Suprapatellar Nailing in Segmental Fractures of the Tibia: A Contemporary Surgical Perspective

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Abstract

Introduction: Segmental tibial fractures, defined by two distinct fracture lines creating an intermediate cortical segment, represent high-energy injuries with significant management challenges. Traditional infrapatellar nailing often falls short due to difficulties in maintaining alignment and a high incidence of anterior knee pain.

Technique: This article outlines the suprapatellar approach for intramedullary nailing in segmental tibial fractures, highlighting surgical nuances, anatomical rationale, and advantages in challenging fracture configurations.

Conclusion: Suprapatellar nailing offers improved alignment control, reduced anterior knee morbidity, and superior intraoperative ergonomics, making it a preferred technique in segmental tibial injuries.

Keywords: Suprapatellar nailing, High energy trauma, Segmental tibia fracture

Introduction

Segmental tibial fractures are a rare but complex subtype of long bone fractures, accounting for approximately 3–12% of all tibial shaft injuries. These fractures are characterized by two distinct fracture lines, resulting in an isolated intermediate segment. The mechanism typically involves high-energy trauma, such as motor vehicle accidents or falls from height. These injuries are frequently associated with significant soft tissue compromise, posing challenges not only in fracture stabilization but also in wound care and infection prevention [1,2].

Conventional treatment with intramedullary nailing through the infrapatellar approach has been considered the gold standard. However, in segmental patterns – particularly those involving metaphyseal extensions – alignment control becomes difficult due to limited leverage, comminution, and soft tissue swelling. In addition, the infrapatellar approach has been associated with increased post-operative anterior knee pain, altered patellar tracking, and difficulty in intraoperative positioning.

The suprapatellar approach, initially met with hesitation due to concerns about potential chondral damage to the patellofemoral joint, has recently gained momentum with improved instrumentation and technique. It allows semi-extended positioning of the knee, which aids fluoroscopic visualization, improves mechanical alignment, and minimizes soft tissue trauma.

Anatomical Considerations

Understanding the anatomy of the suprapatellar pouch is crucial. The suprapatellar bursa, extending approximately 4–6 cm above the patella, lies between the quadriceps tendon and the anterior femur [3]. By entering the suprapatellar pouch through a blunt, sleeve-guided dissection, the approach avoids the infrapatellar fat pad and the patellar tendon – structures commonly implicated in post-operative anterior knee pain [4].

In addition, the trajectory offered by the suprapatellar entry aligns better with the long axis of the tibia, especially in fractures extending to the proximal or distal metaphysis [5]. This reduces eccentric reaming and the risk of iatrogenic fracture propagation.

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Figure 1: Pre-operative planning with surface markings for suprapatellar approach.

Figure 2: Initial incision made over the suprapatellar pouch.

Figure3: Exposure of the quadriceps tendon with retraction of soft tissues.

Figure 4: Insertion of protective cannula through the suprapatellar portal.

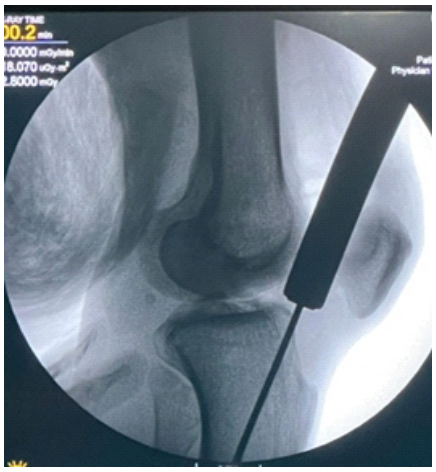

Figure 5: Fluoroscopic anteriorposterior view confirming central entry point.

Figure 6: Fluoroscopic lateral view showing proper trajectory of guidewire.

Figure 7: Fluoroscopy confirming correct intramedullary guidewire placement.

Figure 8: Fluoroscopic image showing advancement of nail under guidance.

Figure 9: Distal locking performed under fluoroscopic control.

Figure 10: Proximal interlocking screw placement seen under image intensifier.

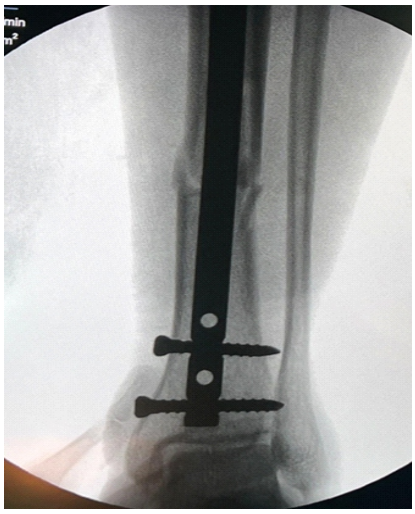

Figure 11: Distal locking screws seen in anteriorposterior view with proper cortical purchase.

Figure 12: Lateral view showing proper placement of proximal interlocking screws.

Indications and Contraindications

Indications

Segmental tibial fractures (AO/OTA 42C)

- Proximal or distal third shaft fractures
- Polytrauma patients requiring supine positioning
- Obese patients where knee flexion is mechanically limited
- Ipsilateral femoral fractures (floating knee).

