacus muscle (which originates from the inner surface of the iliac bone) before inserting into the lesser trochanter. The greater trochanter provides the insertion for gluteus medius and gluteus minimus muscles.[2]

Innervation of the hip joint

The sensory nerve supply to the hip joint includes the FN, ON, articular branches of the sciatic nerve, nerves supplying quadratis femoris, and superior gluteal nerve (Fig. 1).[3] Sensory innervation of the skin on the lateral thigh is supplied by the LCNT and by the lateral cutaneous branch of the subcostal nerve. Sensation to the upper anterior portion of the thigh is supplied by the ilioinguinal and genitofemoral nerves (Fig. 2).[3] The FN, ON, and LCTN arise from the lumbar plexus, whereas the sciatic nerve, nerve supplying quadratis femoris, and superior gluteal nerve arise from the sacral plexus. Therefore, anaesthesia of the hip joint cannot be fully achieved with a FICB alone.

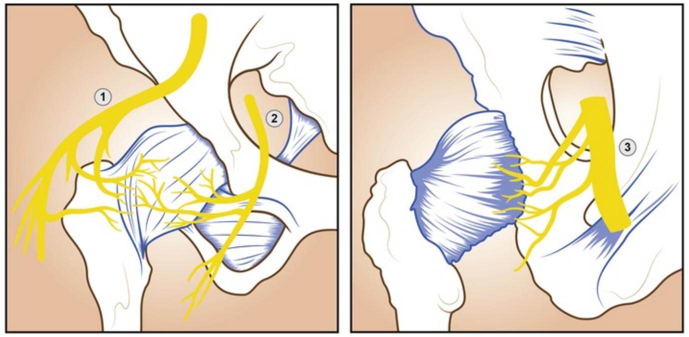

Fig 1 Innervation of the hip. Anterior portion of the joint capsule: (1) branch of the femoral nerve (L1–L4) along the iliopsoas muscle. Anteromedial portion: (2) a branch of the obturator nerve (L1–L4). Posterior portion: (3) branches of the sciatic nerve.

alt-text: Fig 1

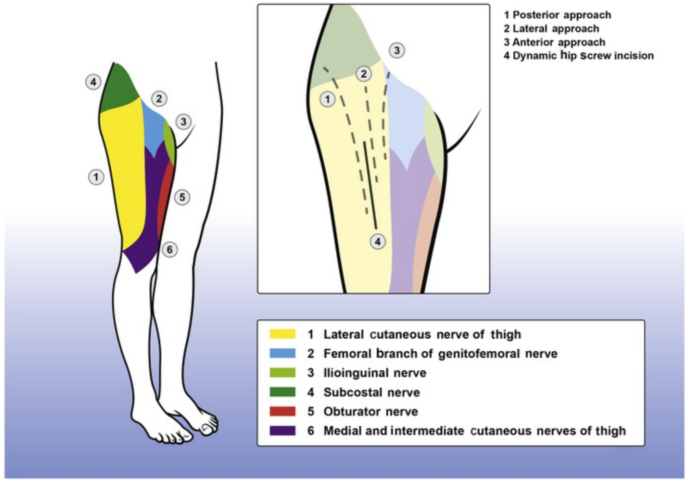

Fig 2 Cutaneous innervation of the hip and relation to surgical incision sites for (1) THR posterior approach, (2) THR lateral approach, (3) THR anterior approach, (4) dynamic hip screw incision. Note that the posterior incision extends beyond the territory of the lateral cutaneous nerve of the thigh to the subcostal territory and may also involve the lateral cutaneous branch of the iliohypogastric nerve (origin L1) not shown here. THR, total hip replacement.

alt-text: Fig 2

Fascia iliaca, and its relationship to femoral, lateral cutaneous, and obturator nerves

The fascia iliaca compartment is a potential space lying between the fascia ilaca anteriorly and the iliacus and psoas muscles (iliopsoas) posteriorly. The fascia iliaca attaches to the iliac crest laterally and to the fascia overlying the psoas muscle medially. It lies posteriorly to the external iliac vessels and anteriorly to the nerves of the lumbar plexus. More distally, the fascia iliaca invests the FN and passes posterior to the femoral artery and vein which lie within the lacuna vasorum. The FN arises from the second to fourth lumbar nerve roots and descends through the fibres of psoas major before passing distally between the psoas and iliacus muscles. It then exits the pelvis to lie anterior to iliopsoas and lateral to the femoral vessels. The LCNT is a purely sensory nerve which arises from the second and third lumbar nerve roots and passes deep to the fascia iliaca before leaving the fascial plane around the level of the inguinal ligament. The ON arises from the second to fourth lumbar roots, is predominantly a motor nerve, and inconsistently innervates a proportion of the skin of the medial thigh.[4] After penetrating the fascia and leaving the fascia iliaca compartment, the ON passes posterior to the common iliac artery before reaching the obturator foramen. All of these nerves lie within the fascia iliaca compartment at the proximal end of their anatomical course, and therefore placement of LA beneath the fascia iliaca should, in theory, result in anaesthesia of FN, ON, and LCNT. The genitofemoral nerve runs on the anterior aspect of the psoas muscle posterior to the fascia iliaca and therefore, the FICB may also result in anaesthesia of the genitofemoral nerve (Fig. 3).[5]

