Ultrasound Guided Genicular Nerve Block-A Motor Sparing Technique for the Treatment of Acute and Chronic Knee Pain

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Abstract: The use of standard block nerve techniques to treat acute and chronic knee pain are limited by their propensity to cause motor weakness which can make the knee unstable and put the patient at risk for additional knee injury and/or falls. Ultrasound guided genicular nerve block with local anaesthetic provides excellent blockade of the sensory innervation to the joint capsule and internal and external ligaments of the knee joint without the motor block associated with conventional nerve block techniques such as femoral nerve and lateral femoral cutaneous nerve blocks making this technique useful in the palliation of acute knee pain secondary to trauma as well as the management of acute post-operative knee pain following intra-articular procedures and total knee arthroplasty. The use of ultrasound guidance simplifies the localization of the genicular nerves and allows identification of adjacent vasculature.

Keywords: Genicular nerve block, genicular nerve, knee pain, ultrasound, acute post-operative pain.

INTRODUCTION

It is estimated that over 100 million Americans suffer from chronic pain that interferes with their activities of daily living. Chronic knee pain is the second most common pain complaint, exceeded only by low back pain [1]. It is not surprising that knee pain is so common given that the knee joint is susceptible to the development of arthritis from a variety of conditions that have in common the ability to damage the joint cartilage. Osteoarthritis of the joint is the most common form of arthritis that results in knee joint pain [2]. Rheumatoid and posttraumatic arthritis also are frequent sources of knee pain. Less commonly, knee pain is the result of the crystal arthropathies, septic arthritis, Lyme disease, and the collagen vascular diseases (Figure **1**).

Treatment of knee pain should be directed whenever possible at the correction of the underlying source of the pain. Unfortunately, for many patients, curative treatment options are either not available or have been unsuccessful. For this group of patients, conservative therapy consisting of rest, cold and heat modalities, simple analgesics, anti-inflammatory medications, physical therapy and intra-articular injections of local anesthetic and steroid may provide temporary palliation of pain. For patients who do not respond to these modalities, genicular nerve block may provide longer lasting relief without the impairment of motor function associated with other traditional nerve block modalities [3]. This motor impairment can lead to additional knee injury and/or falls [4].

CLINICALLY RELEVANT ANATOMY

The word genicular means pertaining to the knee and is the name given to a group of small nerves that have in common their function of providing sensory innervation to the joint capsule and internal and external ligaments of the knee joint. The superior and inferior medial genicular nerves and middle genicular nerves are sensory branches of the tibial nerve [5]. The superior lateral genicular nerve and the inferior lateral genicular nerve are sensory branches of the common peroneal nerve [5]. These small sensory nerves are named for the arteries which they accompany as they traverse the knee joint. These arteries are important sonographic landmarks when utilizing ultrasound guidance to perform blockade of the various genicular nerves.

The superior and inferior medial genicular nerves arise in the posterior popliteal fossa. The superior medial genicular nerve is accessible for neural blockade as it passes along the margin of the medial femoral condyle to course anteriorly to the medial knee (Figure **2**). The inferior medial genicular nerves is accessible for neural blockade as it passes along the margin of the medial tibial condyle to course anteriorly to the medial knee (see Figure **2**). The superior lateral genicular nerve is accessible for neural blockade as it passes along the margin of the lateral femoral condyle to course anteriorly to the lateral knee (see Figure **2**). The inferior lateral genicular nerve is accessible for neural blockade as it passes along the margin of the