Contraindications

- Open patellar tendon injuries
- Active infection in the suprapatellar pouch or knee joint
- Severe intra-articular involvement of the knee
- Pre-existing knee arthroplasty or hardware obstructing access.

Surgical technique

Positioning (Fig 1)

- The patient is placed supine on a radiolucent table.
- A radiolucent bolster is used under the knee to maintain slight flexion (10–20°).
- The limb is draped free to allow unimpeded fluoroscopy in both planes.

Incision and entry (Fig 2, 3)

- A 2–3 cm longitudinal midline incision is made 2–3 cm proximal to the superior pole of the patella
- Blunt dissection is carried out through the quadriceps tendon to access the suprapatellar pouch
- A cannulated protective sleeve (with a trocar) is inserted into

Figure 13: Central segment stabilized by intramedullary nail showing correct alignment.

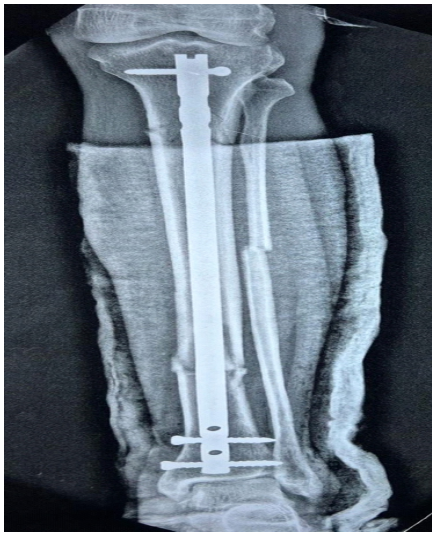

Figure 14: Post-operative anteriorposterior X-ray showing well-aligned segmental tibial fracture with nail in situ.

Figure 15: Post-operative lateral X-ray confirming proper reduction and implant position.

the pouch, resting on the trochlear groove of the femur
• Under fluoroscopic control, a guidewire is advanced centrally through the tibial plateau into the canal.

Canal preparation and nailing (Fig 4-6)
• Sequential flexible reaming is performed over the guidewire (Fig 7-8)
• The nail is inserted in a semi-extended position, reducing the risk of posterior malalignment
• Proximal and distal interlocking screws are placed with standard jigs or freehand technique (Fig 9-13)
• Wound closure is done in layers after confirming alignment and rotational profile

Post-operative protocol
• Early quadriceps activation and passive knee mobilization from day 1
• Toe-touch weight bearing is advised until radiological union is observed
• Full weight bearing typically resumes at 6–8 weeks, depending on callus formation (Fig. 14-15).

Discussion

Segmental fractures necessitate a technique that can secure both ends of the fractured bone without disturbing the intermediate segment. The suprapatellar approach provides a linear trajectory for nail insertion and enables improved control over the alignment during reduction and fixation.

Advantages over infrapatellar approach (Table 1)
• Improved alignment: Particularly in proximal third fractures
• Better ergonomics: Semi-extended position eases imaging and reduces surgical fatigue
• Reduced anterior knee pain: Due to avoidance of infrapatellar structures
• Improved fluoroscopic visualization: Lateral and anteriorposterior views are easier to obtain without extreme knee flexion.

Evidence from literature
Franke et al. [2] conducted a meta-analysis showing improved coronal and sagittal alignment with suprapatellar nailing.
Kubiak et al. [3] highlighted reduced anterior knee pain and improved outcomes in proximal tibial fractures.
Gelbke et al. [4] reported lower rates of malreduction and easier handling in proximal tibial injuries.

Table 1: Comparison between suprapatellar and infrapatellar nailing in segmental tibia fractures

Parameter	Suprapatellar approach	Infrapatellar approach
Positioning	Semi-extended	Hyperflexed knee
Visualization	Excellent	Compromised
Entry alignment	Anatomical trajectory	Anterior apex malreduction risk
Anterior knee pain incidence	Lower	Higher
Radiation exposure	Reduced	Higher
Polytrauma/obese patient ease	Superior	Challenging
Soft tissue disruption	Minimal	Moderate

Conclusion

The suprapatellar approach to intramedullary nailing has transformed the management of segmental tibial fractures by addressing key limitations of the traditional infrapatellar technique. It offers superior mechanical alignment, reduced anterior knee pain, and better surgical ergonomics. When performed using appropriate instrumentation and sterile technique, this approach is safe and reproducible.
With increasing surgeon familiarity and supporting literature, suprapatellar nailing is poised to become the standard of care for complex tibial fracture patterns, especially segmental injuries involving the metaphyseal ends.

Clinical Message
In segmental tibial fractures, suprapatellar intramedullary nailing offers a biomechanically sound, patient-friendly alternative to the traditional infrapatellar technique. Its ability to improve alignment and reduce anterior knee morbidity makes it a valuable tool in the orthopaedic trauma armamentarium.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.
Conflict of Interest: NIL; **Source of Support:** NIL

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