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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. The authors provide a technical note on the use of the reduction plating technique for nail insertion as the management of distal tibia fractures.

Keywords: Distal tibia fracture; open reduction internal fixation; percutaneous plating; plate-assisted reduction; intramedullary nail; nail plate combination.

Introduction

Distal third tibial fractures comprise 5-13% of all tibial fractures[1] and their surgical management remains challenging [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 at the expense of extensive soft tissue stripping and resultant devitalization 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 as far as healing goes [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 optimal outcomes[7, 8, 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 utilizing reconstruction plates with non-locking screws and in articular tibial fractures with periarticular plates using locking screws.

The authors provide a technical note on the use of a reduction plating technique for nail insertion for the management of distal tibial fractures using a combination of the extraordinary utility of a one third tubular plate in a unicortical fashion assisted reduction of IMN.The whole procedure was performed under limited fluoroscopy.

Technical note

The inclusion criteria for this study were patients 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 prepped and draped below it in a standard sterile fashion. 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 it was facilitated using pointed reduction forceps [Figure 2A]. 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 2B-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 reduced 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 2D]. Whereas rotational stability of the distal tibia was maintained, removed the screw passing through the plate and IMN and added 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 include simplicity, reproducibility, and limited fluoroscopy time since the reduction is maintained throughout nail insertion. 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 woman presented to the Leeds Teaching Hospital, UK after a low energy fall with severe pain and tenderness over distal tibial third. 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 1]. The limb was temporarily immobilized 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.

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

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

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 [8] have reported extending this to the distal end of the tibia for 30 cases and for selected cases [9], such as after nonunion and revision of hardware failure. Furthermore, the preservation of the mechanical axis and final alignment of the distal tibial fracture was accomplished with a reconstruction or periarticular plate[8, 9, 10, 11] In the literature the utility of the 1/3 tubular plate is recommended for distal fibula fractures.[11] In our case the extension of application of the

unicortical 1/3 tubular plate aided firstly in the bridging of fractured segments and facilitated the final reduction and stabilization of the IMN.

The philosophy of our technique was to combine the temporary reduction achieved by the unicortical plate and the alignment and stability achieved by the IMN. The relative reduction through the tubular plate can be considered a limitation in our case, however the 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 1/3 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, we were far from the periarticular area and so we chose a tubular instead of a reconstruction or a locking plate. 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 surgical technique presents the treatment of extra-articular non-comminuted distal tibial fractures. The described technique is a simple and reproducible that 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 to clarify possible complications during this procedure.

Authors' Contribution

GC designed the methodology and investigation. IK drafted the manuscript and revised it. PB supervised the work. All authors approved the final version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interests.