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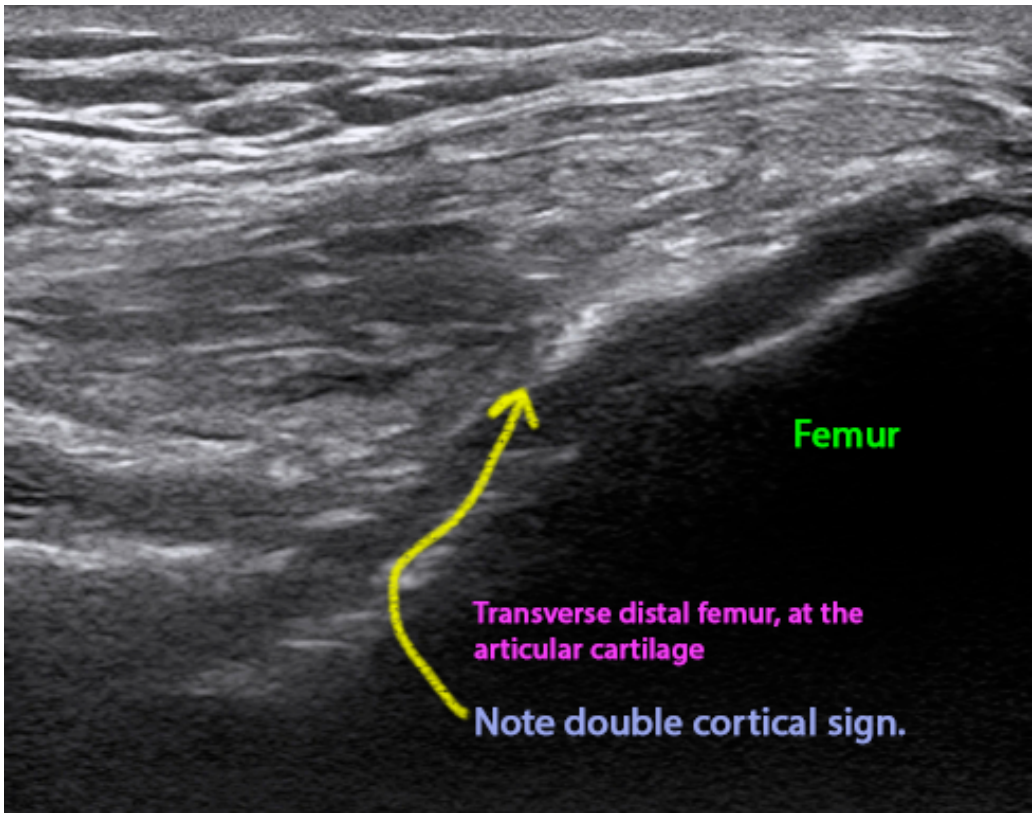

Figure 1: Ultrasound image demonstrating gout induced arthropathy of the knee joint. Note the double cortical sign which is characteristic of crystal arthropathy.

lateral fibular condyle to course anteriorly to the lateral knee (see Figure **2**).

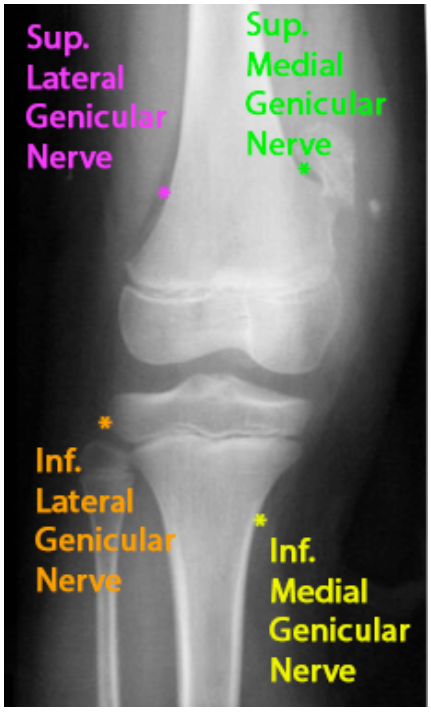

Figure 2: Relative locations of the genicular nerves.

Ultrasound Guided Technique

To perform ultrasound guided intra-articular injection of the superior and inferior medial genicular nerves, the patient is then placed in the modified Sim's position with the medial knee accessible for ultrasound imaging.

