A femoral nerve block is both rapid and effective for relief of pain.

Indications for femoral nerve block include: Femoral neck fractures, femur fractures, and patellar injuries.

It can also be used for abscess drainage, large laceration repairs, or any painful process or procedure of the area that the femoral nerve innervates.

An ultrasound-guided femoral nerve block (USFNB) can be a rapid and definitive tool for pain control for a traumatic injury to a lower extremity. The femoral nerve is one of three major nerves that arise from the first through fourth lumbar (L1-L4) ventral rami. The femoral nerve travels under inguinal ligament, anterior to the psoas muscle, just under the fascia iliaca, and lateral to the femoral artery (Illustration 5.1).
This large nerve innervates the femur, hip joint, anteromedial thigh, knee and the medial aspect of the leg from the knee to the foot. It is important to note that the other two major branches of the L1-L4 ventral rami (lateral femoral cutaneous nerve and obturator nerve) also innervate the hip joint, and clinicians using the ultrasound-guided femoral nerve block for pain reduction after a hip fracture will get significant pain reduction, but not complete anesthesia\textsuperscript{1-3} (Illustration 5.2).

**ILLUSTRATION 5.2 - Femoral Nerve Innervation**

Indications for the emergency physician include pain reduction for hip fractures, femur fractures, and patellar injuries (and their tendinous attachments). Also, an ultrasound-guided femoral nerve block can be ideal as an alternative to procedural sedation for abscess drainage or large laceration repair on the anterior and lateral aspect of the thigh.\textsuperscript{4-6}

As an adjunct for pain control, ultrasound-guided femoral nerve blocks can also reduce the complications from systemic opioid administration (respiratory depression, confusion, etc.). Ultrasound guidance allows the clinician the ability to target deposition of anesthetic safely around the femoral nerve, reducing the chances of inadvertent vascular puncture. There is also some belief that reduction in afferent pain fiber signaling after acute injuries can help reduce post-traumatic pain syndromes. As with all nerve blocks, when compartment syndrome is of concern (high mechanism crush injuries, etc.), we recommend a clear discussion with consultative services before the block is performed.\textsuperscript{7}
SECTION 2
Preparation and Technique

HIGHLIGHTS

Take the time to position the patient and the machine properly.

The needle size will depend on the size of your patient.

The linear probe is used.

Make sure you inject underneath the fascia iliaca.

PATIENT POSITION

Place the patient in a supine position with the inguinal region exposed. Slight flexion and external rotation of the hip may be beneficial if tolerated. Attach a cardiac monitor and pulse oximeter to the patient. Place the ultrasound system opposite the operator, across the bed, so it is in clear view (Image 5.1).

IMAGE 5.1 - Patient Positioning
**Probe Selection**

A high-resolution linear array transducer (5-10MHz) with a large footprint is recommended. Clean the probe in the standard manner (quaternary ammonia solution) and cover the probe with a transparent adhesive dressing (Image 5.2).

**Image 5.2 - Probe Cover Using Transparent Adhesive Dressing**

**Anesthetic and Needle Selection**

We recommend using lidocaine 1-2% until the provider is comfortable with the procedure due to the increased risk of associated local anesthetic systemic toxicity with bupivacaine. Draw up 20cc of anesthetic in a 20cc syringe and attach a 3.5-in 20-gauge spinal needle. In thin patients, the standard 1.5-inch 21-gauge needle may be sufficient in length. More experienced operators can approximate the depth of the femoral nerve and use a small length needle if desired.

**Scanning Technique**

Place the ultrasound probe in a transverse orientation in the inguinal crease with the probe marker to the provider’s right. Always locate the femoral vein and artery, and then move the probe slightly lateral until a hyperechoic triangular bundle is noted. Important landmarks to identify include the fascia iliaca (the fascial covering of the femoral neurovascular bundle) and the iliopsoas muscle (deep to the femoral nerve) (Gallery 5.1). The goal of the block will be to place anesthetic at the lateral aspect of the femoral nerve, under the fascia iliaca and above the iliopsoas muscle. Anesthetic in this space will ideally spread and bathe the femoral nerve. After the femoral nerve and relevant structures are located, inject a 1cc lidocaine skin wheal at 0.5cm lateral to the probe.

**Gallery 5.1 - Femoral Anatomy**

Correct view for block. See next image for labels.
**INJECTION TECHNIQUE**

We recommend a lateral to medial in-plane technique for the procedure, so that the needle can be visualized during the entire procedure. From the location of the skin wheal, enter the skin at an approximately 30-degree angle (Gallery 5.2).

**GALLERY 5.2 - Injection Techniques**

Advance the needle in 1-2 cm increments, ensuring that the entire needle including the tip is visualized. Direct the needle tip to the lateral border of the femoral nerve. Make sure to get under the fascia iliaca, aspirate to ensure lack of vascular puncture and inject a small amount of anesthetic (0.5-1cc) (Movies 5.1, 5.2).
If anechoic fluid is not visualized on the ultrasound screen with the test injection, stop the procedure and move the ultrasound probe until the needle tip is clearly visualized. Small aliquots of anesthetic (1cc) should be deposited initially, ensuring that the anechoic fluid is located under the fascia iliaca and above the iliopsoas muscle. By placing the needle just lateral to the nerve and below the fascia iliaca, the chance of intraneural injection is reduced while maintaining a high chance for procedural success (Movie 5.3).

**MOVIE 5.3 - Femoral Block How-To**
PERIPHERAL NERVE INJURY

Nerve injury is a rare event, but the likelihood of its occurrence can be reduced with injection of the anesthetic outside of the epineurium. With this in mind, the injection should be stopped if the patient experiences painful paresthesias or if high pressures are required during the injection. In this case, the needle should be repositioned and injection attempted again. The needle tip should be visualized and anechoic fluid should be seen surrounding the nerve during injection to ensure needle placement is appropriate.

COMPARTMENT SYNDROME

Compartment syndrome is a devastating and feared, albeit uncommon, complication of fractures, crush injuries, and burns. Although typically described in the compartments of the lower leg and forearm, rare case reports have described this complication in mid-shaft femur fractures. Despite the possibility, to date there is no evidence in the literature to suggest that a femoral nerve block can delay the diagnosis of compartment syndrome of the thigh.

LOCAL ANESTHETIC SYSTEMIC TOXICITY

Although ultrasound guidance should significantly reduce the risk of intravascular injection, local anesthetic systemic toxicity (LAST) is a life-threatening complication, which should be recognized. LAST can lead to cardiovascular collapse and should be treated with standard ACLS procedures and lipid emulsion therapy. It is recommended that intravenous lipids be stocked in the department in which the procedure is being performed.
CONCLUSION

Ultrasound-guided nerve block of the femoral nerve is a useful technique for emergency physicians in cases of injury to the hip, femur and knee. The single shot injection is an effective tool for pain reduction and is ideal in patients who may not tolerate large doses of intravenous opioids. Ultrasound guidance will decrease complications and increase the likelihood of an effective block.


