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TECHNICAL NOTE

Plate-Assisted Intramedullary Nailing of Distal Tibia Fractures

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ABSTRACT: The combination of plate and intramedullary nailing has been established as the treatment of proximal tibial fractures. Nevertheless, at the distal end of the tibia, the application of the plate-assisted intramedullary nailing is rarely applied as a therapeutic technique. This technical note demonstrates the use of the reduction plating technique for nail insertion as the management of distal tibia fractures.

Keywords: Tibial Fracture; Closed Fracture; Fracture Fixation; Internal Fixation; Intramedullary Nailing.

Distal third tibial fractures comprise 5–13% of all tibial fractures and their surgical management remains challenging.[1,2] Several techniques are available including intramedullary nailing (IMN) and open reduction and internal fixation (ORIF), each having potential complications.[3]

ORIF with a plate may provide anatomical reduction and stable fixation; however, this is at the expense of extensive soft tissue stripping and resultant devitalisation and potential increased risk of infection.[4] Minimally invasive plate osteosynthesis (MIPO) technique may potentially decrease the incidence of complications but it is not a panacea for the healing process.[5] IMN is less invasive but still not devoid of complications, as malalignment and the need for secondary procedures may still occur.[4,5] In particular, adequate reduction may be challenging during IMN procedures and therefore, the use of adjuncts have been advocated.[6,7] In a few cases, a combination of devices and/or supplemental fixation including the use of an additional unicortical plate and/or blocking screws may be necessary in order to achieve an optimal outcome.[7–9]

IM nailing with plate-assisted reduction has been reported for treating distal tibial fractures.[8,9] In particular, intramedullary nailing can be combined with a plate as an additional tool in diaphyseal or distal tibial fractures utilising reconstruction plates with non-locking screws and in particular tibial fractures with periarticular plates using locking screws.

This technical note demonstrates the use of a reduction plating technique for nail insertion for the management of distal tibial fractures. This technique combines the extraordinary utility of a one-third tubular plate in a unicortical fashion assisted reduction of IMN. This procedure was performed under limited fluoroscopy.

Technical Note

The inclusion criteria for this study was that the patient had to be above 18 years old with a closed extra-articular distal tibial fracture. Exclusion criteria were distal partial intra-articular, intra-articular fractures of the tibia and bone loss or comminution fractures.

Intraoperative prophylactic antibiotics were routinely administered intravenously. The patient was placed in a supine position. A mid-thigh level tourniquet was used and the leg was prepared and draped below it in a standard sterile manner. Fluoroscopy was used to identify the fracture line and a 3–4 cm anterior incision was made over the distal tibia. Subperiosteal dissection was used to expose the fracture site. Reduction was achieved under direct vision and was facilitated using pointed reduction forceps [Figure 1A]. A five-hole one-third tubular plate was applied to the fracture site and was secured using five unicortical screws. Fluoroscopy confirmed appropriate reduction [Figure 1B and C]. Subsequently, IMN using a supra-patellar approach was carried out in a standard fashion. During reaming and nail passage, the plate held the fracture in a reduced manner and there were no complications. Furthermore, the rotational instability of the fracture was initially preserved, through a peripheral screw passing through the plate and the nail [Figure 1D]. Rotational stability of the distal tibia was maintained by removing the screw passing through the plate and IMN and adding one screw to the plate and one screw to the IMN. The final fluoroscopy was performed with the reduction of the fracture using a combination of the nail and plate [Figure 3].

Advantages of this technique are its simplicity, reproducibility and limited fluoroscopy time as the reduction is maintained throughout nail insertion.

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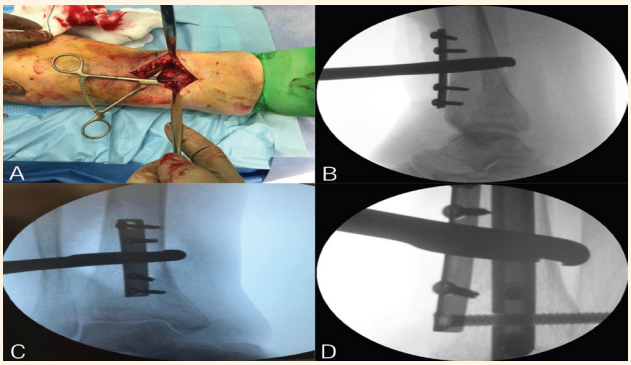

Figure 1: Intraoperative direct reduction under open incision and fluoroscopy of a 77-year-old female patient showing; **A:** distal tibia fracture reduced with pointed reduction clamp; **B:** The lateral and; **C:** anteroposterior view showing the reduction was achieved by a one-third tubular plate and unicortical unlocking screws. Rotational instability of the fracture was preserved, through; **D:** a peripheral screw passing through the plate and the nail.