Ultrasound Guided Superior Medial Genicular Nerve Block

To perform superior medial genicular nerve block, proper preparation with antiseptic solution of the skin overlying the medial knee is carried out. A sterile syringe containing 2.0 mL of 0.25% preservative-free bupivacaine and 20 mg of methylprednisolone is attached to a 1½-inch, 22-gauge with strict aseptic technique. A linear high frequency ultrasound transducer is placed over in the longitudinal plane over the medial joint space. The ultrasound transducer is then moved superiorly following the medial hyperechoic margin of the femur to identify the point at which the medial femoral condyle joins the shaft of the femur (Figure **3**). Color Doppler is then utilized to try and visualize the superior medial genicular artery which will serve as a landmark for the superior medial genicular

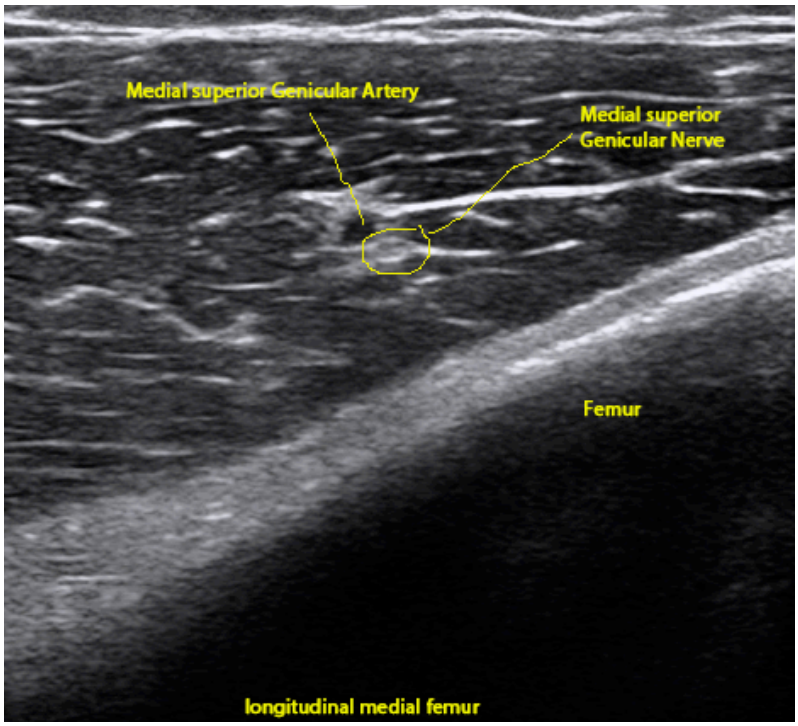

Figure 3: Ultrasound guided superior medial genicular nerve block. The superior medial genicular nerve close to the superior medial genicular artery. Note the relationship of the artery seen on color Doppler imaging and the femoral cortical surface at the transition point between the shaft and the medial condyle.

nerve (Figure **4**). If the artery is cannot be visualized, the transition point where the shaft of the femur joins the femoral condyle will serve as the target for needle placement. After the target is visualized, the needle is placed through the skin just posterior to the middle of the transducer and is then advanced using an out of plane approach with the needle trajectory adjusted under real time ultrasound guidance to lie in proximity to the target. After proper needle tip placement is confirmed, gentle aspiration is carried out and the contents of the syringe are slowly injected. The needle is then removed, and a sterile pressure dressing and ice pack are placed at the injection site.

Ultrasound Guided Inferior Medial Genicular Nerve Block

To perform inferior medial genicular nerve block, proper preparation with antiseptic solution of the skin