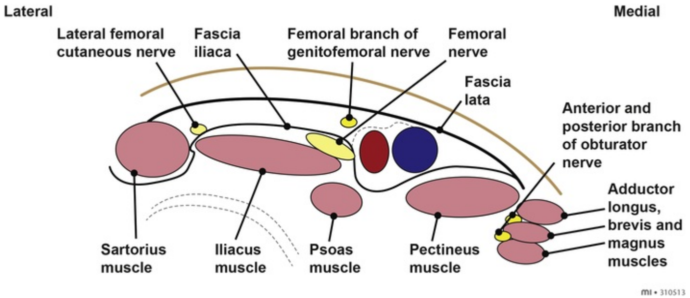

Fig 3 Schematic diagram of fascia iliaca and related structures.

alt-text: Fig 3

Fascia iliaca compartment block

Indications, contraindications, and complications

Indications for FICB include pre-, peri-, and postoperative analgesia after fractured neck of femur (NOF). Additional indications include hip and knee surgery, above knee amputation, and application of plaster cast to femoral fracture in paediatric patients, although data to support these indications are limited. Contraindications include previous femoral bypass surgery, patient refusal, allergy to LA, and infection at the block site. Relative contraindications include patients with coagulopathy, peripheral neuropathy, or neurological conditions. Complications include: block failure, haematoma, neuropraxia, local anaesthetic systemic toxicity (LAST), quadriceps weakness, perforation of peritoneal cavity contents, and bladder puncture.

Block technique

Traditionally, the FICB was undertaken using a simple, landmark-guided approach. Ultrasound guidance is now commonplace, however. Ultrasound has also facilitated the development of more proximal, suprainguinal approaches to the FICB. This is because successful blockade of LCNT and ON relies on proximal spread of LA as both of these nerves generally lie superior to the fascia iliaca distal to the inguinal ligament (Fig. 3).

Landmark technique

Anatomical landmarks are the inguinal ligament, anterior superior iliac spine (ASIS), and pubic tubercle. The patient is positioned supine, and a line connecting the ASIS and the pubic tubercle is divided into thirds. The injection is performed at a point 1 cm caudad to the junction of the lateral third and medial two thirds. The ipsilateral femoral pulse is palpated approximately 1.5 cm medial to the point of injection. A blunt, short-bevel needle is inserted perpendicular to the skin and the needle angle adjusted to approximately 60° and directed cranially. A ‘give’ or ‘pop’ may be felt as the needle passes through fascia lata, and a second ‘give’ as it passes through the fascia iliaca. The needle angle is adjusted to approximately 30° and advanced a further 1–2 mm. LA should be injected without experiencing resistance. If resistance occurs, the needle should be withdrawn slightly and injection reattempted after further aspiration.

Ultrasound guided infrainguinal approach

In the supine position as before, a high frequency (6–14 MHz) linear probe is placed transversely to identify the femoral artery at the inguinal crease. The iliopsoas muscle with the overlying fascia iliaca is identified and the hyperechoic FN is typically seen lying between the iliopsoas and fascia iliaca at a depth of 2–4 cm, lateral to the femoral artery (Fig. 4). The fascia lata may also be identified above the fascia iliaca, although this is neither always reliably seen nor essential to the performance of the block. The probe may be tilted cranially and caudally until optimal images of the FN and fascia iliaca are obtained. The triangular shaped sartorius muscle and the ASIS are identified on moving the probe laterally. After skin disinfection and LA infiltration, a 50–100 mm blunt ended needle is inserted using an in-plane technique with the aim of placing the needle tip beneath the fascia iliaca around the lateral third of a line between the ASIS and pubic tubercle. Aspiration is performed before injection of 1–2 ml LA. Correct needle placement is confirmed by separation of the fascia iliaca from the iliopsoas muscle with LA spreading towards the FN medially and the iliac crest laterally.[6] Volumes of 30–40ml, ensuring compliance with safe dose limits for the LA, are routinely used to ensure optimal spread.

