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Educational Corner

Closed Femoral Nailing of Acute Femoral Shaft Fractures with the AO-Femoral Distractor: An Educational Corner

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Background

Femoral shaft fractures regularly occur after major trauma, such as road traffic accidents and falls from a height (1, 2). These fractures usually are associated with concurrent injuries due to the high-energy forces in the trauma (3). In addition, due to osteopenia, this type of fracture is also frequent in the elderly population (1, 4). The AO Foundation/Orthopedic Trauma Association (AO/OTA) has categorized femoral shaft fractures into three subtypes: A, B, and C; they represent the simple fracture, fractures with more than two fragments (with maintained continuity), and complicated with disjoined bone cortex subsequently (5).

Intramedullary nailing (IMN) is considered the best available treatment option at the moment for femoral shaft fractures. It is an internal fixation technique that preserves hematoma formed at the initial repair phase and reduces complications such as malunion and nonunion (6-10). This technique has different variations based on entry site (retrograde and antegrade), but ultimately, they both result in satisfactory postoperative outcomes (7, 9, 11). In both of these variations, the pre-operative reduction is of utmost importance (12, 13). In the case of femoral shaft fractures, the reduction is critically important due to deforming force from the passage of strong muscles such as quadriceps, hamstrings, and gastrocnemius, and surgeons choose different techniques to reduce accurately (1, 12-17).

This educational corner aims to describe traumatic femoral fractures treated by IMN fixation after using a femoral distractor device to reduce the fracture closely. Then we hope to describe the technique of using AO-femoral distractor in a way that helps the medical staff use close reduction techniques even in patients with injuries that impede the use of fracture table.

Reduction Prior to Nailing

In femoral shaft fractures, due to strong muscles attached to the bone (quadriceps, gastrocnemius, hamstrings, etc.), expected deformities might happen that highlight the importance of accurate pre-operative reduction (12, 13). Based on the type of reduction, IMN is divided into open IMN and closed IMN. In open IMN, the fracture site is exposed during the reduction process. On the other hand, there is no need for exposing the fracture in the closed IMN technique. However, the open IMN technique is generally easier to perform and does not need specific devices used in close reduction. Therefore, the open technique is frequently used even when the closed technique is preferred (18, 19). Besides, a fracture table often hinders access to concurrent injuries in patients with multiple trauma and is demanding to perform in obese patients, prompting the surgeon to use open IMN techniques (20).

Femoral Distractor

The femoral distractor is a device used in the closed reduction of different fractures (Figure 1). This device applies the force directly to the bone and not the nearby structures (21). It has application in various orthopedic procedures such as distracting the bone in the arthroscopic meniscal repair (22), facilitating complex total hip arthroplasty (THA) surgeries with high mechanical effectiveness (23), as well as helping in ankle arthroscopy with distraction for easier visualization (24). Orthopedic surgeons also used femoral distractors in ankle arthroscopy to provide easy visualization by providing distraction (24). As discussed in this paper, this device has shown appropriate results in reducing femur fractures prior to IMN in some instances (18, 25).

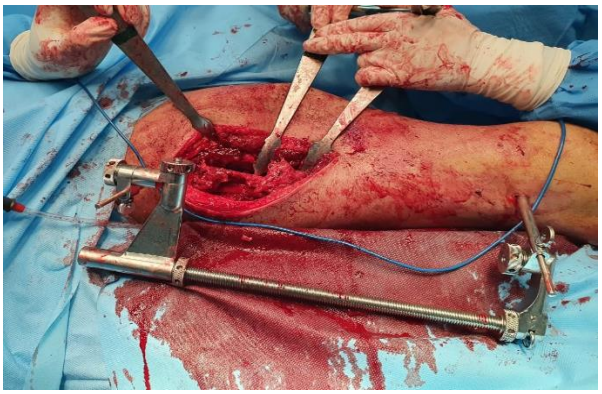

Figure 1. Femoral distractor device

For obese patients, which hindered surgeons' utilization of a fracture table for closed reduction, using a femoral distractor device is promising to achieve the reduction and alignment prior to IMN installation surgery. Sample radiography of a suitable case for using a femoral distractor with a transverse displaced mid-shaft femoral fracture is represented in figure 2.

