Endoscopic Guided Tibiotalocalcaneal Arthrodesis After Failed Osteosynthesis of Pilon Fractures

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Abstract

Pilon fractures are difficult to treat because of the fracture pattern and are usually associated with significant soft tissue injury, which may result in a series of complications. Patients with diabetes and sensory neuropathy are at even greater risk of fixation failure, skin flap necrosis and deep infection. Treatment of complicated situations in patients is even more challenging and often results in an amputation. We describe a surgical treatment in two steps. First, we recommend an aggressive debridement to eradicate infection. After recovery of soft tissues, hindfoot fusion with a retrograde intramedullary nail helps to obtain a stable fixation. The removal of the cartilage can be performed endoscopically. This minimizes new soft tissue damage and favours wound healing. This treatment provides the patient with a pain-free plantigrade foot for ambulation.

Keywords: Pilon fracture; Tibiotalocalcaneal arthrodesis; Retrograde nailing; Ankle arthroscopy; Diabetes; Infection; Minimally invasive

Introduction

Pilon fractures are usually associated with significant soft tissue injury caused by high energy trauma, which may result in a series of complications such as fixation failure, skin flap necrosis or deep infection [1,2]. Patients with underlying systemic diseases, such as diabetes, have an increased risk of developing these complications, which may result in failure of osteosynthesis [3].

Tibiotalocalcaneal (TTC) arthrodesis by retrograde nailing has been shown to be an adequate salvage in situations such as arthrosis and complex malalignment, failed ankle arthroplasty, or failed primary hindfoot fusion [4-8]. This technique is usually performed with an open approach and the complication rate is high in diabetic patients [9]. In case of a recent failed pilon fracture, the scarring and soft tissue damage following prior operations is significant. In our study we present two cases of a failed pilon fracture with associated osteomyelitis and deep infection. The use of an arthroscopic posterior approach limits soft tissue damage and encourages fusion [10].

Patients and Methods

Case 1

A 35-year-old male patient with Charcot-Marie-Tooth disease presented on the emergency department with an articular multimalgment pilon fracture AO/OTA type C2 below an intramedullary tibia nail (Figure 1) [11].

The medical history revealed diabetes mellitus, morbid obesity and significant tobacco abuse. During the further course of treatment in compliance was noticed due to a reduced pain awareness as a consequence of his sensory neuropathy related to his Charcot-Marie-Tooth disease. After two weeks of lower leg elevation to reduce the soft tissue swelling, a plate and screw osteosynthesis was performed. At one month of follow-up, a posterosmedial dislocation of both talus and medial malleolus was noticed (Figure 1). A second plate osteosynthesis was performed with an external fixator left in place, due to the instability of the fracture. At three months of follow-up, a failure of the osteosynthesis occurred with recurrence of the posterosmedial talus dislocation. The implants were removed and a culture was taken from the tibiofotal joint and surrounding tissues. Finally an osteomyelitis with significant avascular bone necrosis occurred. Culture results were positive for S. aureus.

An aggressive debridement was performed, removing all avascular infected bone and nonviable fibrotic tissue. The large bone defect was filled with an antibiotic-impregnated cement spacer (Figure 1).

Laboratory results and wound healing showed a favourable progress after two weeks of intra-venous antibiotics. Because of the unstable bone situation and the repetitive surgery damaging the soft tissues, an endoscopic guided TTC arthrodesis was planned.

The patient was placed prone on the operating table with the foot and ankle extended slightly past the end of the table. No supports were used to allow a good access around ankle and distal tibia.