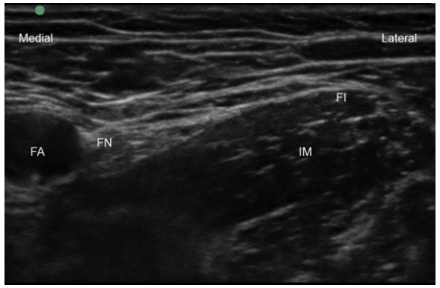

Fig 4 Sonoanatomy of infrainguinal approach to fascia iliaca compartment block. FA, femoral artery; FN, femoral nerve; FI, fascia iliaca; IM, iliacus muscle; IPM, iliopsoas muscle.

alt-text: Fig 4

Ultrasound guided suprainguinal approach

The ultrasound-guided (USG) longitudinal suprainguinal approach to the FICB was first described in a cadaver study by Hebbard in 2011.[7] In this technique, the patient is positioned supine and a high-frequency linear probe (6–14 MHz) is placed sagitally to obtain an image of the ilium and iliacus muscle. The femoral artery is seen by moving the probe inferiorly and medially along the inguinal ligament. The probe is then moved laterally and superiorly along the inguinal ligament towards the ASIS to lie laterally to the FN. The deep circumflex artery is identified superficial to the fascia iliaca and 1–2 cm cephalad to the inguinal ligament, and this provides a further landmark for needle placement. The needle is inserted 2–4 cm caudad to the inguinal ligament aiming ultimately to be beneath the fascia iliaca cephalad to the inguinal ligament. LA spread should be seen between the fascia iliaca and iliacus muscle and into the iliac fossa. The authors concluded that this technique may provide a more targeted approach to the FICB, reducing LA volume requirements and facilitating FICB catheter placement. Spread of LA to the ON was not reported in this study.

The suprainguinal approach to the FICB has also been described using a more proximal needle insertion point.[8] With the patient supine, a linear high frequency probe (6–14 MHz) is placed in the sagittal plane to obtain an image of the ASIS. The probe is moved medially and the fascia iliaca and sartorius, iliopsoas, and internal oblique muscles are identified. After identifying the ‘bowtie sign’ formed by the muscle fasciae, a 100 mm needle is introduced 1 cm cephalad to the inguinal ligament. Using an in-plane approach, the needle tip is positioned beneath the fascia iliaca, and hydro-dissection is used to separate the fascia iliaca from the iliacus muscle. The needle is further advanced in this space in a cranial and slightly dorsal direction. The deep circumflex artery lies superficial to the fascia iliaca and upward movement of this artery upon injection can be used as a marker of fascia iliaca penetration. An injection is considered successful if spread of LA is observed cranial to the point where the iliac muscle passes under the abdominal muscles (see Fig. 5). If adequate spread is not observed, the needle should be repositioned. A recent cadaveric study found that a volume of 40 ml was required to reliably block all three nerves using this approach.[6]

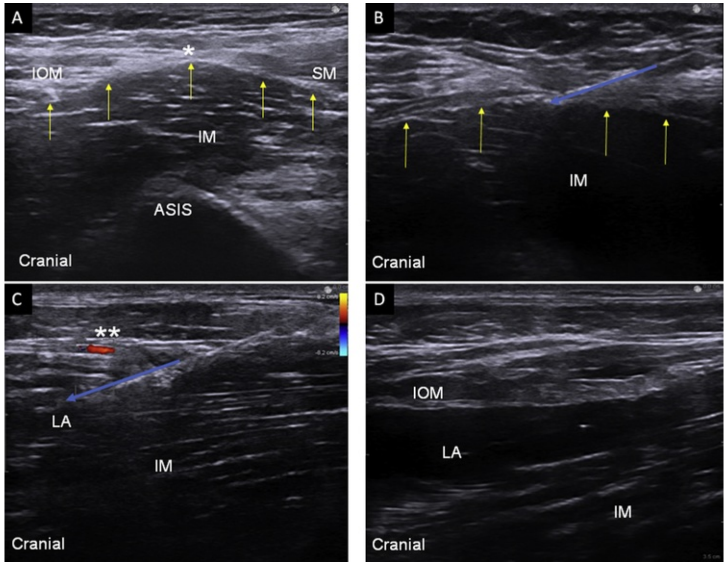

Fig 5 Ultrasound guided suprainguinal approach to the fascia iliaca compartment block. (A) Identification of relevant anatomy. *, 'bowtie sign'; yellow arrows, fascia iliaca; ASIS, anterior superior iliac spine; IM, iliacus muscle; IOM, internal oblique muscle; SM, sartorius muscle. (B) Needle placement under fascia iliaca using an in-plane approach. Blue arrow, needle trajectory. (C) Injection of local anaesthetic under fascia iliaca. **, deep circumflex artery seen superficial to fascia iliaca; blue arrow, needle trajectory; LA, local anaesthetic beneath the fascia iliaca (D) Successful placement of LA with cranial spread under fascia iliaca.