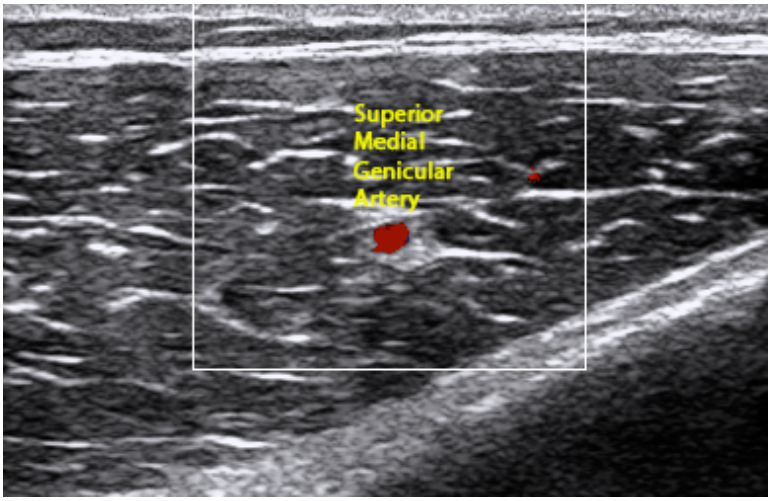

Figure 4: Color Doppler image demonstrating the superior medial genicular artery which serves as a landmark for the superior medial genicular nerve.

overlying the medial knee is carried out. A sterile syringe containing 2.0 mL of 0.25% preservative-free bupivacaine and 20 mg of methylprednisolone is attached to a 1½-inch, 22-gauge with strict aseptic technique. A linear high frequency ultrasound transducer is placed over in the longitudinal plane over the medial joint space. The tibia is identified and the ultrasound transducer is then moved inferiorly to identify the point at which the medial tibial condyle joins the shaft of the tibia (Figure **5**). Color Doppler is then utilized to try and visualize the inferior medial genicular artery which will serve as a landmark for the inferior medial genicular nerve (Figure **6**). If the artery is cannot be visualized, the transition point where the shaft of the femur joins the tibial condyle will serve as the target for needle placement. After the target is visualized, the needle is placed through the skin just posterior to the middle of the transducer and is then advanced using an

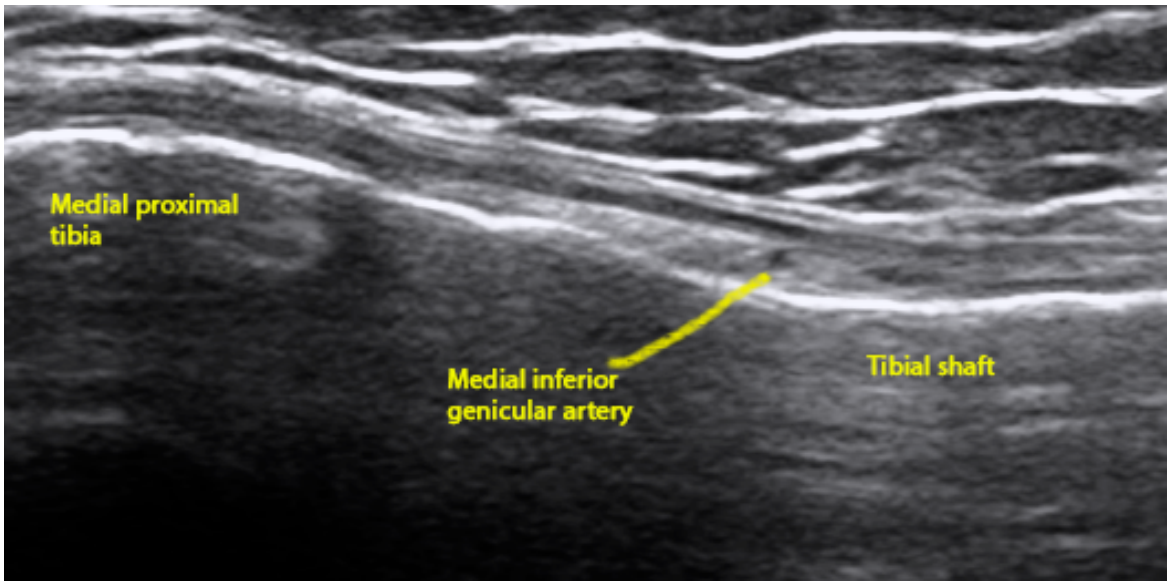

Figure 5: Longitudinal ultrasound image demonstrating the injection site for inferior medial genicular nerve block.

