

Retrograde Tibial Intramedullary Nailing in Complex Fracture-Related Infection

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Fracture-related infection (FRI) after high-energy comminuted tibial fractures frequently leads to segmental bone defects and atrophic nonunions. In the distal tibia, the condition of the soft tissue envelope often limits reconstructive options. We used retrograde tibial nailing by a tibial nail with a calcaneus entry point (RTNC) as a salvage technique in selected complex FRI cases.

This study aims to evaluate its advantages, limitations, and clinical outcomes.

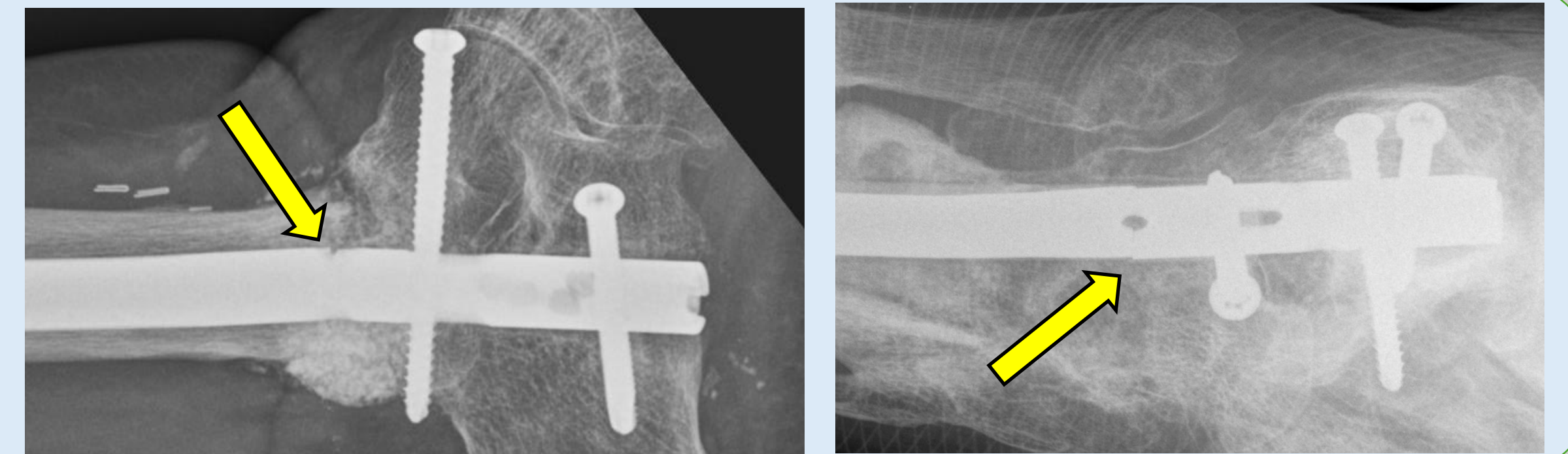
Over the past 10 years, seven patients with FRI after distal intra-articular tibial fractures were treated with RTNC.



- 1** **Male, 66 y/o.** A distal tibia intra-articular fracture treated with open reduction and internal fixation (ORIF) resulted in an early FRI, which was not addressed properly. A segmental resection and sural flap were performed, followed by bone transport. We observed **slow ossification of the distraction callus and delayed union of docking site**. RTNC, in combination with a plate proximally, resulted in good healing, full weight-bearing, and no infection recurrence.
- 2** **Female, 58 y/o.** 10 years after segmental resection of 15 cm of distal tibia for osteitis. Treated with a latissimus dorsi flap and bone transport. Many interventions for infection recurrence, then a **pathological fracture** at the end of an antibiotic spacer. **Antibiotic cement-coated RTNC** was used for revision surgery to treat infection and to provide good stability. The fracture healed in 4 months.
- 3** **Female, 60 y/o.** Operated for 6 months lasting FRI by using the Masquelet technique. The infection recurred and a segmental resection of 11 cm distal tibia was necessary. Soft tissue cover by latissimus dorsi flap was performed and bone transport was used. After frame removal, a **fracture of the distal distraction callus** occurred. We used an **RTNC**, which resulted in healing of both distraction calluses and docking site.
- 4** **Male, 70 y/o.** FRI after closed pilon osteosynthesis was treated with a two-stage revision, anterolateral thigh flap and bone transport. Early removal of the circular frame resulted in **deformation of the unhealed docking site; the distraction callus did not heal well either**. We decided on **RTNC** and managed to observe obvious healing in good position with no infection recurrence thereafter.
- 5** **Male, 44 y/o.** Operated for open pilon fracture; FRI occurred after 4 months. Two-stage revision with antibiotic cement-coated RTNC (**classic hindfoot nail was too short** for the affected segment) was performed, resulting in delayed union with nail fracture at 6 months. Revision by reaming and hindfoot nail; fracture healed, no infection recurrence.
- 6** **Male, 38 y/o.** Presented 4 months after ORIF of a closed distal tibia pilon fracture with no signs of fracture healing. Segmental resection, sural flap and bone transport were necessary. Because of **slow healing potential**, an RTNC was performed. Unfortunately, delayed union with nail fracture occurred, and we removed the nail. 3 months later, full weight-bearing is possible with some signs of healing.
- 7** **Female, 68 y/o.** The polytraumatized patient has suffered a high-energy open (GA3A) fracture of the distal tibia. After two revisions for the open fracture, we began treating the fracture with a circular frame. Not successfully. Regarding the other injuries and no signs of infection, we decided on reaming of the canal **to evoke a biological response**, followed by **RTNC** fixation.

Arthrodesis of the upper ankle joint and distal tibia comminution healed uneventfully. There is no signs of infection, but the main diaphyseal fracture is not healed. Full weight-bearing is painless. A revision with bone grafting is planned in the future.

The classic tibial nail is not reinforced on the insertion side as the hindfoot arthrodesis nail is. So, with retrograde insertion, it withstands less force distally. Therefore, a fatigue fracture of the nail can occur when upper ankle arthrodesis healing is still impaired, or, more distally, if the subtalar joint is not debrided for arthrodesis. We have observed this complication in two patients. There were no other complications observed intra- or post-operatively in our group of patients.



RTNC can be performed in the supine position, with technically straightforward proximal and distal locking. Proximal bending of a tibial nail is similar to that of a hindfoot arthrodesis nail and allows for an appropriate valgus position at the same entry point. An optional antibiotic cement coating may assist with infection control, acting simultaneously as a fixation device and an antibiotic spacer.



RTNC is a valuable option for impaired ossification of a calus distraction and healing of the docking site in bone transport treatment. Reaming enhances blood flow and stimulates bone healing, while the nail provides excellent relative stability. The technique is a salvage procedure in complex FRI cases