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Technical Note

Suprapatellar nailing of tibial fractures–Indications and technique

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ABSTRACT

Intramedullary nailing is the standard procedure for surgical treatment of closed and Gustilo-Anderson Grade I-II° open fractures of the tibial shaft. The use of intramedullary nailing for the treatment of proximal metaphyseal tibia fractures is frequently followed by postoperative malalignment, whereas plate osteosynthesis is associated with higher rates of postoperative infection. Intramedullary nailing of tibial fractures is generally performed through an infrapatellar approach. The injured extremity must be positioned at a minimum of 90° of flexion in the knee joint to achieve optimal exposure of the correct entry point. The tension of the quadriceps tendon causes a typical apex anterior angulation of the proximal fragment.

The suprapatellar approach improves reduction of the fracture and reduces the occurrence of malalignment during intramedullary nailing of extra-articular proximal tibial fractures. The knee is positioned in 20° of flexion to neutralise traction forces secondary to the quadriceps muscle, thus preventing an apex anterior angulation of the proximal fragment. An additional advantage of the technique is that it allows the surgeon to avoid or minimise further soft tissue damage because of the distance between the optimal incision point and the usual area of soft tissue damage.

Introduction

Extra-articular proximal tibial fractures account for 5–11% of all tibial fractures [6,11,24]. They usually result from high-energy injuries and are frequently associated with severe soft tissue damage and complex comminution of bone [6,24]. Various treatment options are available [9,15–17,21,24,27,32,40,48,58], but there is no consensus regarding the optimal treatment for extra-articular proximal tibial fractures – especially those with additional soft tissue damage.

Conservative treatment is of secondary importance. Open reduction and plate fixation is a common approach [46,56], which permits a direct view of the fracture and anatomical reduction. However, a significant disadvantage of plate fixation is poor axial and varus stability [16,43]. Although angle-stable plate osteosynthesis provides greater rotational stability [43], open reduction and plate fixation may be associated with a high rate of postoperative infection attributable soft-tissue dissection [6,32,34,37,44]. Minimally invasive plate osteosynthesis (MIPO) may overcome this disadvantage, but precise reduction and correct alignment of the fracture is much more difficult, and occasionally impossible, compared to open procedures [9,34,37,46]. In extra-articular tibial fractures with extensive soft tissue injury, temporary or definitive external fracture fixation provides satisfactory stabilisation in accordance with the damage control concept [6,26,34]. However, an external fixator for definitive treatment is uncomfortable for the patient and postoperative pin track infection is common [5,6,58].

Intramedullary nailing of extra-articular proximal fractures appears to be the best treatment option to avoid soft tissue complications [3,34]. But high rates of malunion have been reported for this technique, which is challenging and debated [1,8,18,23,29,35,45]. Bhandari et al. evaluated the outcome of surgical techniques in the management of extra-articular proximal third tibial fractures with regard to rates of nonunion, malunion, infection, compartment syndrome, and implant failure [5]. Although the analysis of three prospective and 14 retrospective case series yielded rather weak evidence, higher rates of malunion were noted for intramedullary nails, while infection rates were significantly lower compared to plates or external fixators.

Several techniques have been employed for intramedullary tibial nailing, including medial parapatellar, lateral parapatellar,