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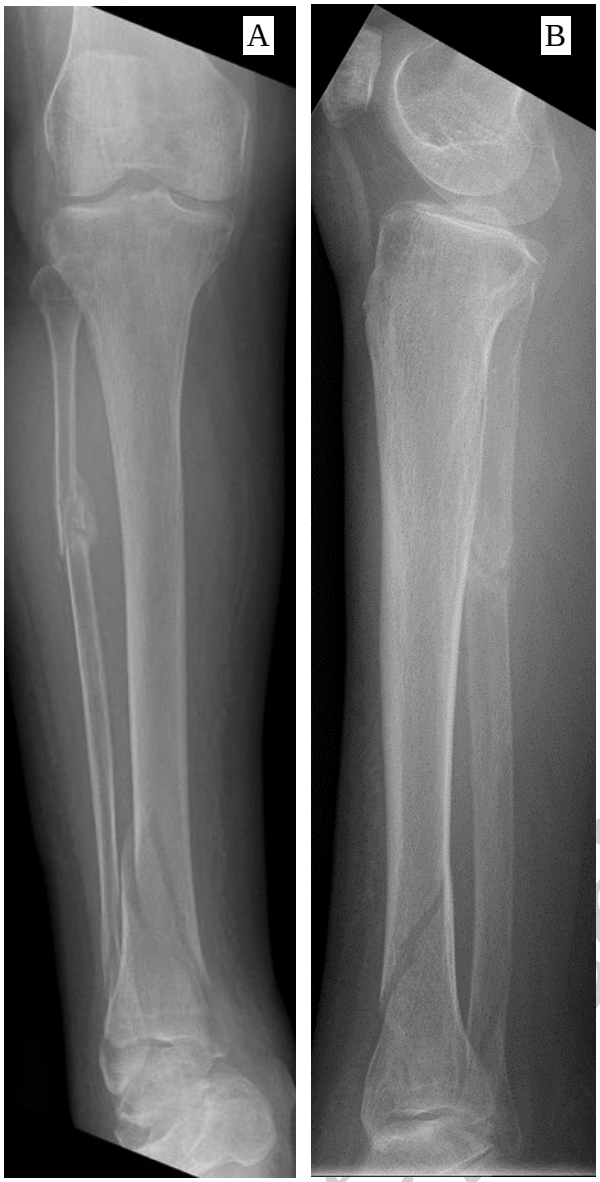
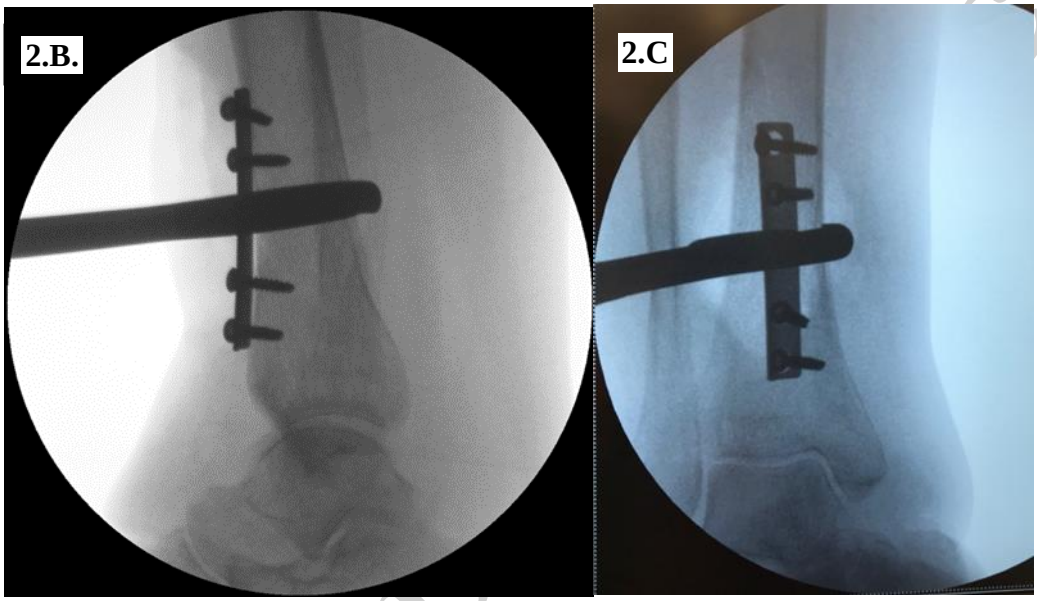


Figure 1: (**A)** AP and **(B)** Lateral radiographs demonstrating a fracture of the distal tibia associated with a fracture of the fibula. Of note, the patient had an old proximal fibula fracture.



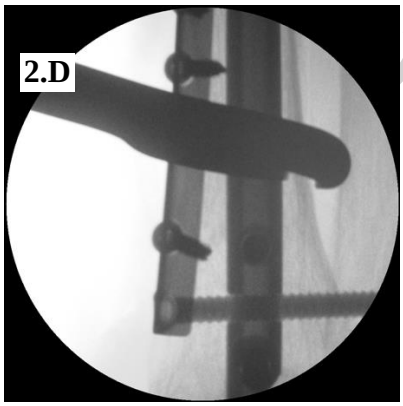


Figure 2: A-D: Intraoperative direct reduction under open incision and fluoroscopy**. (A)** Distal tibia fracture reduced with pointed reduction clamp. **(B)** Lateral view, **(C)** AP view. The reduction was achieved by a 1/3 tubular plate and unicortical unlocking screw**s. (D)** Rotational instability of the fracture was preserved, through a peripheral screw passing through the plate and the nail.

Figure 3: (A) AP and **(B)** lateral radiographs of the final fluoroscopy.

Figure 4: (A) AP and **(B)** lateral radiographs at 12 months follow-up with complete healing and excellent alignment of the fracture.