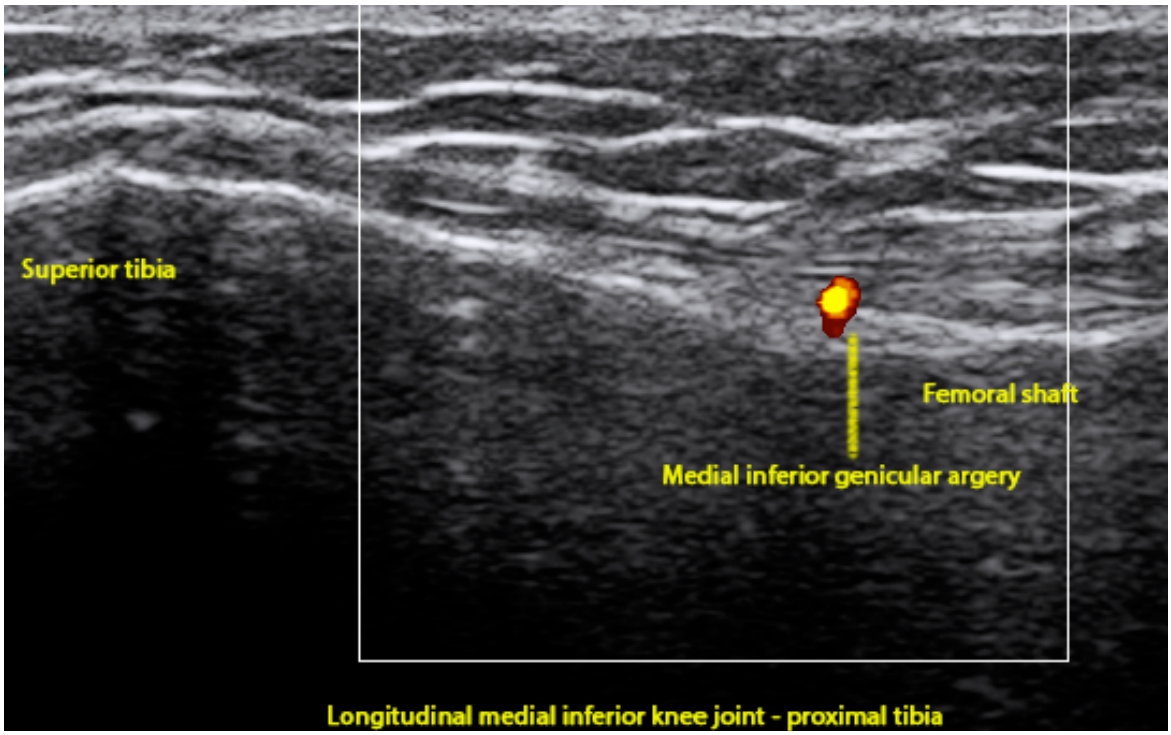

Figure 6: Color Doppler image demonstrating the inferior medial genicular artery which serves as a landmark for the inferior medial genicular nerve.

out of plane approach with the needle trajectory adjusted under real time ultrasound guidance to lie in proximity to the target. After proper needle tip placement is confirmed, gentle aspiration is carried out and the contents of the syringe are slowly injected. The needle is then removed, and a sterile pressure dressing and ice pack are placed at the injection site.

To perform ultrasound guided intra-articular injection of the superior and inferior lateral genicular nerves, the patient is then placed in the curled up position on the side with the lateral knee accessible for ultrasound imaging.

Ultrasound Guided Superior Lateral Genicular Nerve Block

To perform superior lateral genicular nerve block, proper preparation with antiseptic solution of the skin overlying the lateral knee is carried out. A sterile syringe containing 2.0 mL of 0.25% preservative-free bupivacaine and 20 mg of methylprednisolone is attached to a 1½-inch, 22-gauge with strict aseptic technique. A linear high frequency ultrasound transducer is placed over in the longitudinal plane over the lateral joint space. The ultrasound transducer is then moved superiorly following the lateral hyperechoic margin of the femur to identify the point at which the