A 4.0 mm, 30 degree arthroscope was placed in a posterosmedial portal. The posterosmedial portal was used as an instrumental portal to remove the cartilage articular surface of the subtalar and subsequently the tibiotalar joint with shaver, chisels and curettes (Figure 2). Several holes were created in the subchondral bone to promote cancellous bleeding and improve arthrodesis. After cartilage removal from both joints an intramedullary K-pin was placed as a guide for the retrograde nail. Once a centralized position of the guide wire in talar dome through endoscopy was verified, the cement spacer was removed. The guide pin was moved into the distal tibia and the Hindfoot Arthrodesis Nail® (Synthes AG, Bettlach, Switzerland) was placed. The remaining bone defects were filled with antibiotic-impregnated autologous bone.
grafts. Post-operative treatment consisted out of wound care, IV antibiotics for 2 weeks and non-weight-bearing with crutches for six weeks.

Figures 1a-d: Preoperative (a and b) and postoperative (c and d) AP and lateral radiographs after tibiotalocalcaneal arthrodesis in case 1.

Figures 1e and 1f: Post-operative complications in case 1; e. Recurrence of posterolateral talar dislocation after plate and screw osteosynthesis; f. Deep infection treated with debridement and antibiotic spacer.

At 6 weeks of follow-up, the patient achieved complete wound healing and partial weight-bearing was allowed. CT-scan confirmed fusion after 12 weeks (Figure 1).

The American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score improved from 25 to 76 [12].

Figures 1g and 1h: Postoperative CT-scan case 2 showing fusion 3 months postoperatively.

Figure 2: Patient positioning during endoscopy using a medio- and posterolateral portal.

Case 2

A 68-year old woman sustained a pilon fracture AO/OTA type C2 grade II open according to Gustilo and Anderson after falling down the stairs (Figure 3).

The medical history revealed an aortic valve transplantation for which she used oral anticoagulants and diabetes mellitus with a pronounced polyneuropathy in both lower limbs.

Initial treatment consisted of external fixation due to the complexity of the fracture and conditions of the soft tissues. This proved to be very unstable with recurrence of talar dislocation. An additional external fixation was required before converting to a plate and pin cerclage osteosynthesis.

After two months of casting and wound care, the patient was allowed to start partial weight-bearing using crutches and a walker boot. This resulted in a failure of fixation and a deep wound infection with positive cultures for Staphylococcus epidermidis (Figure 3). Because of the polyneuropathy she probably started full weight-bearing and didn’t notice the seriousness of the situation. A debridement was performed with removal of the hardware. After wound healing a TTC arthrodesis was planned. An endoscopic removal of the cartilage of the
advantages of TTCA are maintenance of alignment, length, and case of a recent failed pilon osteosynthesis, the risk of wound problems. Finally, ankle fusion using iliac crest bone graft. A
aggressive debridement to eradicate infection and the use of IV
failed primary hindfoot fusion. Patient satisfaction is high, but the
treatment strategy [13]. Failure to eradicate infection probably is a
complaint of inadequate initial debridement in an effort to preserve bone
length [13]. Two weeks before the debridement, no oral or intravenous
antibiotics are given. Obtaining an accurate culture of the infecting
bacteria is essential. An infected nonunion may need second and third
debridements. When the infected nonunion has clean bleeding tissue
at the last debridement and has had 1 week of intravenous antibiotics,
the distal leg is ready for reconstruction [13]. However, complete
eradication of infection is always difficult to confirm and a late
recurrence is never ruled out. We recommend to follow the guidelines
discussed above to diminish the risk of recurrence. In case of a large
bone defect an antibiotic spacer can be used to offer stability and
occupation of debrided area [17]. The use of debridement and
implanting a cement spacer in a first episode followed by an
endoscopic guided arthrodesis in a second episode has been
demonstrated as a valid option to treat osteomyelitis after a calcaneus
fracture [19]. The cement spacer offers stability and occupies the
defect. After healing of the soft tissues the second step can be planned.
The intramedullary nail offers a stable fixation. Usually an
anteromedial or anterolateral approach is recommended [8]. Because
of the high risk of complications, minimally invasive approaches have
been described [8]. Preservation of the soft tissue, surrounding the
tibiotalar and subtalar joint, results in maintenance of a good blood
supply to the healing arthrodesis [20]. The endoscopic approach helps
to avoid soft tissue problems and favours wound healing [10]. By
arthroscopically de visu controlling resection down to subchondral
bleeding bone and taking care not to alter the geometry of both joints,
a maximum amount of bone mass is preserved and an optimal
coaptation of the bone surface obtained [10]. This is advantageous in
bony fusion. Despite the severity of our study population (diabetes,
sensory neuropathy, morbid obesity, non-compliance), the failed pilon
osteosynthesis and deep infection, the limb could be saved in both
patients. A bony fusion could be obtained and the patient could
ambulate with a stable plantigrade foot without soft tissue problems.
In view of the type of patients, one could consider to perform the
retrograde intramedullary nail fixation at the time of the index
surgery. This would avoid soft tissue problems and diminish the risk
to infection.