alt-text: Fig 5

Single shot techniques and catheters

The FICB is a fascial plane block and therefore success depends upon adequate spread of LA towards the targeted nerves. For the landmark and USG infrainguinal approach 30–40 ml of LA is recommended, and for the USG suprainguinal approach at least 40 ml of LA is required to consistently block the FN, ON, and LFCN.[9] Long-acting LA such as ropivacaine and levobupivacaine are commonly used to provide extended analgesia. Safe dosing limits clearly must not be exceeded to avoid systemic toxicity. Reassuringly, in a study investigating longitudinal suprainguinal FICB in patients undergoing total hip arthroplasty, plasma ropivacaine levels after 40 ml ropivacaine 0.5% were within the maximal tolerated plasma concentrations (as described by Knudsen and colleagues[9]) in all patients. Time to maximum concentration was 45 min, indicating that patients should be monitored and observed for at least 45–60 min after block performance.[8] Care should also be taken to minimise intramuscular injections to avoid LA-associated myotoxicity.

The duration of analgesia may be extended using a catheter technique. However, data are surprisingly scarce. It is also unclear whether a fixed infusion rate or intermittent bolus is superior although an intermittent bolus regimen with injection of sufficiently large amounts of LA intuitively may lead to better spread than a fixed infusion.

Evidence

Initial studies comparing a landmark technique FICB with a '3 in 1' block in both children and adults resulted in higher success rates for FICB. However, LA spread was variable and inconsistent and neither block achieved sensory anaesthesia in all three nerves in any more than 38% of patients.[1,10] The advent of USG renewed interest in the FICB prompting studies comparing landmark and USG techniques. In a study comparing USG infrainguinal and landmark techniques, sensory anaesthesia in all parts of the thigh was significantly higher in the USG infrainguinal group.[11] The incidence of femoral and obturator motor block was also higher in the USG infrainguinal group. To confirm ON motor block, a reduction of adductor strength of at least 75% is necessary to exclude the effect of the FN, as an FN block will also reduce adductor strength because of its innervation of the pectineus muscle.[8] In a study using MRI to evaluate the spread of LA after USG infrainguinal FICB, the FN and LFCN were consistently blocked but there was no evidence of spread medially or cranially to reliably block the ON.[12] The USG longitudinal suprainguinal approach to the FICB theoretically improves block success rates as the LA is injected more cranially allowing more consistent block of the three targeted nerves (FN, LFCN, and ON). Success rates of ON blockade and blockade of all three nerves were 86% and 67%, respectively, in an RCT comparing USG suprainguinal FICB with placebo in patients undergoing total hip replacement (THR).[8] Indeed, a recent cadaver study demonstrated that the FN, LFCN, and ON could be reliably blocked using an USG suprainguinal FICB, but only if a volume of 40 ml was injected.[6] Further research comparing suprainguinal and infrainguinal techniques is necessary to confirm these findings.

An alternative but more technically challenging and time-consuming approach is to block all three nerves individually using US. Articular branches of FN and ON may, however, be missed by blocking these nerves too distally. A recently described technique targeting the articular branches of FN and the accessory branches of ON (the PEricapsular Nerve Group ‘PENG’ block) has shown some promise in a small case series of patients undergoing hip surgery although further studies comparing this with FICB are required.[13]

Fractured NOF

FICB is recommended by national guidelines for the provision of analgesia in patients admitted with fractured NOF.[14,15] Conventional analgesics such as non-steroidal anti-inflammatory agents and opioids are associated with a wide range of adverse effects in this patient group, and the use of FICB can provide effective pain relief whilst minimising systemic adverse effects. A Cochrane review found that the performance of peripheral nerve block before, during, or after operation in patients suffering fractured NOF reduced both pain at 30 min and opioid consumption compared with systemic analgesia.[16] Eight of the reported studies examined FICB specifically (six preoperative, one postoperative, and one both pre- and postoperative analgesia) with all studies demonstrating superior pain control compared with systemic analgesia.[16] A further systematic review and meta-analysis found preoperative FIB to be superior to opioids for: pain control on movement, preoperative analgesic consumption, time to first analgesic request, and time to perform spinal.[17] Although three studies showed a protective effect of FICB for delirium, these data were not suitable for meta-analysis, and further evidence is required to confirm these findings.[17] Performing the FICB before operation has the added advantage of providing analgesia for positioning and shortening time to perform spinal anaesthesia.[17] The authors concluded that FICB is ‘an effective and relatively safe supplement’ in the preoperative analgesia of hip fracture patients.[17] FN block may also be effective in this context given that blockade of the LCNT is not required for preoperative analgesia.