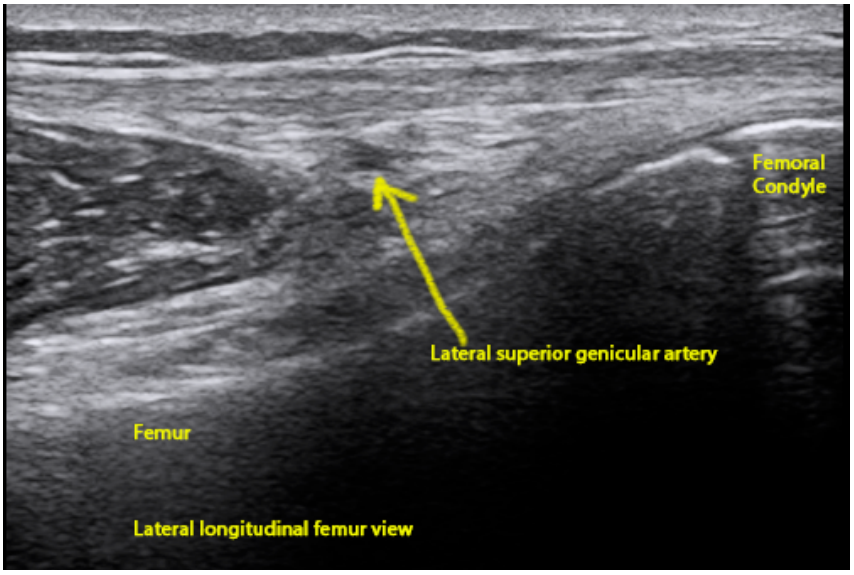

Figure 7: Longitudinal ultrasound image demonstrating the injection site for superior lateral genicular nerve block.

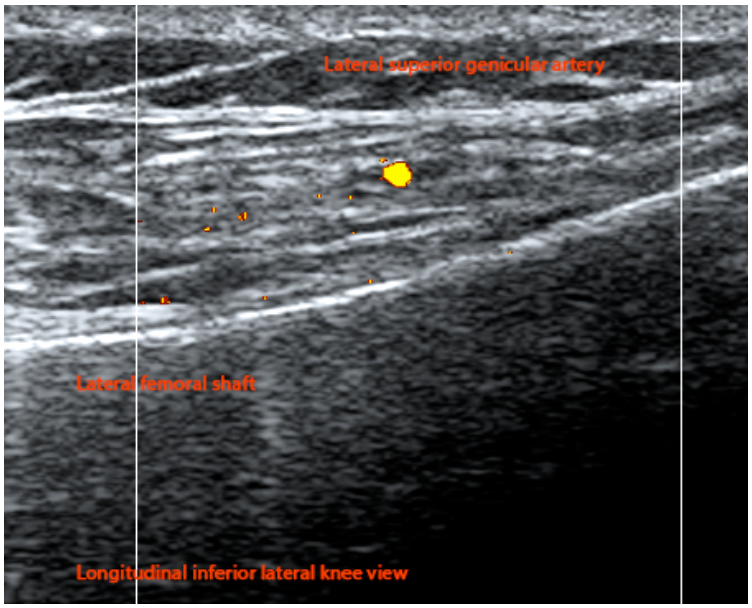

Figure 8: Color Doppler image demonstrating the superior lateral genicular artery which serves as a landmark for the superior lateral genicular nerve.

lateral femoral condyle joins the shaft of the femur (Figure **7**). Color Doppler is then utilized to try and visualize the superior lateral genicular artery which will serve as a landmark for the superior lateral genicular nerve (Figure **8**). If the artery is cannot be visualized, the transition point where the shaft of the femur joins the lateral femoral condyle will serve as the target for needle placement. After the target is visualized, the needle is placed through the skin just posterior to the middle of the transducer and is then advanced using an out of plane approach with the needle trajectory adjusted under real time ultrasound guidance to lie in proximity to the target. After proper needle tip placement is confirmed, gentle aspiration is carried out and the contents of the syringe are slowly injected. The needle is then removed, and a sterile pressure dressing and ice pack are placed at the injection site.

