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Retrograde Nail for Tibiotalocalcaneal Arthrodesis as a Limb Salvage Procedure for Open Distal Tibia and Talus Fractures with Severe Bone Loss

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ABSTRACT

The treatment of complex fractures of the distal tibia, ankle, and talus with soft tissue damage, bone loss, and nonreconstructable joints for which the optimal timing for reduction and fixation has been missed is challenging. In such cases primary arthrodesis might be a treatment option. We report a series of multi-injured patients with severe soft tissue damage and bone loss, who were treated with a retrograde tibiotalocalcaneal arthrodesis nail as a minimally invasive treatment option for limb salvage. After a median follow-up of 5.4 years, all patients returned to their former profession. The ankle and bone fusion was complete, with moderate functional results and quality of life. Calcaneotibial arthrodesis using a retrograde nail is a good treatment option for nonreconstructable fractures of the ankle joint with severe bone loss and poor soft tissue quality in selected patients with multiple injuries, in particular, those involving both lower extremities, as a salvage procedure.

Complex fractures involving the distal tibia, ankle, or talus are often combined with bone loss. The comminution of the joint and bone defects is challenging in reconstructive surgery.

Often these injuries are characterized by soft tissue damage and nonreconstructable joint architecture. Because most of the patients have multiple injuries in a life-threatening situation, the optimal timing for reconstruction is often missed. Additionally, the bone loss results in a high risk of complications, including soft tissue infection, failed fixation, and post-traumatic arthrosis (1,2). The degree of soft tissue injury often mandates the use of initial external fixation. Severe articular destruction and metaphyseal bone loss is often not reconstructable.

In such cases, primary arthrodesis is a treatment option. The compromised soft tissue and bone loss make the use of standard internal fixation such as screws and plates difficult. External fixation can be complicated by pin tract infections and nonunion. Dorsally positioned blade plates are an option but require a soft tissue envelope (3,4).

In this subgroup of patients, we prefer tibiocalcaneal fusion with a retrograde intramedullary nail as a minimal invasive treatment option for limb salvage. We report on a series of multi-injured patients treated with a tibiotalocalcaneal arthrodesis nail for limb salvage.

Case Reports

Three polytraumatized patients (Table) with severe bilateral ankle surrounding open fractures (talus extrusion, distal tibia, pilon) on both sides were evaluated for tibiocalcaneal arthrodesis. The median patient age was 31 (range 19 to 42) years. Of the 3 patients, 1 was female and 2 were male. All patients had experienced high-energy trauma with multiple fractures of the extremities. The mechanisms of injury were a fall from a height and 1 truck and 1 motorcycle accident. The patient who fell from a height was attempting suicide at the time; the cause of the suicide attempt was attributed to borderline psychosis and obesity. All patients presented with soft tissue damage with third-degree open fractures and skin defects (median 10 cm), contamination, and bone defects.

Acute soft tissue management was performed with vacuum-assisted wound therapy and repetitive debridement. Bone stabilization was performed using an external bridging fixator. Primary internal fixation was not reasonable owing to the large soft tissue and bone defects. Thus, for limb salvage, a retrograde calcaneotalotibial arthrodesis with an intramedullary nail was applied. Second, in all cases, soft tissue reconstruction was achieved with a mesh graft or free flap (Figs. 1 and 2). The period between initial treatment and arthrodesis was 16 weeks (range 4 to 36) and was dependent on the soft tissue conditions. Resection of the comminuted fragments and

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Table
Patient demographics

Patient No.	Gender	Age (yr)	AIS	ISS	MESS	Cause of Injury	Pattern of Injury
1	Male	33	15	29	5	Motorcycle accident	Total talar extrusion, tibial shaft fracture, midfoot luxation fractures, contralateral ankle fracture AO 44B3, unstable lumbar spine fracture, blunt chest trauma with rib fractures, traumatic brain injury
2	Female	19	12	41	8	Fall from height	Pilon and tibia fracture with metaphyseal bone loss AO 43C3, peroneal nerve lesion, Syme's amputation of contralateral side, pelvic fracture, soft tissue defect sacral region
3	Male	42	10	42	7	Truck accident	Pilon and tibial fracture with metaphyseal bone loss 43C3, femoral fracture 32B2, femoral amputation on contralateral side, multiple rip fractures, clavicular fracture, pneumothorax, maxillofacial and subcranial fractures, traumatic brain injury

Abbreviations: AIS, Abbreviated Injury Scale; ISS, Injury Severity Score; MESS, Mangled Extremity Severity Score.

remaining articular cartilage was done during the periodic debridements. The nail was inserted retrograde, with additional autologous bone grafting. The nails were locked proximally in the tibia with 1 transverse screw. Distally, the nails were locked with 2 or more screws in the calcaneus or talus or with an angular stable spiral blade. Postoperatively, all patients were mobilized with tolerated weightbearing.