Figure 2. Femoral shaft fracture case suitable for using femoral distractor

Technique

After anesthesia, a close reduction is necessary to perform. First, two 5 mm Schanz screws on the femur should be placed (one in proximal and the other in distal fragment) (Figure 3).

The proximal screw will be placed laterally into the lesser trochanter utilizing a 3.5 mm drill bit to create a hole for the screw. Fluoroscopy is used to identify the best route for the procedure. The distal screw will be placed in a lateral to medial position and at 90° of the long axis of the femur, in the anterior supracondylar area.

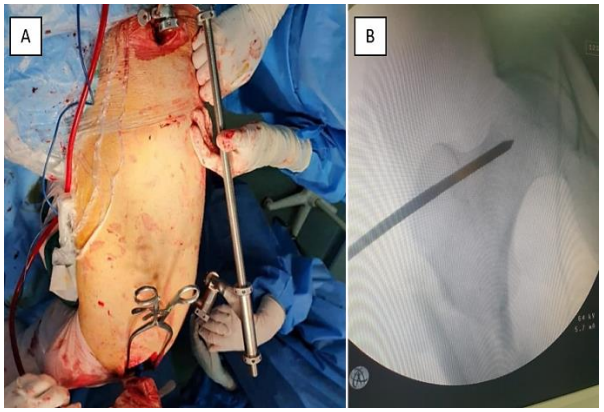

Figure 3. A: The proximal screw, the distal screw, and pre-assembled femoral distractor; B: Proximal screw insertion position

The surgeon should make sure that the screws are not in the way of the nail route to prevent complications during IMN installation. Then the pre-assembled femoral distractor will be attached to the Schanz screws while threaded parallel to the bone shaft in both sagittal and frontal planes. After ensuring that the Schanz screws were tightened appropriately, distracting the bone and reducing will be performed (Figure 4).

Figure 4. A and B: Reducing the femur fracture deformity

The reduction will be held during the nailing process. After the reduction process, the IMN surgery was performed using a femoral nail (Figure 5).

Figure 5. Intramedullary nail in the femur after reduction with the femoral distractor

Discussion

We have described a method of using a femoral distractor prior to femoral nailing in a patient with femoral shaft fracture. We believe that this technique helps patients return to daily activity, work, and sport with scarce limitations. Moreover, professional athletes usually return to sports within one year after injury (26). However, the femoral distractor technique in close reduction can be trusted only in the presence of skillful staff.

Plenty of tools and techniques have been employed to achieve fracture reduction before IMN surgery of femur fractures (27), including the routine fracture table (28, 29), an ultrasound technique (30), a rapid reductor, and a joystick technique (31). However, no single technique can work in every situation.

In acute femoral shaft fractures, a femoral distractor can be used instead of the fracture table and produce comparable results in reduction. A femoral distractor is especially useful when dealing with patients who will benefit from eliminating fracture tables, such as multiple trauma patients. In addition, a femoral distractor is recommended in patients with obesity and associated unstable spine or pelvic fractures (25). These patients benefit from the reduced operative time, and close reduction is recommended instead of the open IMN surgery (32).

However, loosening or rupture of the Schanz screws can complicate the procedure - especially at fracture line distraction - which could lead to increased surgery time,

larger access route, and possibly a change in the surgical procedure. Therefore, screw placement is critical in the procedure and should be perfectly executed (33).

Conclusion

A femoral distractor can closely reduce displaced femoral shaft fractures in adults before surgery, essential for successful closed IMN fixation. This technique requires a high level of skill but is exceptionally successful in reduction and can be used in some instances hindering other techniques.

Conflict of Interest

The authors declare no conflict of interest in this study.

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