Ultrasound Guided Inferior Lateral Genicular Nerve Block

To perform inferior lateral genicular nerve block, proper preparation with antiseptic solution of the skin overlying the lateral knee is carried out. A sterile syringe containing 2.0 mL of 0.25% preservative-free bupivacaine and 20 mg of methylprednisolone is attached to a 1½-inch, 22-gauge with strict aseptic technique. A linear high frequency ultrasound transducer is placed over in the longitudinal plane over the lateral joint space. The lateral tibial condyle is identified and the ultrasound transducer is then moved inferiorly to identify the middle of the lateral tibial condyle (Figure **9**). Color Doppler is then utilized to try and visualize the inferior lateral genicular artery which will serve as a landmark for the inferior medial genicular nerve (Figure **10**). If the artery is cannot be visualized, the transition point where the shaft of the femur joins the tibial condyle will serve as the target for needle placement. After the target is visualized, the needle is placed through the skin just posterior to the middle of the transducer and is then advanced using an out of plane approach with the needle trajectory adjusted under real time ultrasound guidance to lie in proximity to the target. After proper needle tip placement is confirmed, gentle aspiration is carried out and the contents of the syringe are slowly injected. The needle is then removed, and a sterile pressure dressing and ice pack are placed at the injection site. If this technique provides good pain relief, but the pain returns, consideration can be given to radiofrequency lesioning of the genicular nerves to provide longer lasting neural blockade [6,7].

SIDE EFFECTS AND COMPLICATIONS

The major complication of genicular nerve block is infection, which should be exceedingly rare if strict aseptic technique is followed. Approximately 25% of patients report a transient increase in pain after this technique; the patient should be warned of this. Care must be taken to avoid placing the needle too posteriorly or damage to the peroneal nerve could occur.

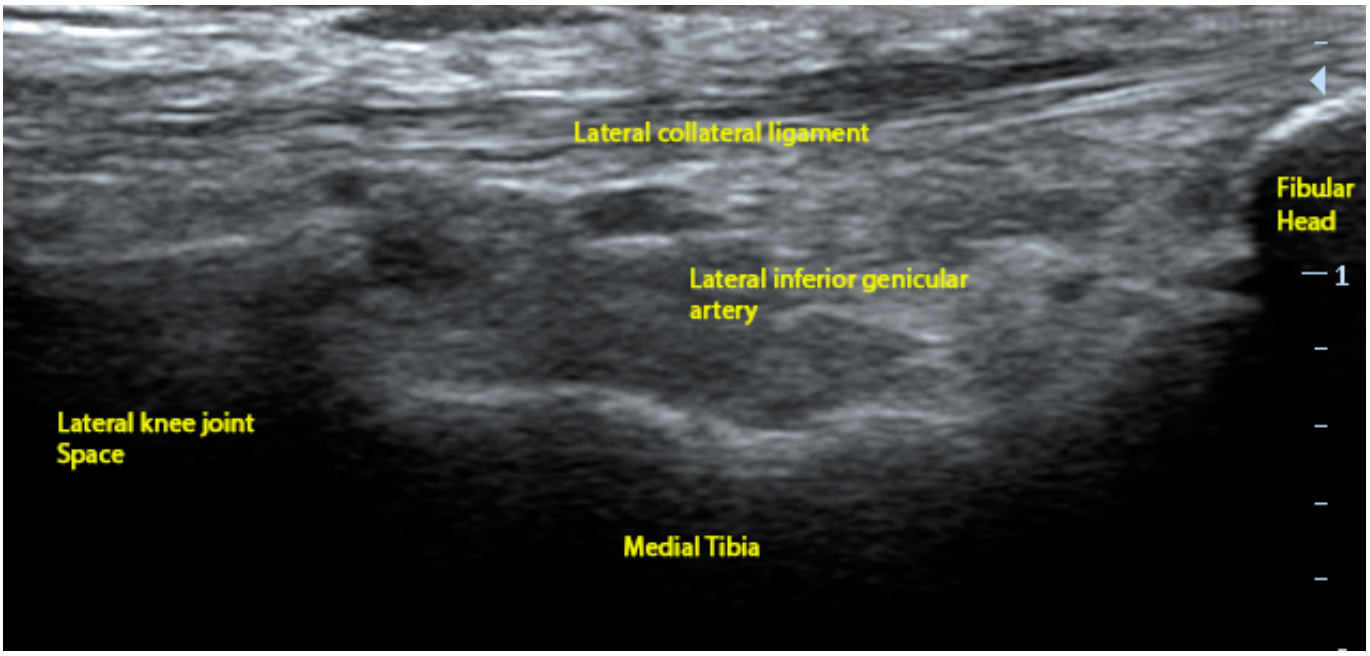

Figure 9: Longitudinal ultrasound image demonstrating the injection site for inferior lateral genicular nerve block.

