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Management of traumatic femoral shaft fractures

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Femoral shaft fracture should be regarded as an orthopedic emergency and requires immediate medical attention to preserve the patient's limb and to minimize complications. Special care must be taken to examine the hemodynamic and neurovascular status of patients who have these injuries because of the potential for a loss of vitality of the limb and a significant increase in morbidity.

FIGURE 1

Right femoral shaft fracture on plain film

Image credit: Bon Secours School of Medical Imaging

Anatomy

The femoral shaft is convex along the anterior surface and concave on the posterior surface. The femur is the first bone to show ossification, which occurs around the seventh week of fetal gestation.[1] The femoral shaft is tube-shaped and extends from the lesser trochanter to the flare of the femoral condyles. The muscles that protect the femoral shaft are divided into three compartments: the anterior (sartorius, pectineus, quadriceps, and iliopsoas), medial (gracilis; adductors longus, brevis, and magnus; and obturator externus), and posterior (biceps femoris, semitendinosis, and semimembranosis).

A rich arterial supply traverses most of the femoral shaft and is supplied by the profunda femoris artery, which is a branch of the common femoral artery. The linea aspera allows the profunda femoris to traverse it proximally and posteriorly. An endothelial blood supply is a tributary of the profunda femoris that supplies the cortex.

Trauma resulting in a femoral shaft fracture will often disrupt the endosteal vascular supply.[2] The venous supply is carried via the great saphenous system, which supplies the lower limb, specifically, the femoral vein along the femoral shaft.

The lumbar plexus and the sacral plexus innervate the femoral shaft muscles. The anterior division of the lumbar plexus gives rise to the genitofemoral nerve and the obturator nerve, and the posterior division gives rise to the lateral femoral cutaneous nerve and the femoral nerve. The sacral plexus has an anterior division that gives rise to the tibial nerve and a posterior branch that gives rise to the common peroneal and the posterior femoral cutaneous nerve.[3]

Classification of fractures

Femoral shaft fractures are defined as existing from the diaphysis between 5 cm distal to the lesser trochanter and 8 cm proximal to the knee joint. These injuries generally can be seen vividly on a plain film (see Figure 1).[4] Various mechanisms of injury are responsible for femoral shaft fractures. The most common mechanisms include motor vehicle crashes, penetrating gunshot wounds, falls, sports injuries, automobile-pedestrian trauma, bone disease, and metastatic cancer.

These fractures are classified in various ways, from nondisplaced single simple fractures to comminuted fractures, of which many types exist. The Orthopaedic Trauma Association describes type A (simple), type B (wedge), and type C (complex) fractures. The Winquist and Hansen classification is primarily based on comminution: Type 1 consists of minimal to no comminution at the fracture site; type 2 includes a larger fragment of bone than type 1, yet at least 50% of the circumference of the cortices of the fragments is unremarkable; type 3 involves comminution between 50% to 100% of the circumference of the fragments; and type 4 is a comminution with complete destruction of cortical contact with the cortex.[2] Figure 2 (page 51)

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shows the right femur, which is comminuted into three major fragments.

Evaluation

Signs of fracture along the femoral shaft include pain, shortening of the leg, misalignment, ecchymosis, engorgement, bleeding, protrusion of osteum, decreased range of motion, physical deformity of the affected limb, and inability to bear weight.[5] Special consideration should be given to the neurovascular and hemodynamic status of the patient. Specifically, sensation should be examined on the affected limb and the unaffected limb to check for deficits. Distal pulses should be evaluated as well. Baseline vital signs are important because they permit monitoring of changes in BP and pulse that can occur with hemorrhage. The contralateral hip and knee are subject to injury with a femoral shaft fracture, so it is crucial to examine them for associated injuries.

Routine laboratory tests should consist of a CBC with differential, comprehensive metabolic panel, prothrombin time, partial thromboplastin time, blood typing and crossmatch, and urinalysis. CT and MRI can be used for imaging, along with plain radiography. CT and MRI can show subchondral fractures, bone lesions, decreased bone densities, soft tissue injuries (ligament, tendon, muscle injuries), and great vessel injuries that usually are latent on plain films.

Management

The treatment of a femoral shaft fracture may or may not involve surgery. A cast brace is often used after initial skeletal traction has been applied. Skeletal traction is another method of early intervention. Traction is also used preoperatively when surgery is delayed while comorbid and preexisting medical conditions are addressed. Traction is usually inserted through the distal femur and proximal portion of the tibia. The use of skin traction is limited because it can cause skin destruction.

Many orthopedic surgeons have preferred to use intramedullary nailing, which has been shown to reduce malrotation and shortening of the femur. This technique has advantages over other methods, such as shorter healing and recovery times, infection rates that are less than 1%, and successful fracture union rates of around 98%. Intramedullary nailing is an efficient technique to realign the femur shaft A (see Figure 3).

Another surgical modality involves external fixation with pins. This modality is exceptionally effective for fixation of bone, but pin infection can occur in up to 50% of patients.[2] Complications that arise may involve internal hardware failure, infection, refracture, malunion, vascular injury, neurologic injury, and compartment syndrome.

FIGURE 2

Comminuted femoral shaft fracture

Image credit: Bon Secours School of Medical Imaging

FIGURE 3

Right femur after open reduction and internal fixation with intramedullary nailing

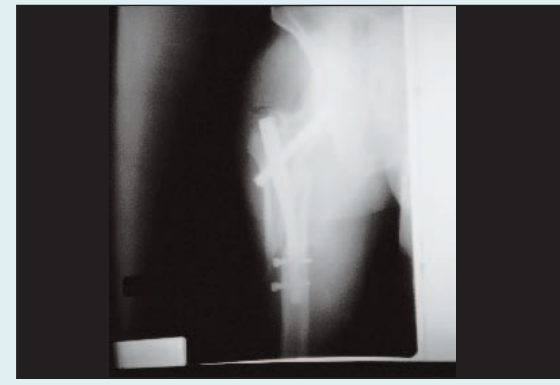

Image credit: Bon Secours School of Medical Imaging

Fat embolism syndrome can be a serious complication of femoral shaft and other long bone fractures. The keys to diagnosis are monitoring arterial blood gases for the development of hypoxia and using pulse oximetry. A team approach to caring for the patient is essential to ensure adequate perfusion and prevent metabolic acidosis.[6] Early fixation of femoral shaft fractures can prevent many complications of such injuries.

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