Total hip arthroplasty

Evidence for the use of FICB in THR remains mixed. One small study compared a modified landmark FICB technique with placebo and demonstrated reduced morphine consumption.[18] A further small, single-centre study failed to demonstrate any reduction in pain intensity or opioid consumption at 1 and 24 h when comparing USG infrainguinal FICB with placebo in patients with uncontrolled pain after operation. In this study, the ON was blocked in only 25% of patients and blockade of all three nerves was achieved in only two of 16 patients.[19] More recently, an infrainguinal FICB was found to be inferior to spinal morphine for analgesia in the first 24 h after THR.[20] In contrast, an RCT using a~~n~~ suprainguinal approach demonstrated a 45% reduction of morphine consumption at 48 h after THR when compared with no block.[6] In this study, ON blockade was achieved in 86% and all three nerves were blocked in 67% of patients.[6] Negative studies are perhaps unsurprising when the innervation from the sacral plexus and the limitations of the more distal approaches to the FICB are considered. In addition, part of the surgical incision may lie~~s~~ outwith the territory of LCNT dependent on which surgical approach is used (Fig. 3). Regardless of which approach is used, the ON is most frequently missed with the FN most reliably blocked. Further work is required to establish whether patients undergoing elective hip surgery benefit from FICB.

Provision of a fascia iliaca block service

Although FICB in the emergency department is becoming a standard of care,[14,15] FICB remains underutilised in the UK. Lack of trained staff and equipment, procedural time, and a disbelief in the efficacy of the technique are the most frequent reasons why FICB is not more widely adopted. To overcome these obstacles, many units have opted to train non-medical practitioners to perform the procedure. Regional Anaesthesia United Kingdom (RA-UK) and the Association of Anaesthetists of Great Britain and Ireland (AAGBI) issued a joint statement in 2013 classifying FICB as a ‘local anaesthetic’ technique rather than a peripheral nerve block because the needle trajectory should not directly impinge on nerves or blood vessels.[21] Non-medical healthcare professionals who have received ‘appropriate training and are following agreed clinical governance procedures’ may perform FICB under the supervision of the associated department of anaesthesia.[21] This may include the pre-hospital setting.[22] This advice was issued before the widespread use of USG, and although it technically did not refer to the landmark- or US-guided technique this advice certainly does not apply to the US-guided suprainguinal approach, which is closer to intraperitoneal structures and is technically more challenging because of the lack of vascular and neural landmarks. The requirements of ‘appropriate training’ are highlighted in Table 1. Robust audit of outcomes and adverse events is recommended.[18]

Table 1 Training requirements for performance of FICB. FICB, fascia iliaca compartment block; LA, local anaesthetics; LAST, local anaesthetic systemic toxicity; USG, ultrasound guided.

alt-text: Table 1

- Knowledge of relevant anatomy, landmarks, and sonoanatomy
- Knowledge of ultrasound physics, knobology for USG technique
- Knowledge of indications and contraindications for FICB

- Knowledge of LA pharmacology
- Knowledge of signs and symptoms of LAST
- Knowledge of treatment of LAST
- Development of technical skills for both USG and landmark techniques

Although adverse events are rare, vigilant practice is essential if these are to be minimised. The Royal College of Emergency Medicine (RCEM) recently clarified its statement about a death occurring after a patient had received a FICB for fractured NOF. The patient developed unrecognised respiratory depression, which was likely to be related to previous treatment with opioids and the subsequent removal of the painful stimulus by the FICB. The RCEM has since emphasised the importance of an adequate period of monitoring after FICB.[23]

Conclusion

FICB is a safe and simple means of providing analgesia for procedures involving the hip joint and femur. The USG suprainguinal approach appears to be most effective at achieving successful block of all three nerves, although technically it may be more challenging to perform. FICB is particularly valuable in patients admitted with hip fracture resulting in opioid sparing and improved dynamic analgesia. The role of FICB in elective hip surgery requires further clarification.

Declaration of interest

The authors declare that they have no conflicts of interest.

MCQs

The associated MCQs (to support CME/CPD activity) will be accessible at www.bjaed.org/cme/home by subscribers to *BJA Education*.

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