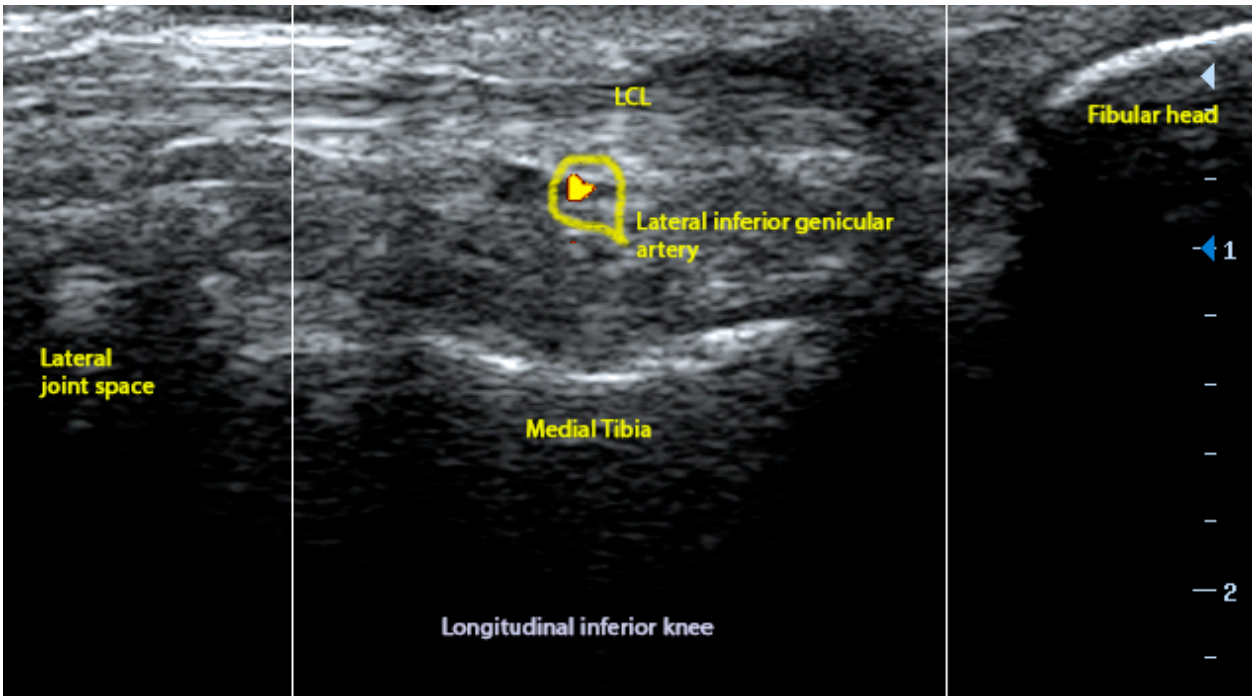

Figure 10: Color Doppler image demonstrating the inferior lateral genicular artery which serves as a landmark for the inferior lateral genicular nerve.

CONCLUSION

Ultrasound guided genicular nerve block is a simple and safe technique that is useful in the management of acute traumatic and post-operative knee pain as well as chronic knee pain that has failed conservative therapy. The use of color Doppler allows easy identification of arteries that lie adjacent to the genicular nerves which allows the operator to avoid inadvertent needle induced trauma. If the pain relief obtained from ultrasound guided genicular nerve block is transient, longer lasting neural blockade can be obtained by radiofrequency lesioning of the genicular nerves.

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