Results

The median follow-up was 5.4 (range 3.25 to 6.75) years. In all patients, ankle fusion was achieved clinically and radiologically. The time between the initial treatment and arthrodesis was 16 (range 4 to 36) weeks, according to the soft tissue conditions. No rotational failure occurred with a correct center line. The patient with complete loss of the talus had a different length in his extremities. In 1 patient, an asymptomatic metaphyseal bone defect was persistent more than 6 years after the trauma. To prevent implant failure, autologous bone graft using RIA® (Reamer-Irrigator-Aspirator, Synthes, Inc., West Chester, PA) was performed (Fig. 3). All patients were reasonably pain free with full weightbearing postoperatively. No serious problems occurred with the surrounding soft tissue. The patients were satisfied with the outcome and were able to return to their former profession. The mean American Orthopaedic Foot and Ankle Society score was 58.3. The mean Medical Outcomes short-form 36-item questionnaire assessing health-related quality of life demonstrated reduced physical and mental health (SF-36 score for physical function, physical role, bodily pain, general health, vitality, social function, emotional role, and mental health: 60, 50, 20.6, 54, 41.6, 70.8, 36.6, and 66.5, respectively).

Discussion

Fractures of the distal end of the tibia typically occur as a result of high-energy trauma with severe soft tissue damage and comminution. Open reduction and internal fixation can restore the diaphyseal region and articulare surface; however, there is a high potential for soft tissue complications (5). Standard open reduction and internal fixation can achieve good alignment and clinical long-term results in patients with low-energy trauma such as skiing accidents (5,6). In high-energy injuries, operative treatment according to the AO principles has demonstrated a high complication rate with soft tissue complications, infection, nonunion implant failure, or osteomyelitis (2).

External fixation is an alternative method to treat distal tibial fractures with soft tissue damage to minimize the complication rate. Complications for this treatment option demonstrated in a meta-

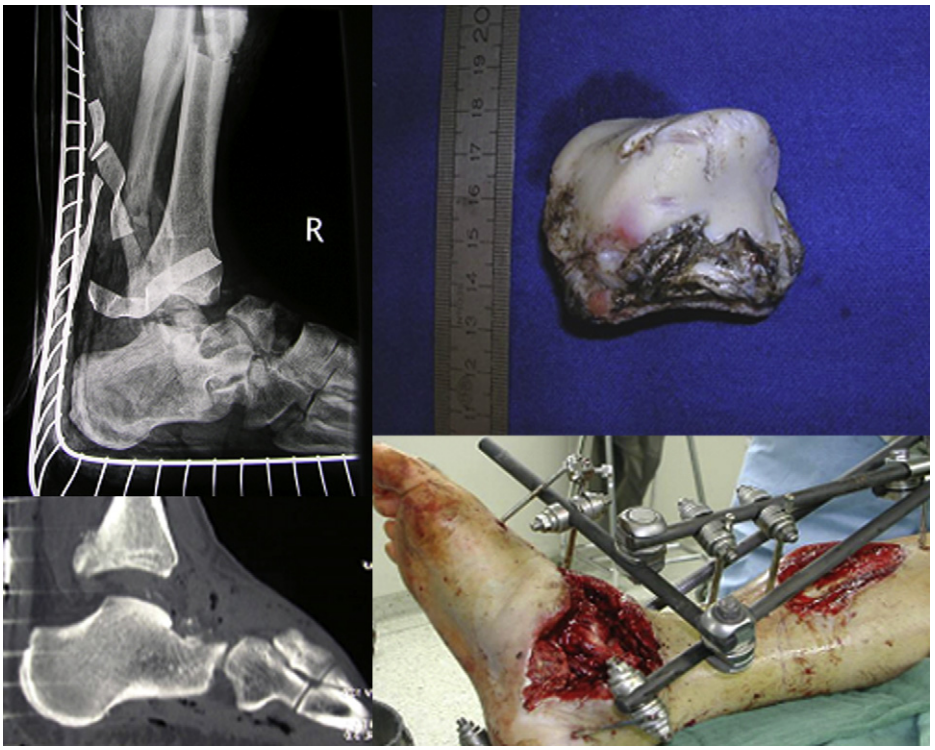

Fig. 1. Plain radiographs and computed tomography scan of complete talus extrusion in 33-year-old polytraumatized male patient after a motorcycle accident with third-degree open soft tissue damage (patient 1, Table). The talus reached our clinic some hours later. Initial external fixation and soft tissue debridement were done as first treatment.