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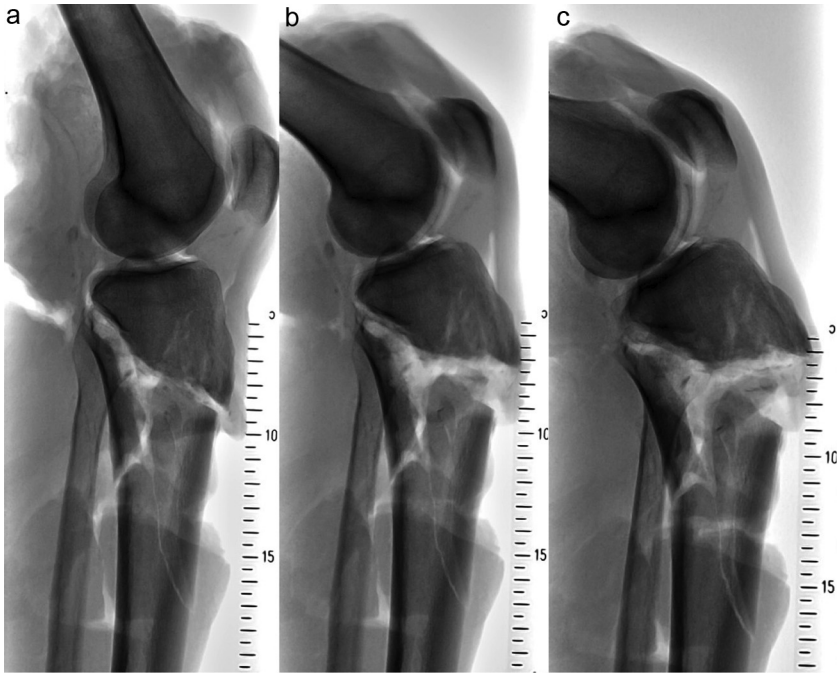

Fig. 1. a–c. Strengthening of "apex anterior angulation" of the proximal fragment during increasing flexion of the knee.

and transpatellar incisions [7,18,42,59]. When using the infrapatellar approach, the knee is usually flexed at least 90°. In this position the fracture will commonly be malreduced in apex anterior angulation, with posterior displacement of the distal fragment [57] (Fig. 1a–c). Malreduction results from sagittal dislocating forces exerted by the quadriceps muscle tendon on the short proximal fragment [22,24,31,35].

Additional plate osteosynthesis, external fixators, and so-called blocking screws have been developed to avoid postoperative malalignment after infrapatellar nailing [13,26,33,38,41,45,49].

Ricci et al. treated 12 consecutive patients with fractures of the proximal third of the tibial shaft using intramedullary nailing and blocking screws, and concluded that blocking screws can be effective in achieving and maintaining fracture alignment [49]. The use of blocking screws is rendered complex by potential bending or breakage of screws, the risk of stress concentration, and difficulties in screw placement [53]. In contrast, Matthews et al. stabilised displaced proximal tibial shaft fractures prior to nail insertion with four- to six-hole (3.5 mm or 4.5 mm) dynamic compression plates applied anteriorly on the tibia with unicortical screws [41]. However, this technique contradicts the principle of closed reduction and intramedullary fixation, and has the disadvantages of open procedures noted above.

The disadvantages of infrapatellar nailing led to the development of a semiextended nailing technique by Tornetta and Collins, who employed a medial parapatellar approach with lateral subluxation of the patella in 10° to 15° of knee flexion in 25 patients with proximal tibial fractures [54]. No patient had more than 5° of apex anterior angulation and 19 had none. As Sanders et al. reported, Dean Cole was the first who advocated a suprapatellar approach using a midline quadriceps tendon insertion [52]. This approach facilitates intramedullary nailing in the semiextended knee and overcomes the problems of reduction in 90° flexion with subsequent malalignment of the fragments. Maintenance of fracture reduction and radiographic imaging is simplified [15].

Bearing in mind these various treatments, here we review the indications and technique of suprapatellar nailing for tibia fractures.

Indications for suprapatellar nailing of the tibia

A proximal tibial fracture located entirely in the metaphysis (AO/OTA classification 41-A2 and A3) is the classical indication for suprapatellar nailing of the tibia (Fig. 2a and b).

When treating an AO/OTA type 42 fracture extending from the proximal tibial aspect into the shaft area by suprapatellar intramedullary nailing, the need for extended soft tissue exposure as in the ORIF technique is not required (Fig. 3a–c).

The main benefit of intramedullary nailing in semiextended position is that it improves postoperative fracture alignment

Fig. 2. a and b. Metaphyseal extra-articular proximal tibia fracture (AO 41-A3).