The limitations of the technique include the non-applicability to intra-articular fractures and/or comminuted fractures with bone loss.

Case Study

A 77-year-old female patient presented to the Leeds Teaching Hospital, Leeds, UK, in 2021 after a low energy fall with severe pain and tenderness over distal tibial third. Her past medical history included hypertension. Physical examination revealed a closed injury, neurovascularly intact. Radiological images showed an unstable extraarticular distal tibial (AO 43A1) with an associated fibula fracture [Figure 2]. The limb was temporarily immobilised with a posterior splint in the emergency department. The patient was taken to the operating room the same day and plate-assisted intramedullary nailing was carried out as described above.

Figure 2: Radiographs in the **A:** anteroposterior and; **B:** lateral view showing a fracture of the distal tibia associated with a fracture of the fibula. It should be noted that the patient had an old proximal fibula fracture.

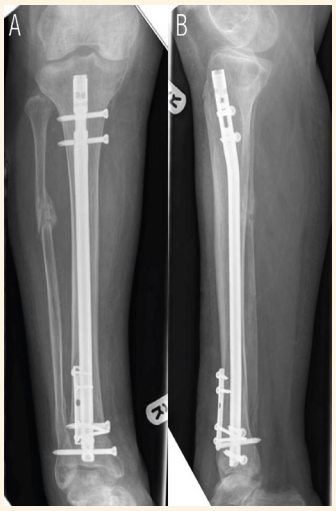

Figure 3: Radiographs in the **A:** anteroposterior and; **B:** lateral view of the final fluoroscopy.

Postoperatively, the patient was full weight-bearing and immediately started active knee and ankle range of motion, as well as quadriceps strengthening exercises. Thromboprophylaxis was prescribed for 6 weeks.

At final follow-up, 12 months after the procedure, radiographs demonstrated complete healing of the fracture with excellent alignment in both frontal and sagittal planes [Figure 4]. The patient reported no pain and was fully weight-bearing. Knee and ankle range of motion was normal and symmetrical to the contralateral extremity.

Figure 4: Radiographs in the **A:** anteroposterior and; **B:** lateral view at 12 months follow-up showing complete healing and excellent alignment of the fracture.

Discussion

Treatment of proximal and diaphyseal tibial fractures with a combination of plate fixation and IMN has been reported as an alternative, viable option for proximal tibial fractures.[7] Yoon *et al*. reported extending this to the distal end of the tibia for 30 cases and for selected cases, such as after nonunion and revision of hardware failure.[8,9] Furthermore, the preservation of the mechanical axis and final alignment of the distal tibial fracture was accomplished with a reconstruction or periarticular plate.[8–11] In the literature, the utility of the one-third tubular plate is recommended for distal fibula fractures.[11] In the current case, the extension of application of the unicortical one-third tubular plate aided firstly in the bridging of fractured segments and facilitated the final reduction and stabilisation of the IMN.

The aim of our technique was to combine the temporary reduction achieved by the unicortical plate and the alignment and stability be achieved by the IMN. The relative reduction through the tubular plate can be considered a limitation in the current case, however a combination of implants can finally provide stability and union. Secondly, the supplementary bicortical screw through the IMN and plate, proposes extra reinforcement to the torsional instability. Final removal does not seem to affect the ultimate reduction of the distal tibia.

Our technique presents a small incision approach and application of one-third unicortical plate, which in combination with the IMN, offers a successful outcome. Radiologically, the articular extension of the distal tibia fracture was not clearly visible. Thus, through the hole we tried to control the extension of the fracture and finally applied the five hole one-third tubular plate. Additionally, the surgical site was far from the periarticular area and therefore, a tubular instead of a reconstruction or a locking plate was chosen. An additional limitation of our technique is that it can be applied only in simple and spiral fractures, but in fractures with high comminution or bony stock and intraarticular extension it may be an unsafe option.

The ORIF of the tibial distal part, in a significant percentage, causes complications due to the disruption of the soft tissues and the extraosseous vascular supply.[12,13] The aforementioned technique presents an additional limitation, such as the future potential occurrence of local wound complications.

Conclusion

This technical note presents a surgical technique of the treatment of extra-articular non-comminuted distal tibial fractures. The described technique is simple and reproducible and should be considered in the treatment of these challenging injuries. The use of a plate, that facilitates reduction from the intramedullary nail, should be applied in cases without high comminution or intraarticular extension in the distal tibial fracture. Nevertheless, future studies should include more patients, in order to better evaluate the results of this surgical technique and clarify possible complications during this procedure.

AUTHORS' CONTRIBUTION

IEK was responsible for writing, revision and editing. GDC was responsible for the methodology and investigation. PB was responsible for supervision. All authors approved the final version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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