Discussion

This study illustrates the usefulness of an endoscopic guided
tibiotalocalcaneal arthrodesis as a salvage procedure in an infected
tibia pilon osteosynthesis in patients with associated diabetes and
sensory neuropathy.

Pilon fractures are difficult to treat because of the fracture pattern
and are usually associated with significant soft tissue injury, which
may result in a series of complications. Patients with underling
systemic diseases, such as diabetes, have an increased risk of
developing these complications [3]. Pilon non-unions, with a poor soft
tissue envelop, infection and bone loss have limited treatment options
and generally require external fixation [13]. Green and Roesler used
Hoffman external fixators to treat 11 infected nonunions of pilon
fractures [14]. The salvage rate was 56% (6 of 11). Zalavras and
colleagues treated six infected nonunions of pilon fractures with a 3-
stage technique [15]. First radical debridement and stabilization of the
ankle with a bridging external fixator. Second soft tissue coverage
with free muscle flaps. Finally ankle fusion using iliac crest bone graft. A
fusion rate of 100% was achieved in six cases, but the external fixator
had to be maintained for prolonged periods of time (5-14 months).
This treatment required a compliant patient without any use of
tobacco.

Hindfoot arthrodesis with intramedullary nailing is an effective
technique for treating complex foot deformities in situations such as
arthrosis and complex malalignment, failed ankle arthroplasty, or
failed primary hindfoot fusion. Patient satisfaction is high, but the
procedure is demanding and complications are frequent [6]. The
advantages of TTCA are maintenance of alignment, length, and
stability [7].

Complications after intramedullary nailing for tibiotalocalcaneal
arthrodesis include wound dehiscence, infection, nerve injury, gait
disturbances, malunion, and non-union [5]. Mendicino et al. published an overall complication rate of 70% with all major
complications occurring in patients with diabetes mellitus [9]. In the
case of a recent failed pilon osteosynthesis, the risk of wound problems
is even greater due to the scarring following prior surgeries. The
presence of an infection has been seen as a contra-indication for this
procedure [16]. An infection was confirmed in our two patients. This
was countered by performing surgery in two steps. The first step is an
aggressive debridement to eradicate infection. The first step is an
aggressive debridement to eradicate infection and the use of IV
antibiotics [15,17,18]. An aggressive debridement with excision of all
necrotic bone and removal of all hardware is the essential step of the
treatment strategy [13]. Failure to eradicate infection probably is a
result of inadequate initial debridement in an effort to preserve bone
length [13]. Two weeks before the debridement, no oral or intravenous
antibiotics are given. Obtaining an accurate culture of the infecting
bacteria is essential. An infected nonunion may need second and third

Figures 3a-d: Preoperative (a and b) and postoperative (c and d) AP
and lateral radiographs after tibiotalocalcaneal arthrodesis in case 2.
Figures 3e and 3f: Post-operative complications in case 2 e. Recurrence of fracture dislocation after primary external fixation f. Recurrence of fracture dislocation despite plate and screw osteosynthesis.

Figures 3g and 3h: CT-scan case 2 showing fusion 3 months (h) postoperatively.

A disadvantage of this study was the short follow up making it difficult to point out if complete eradication of infection was successful.

Conclusion

The use of an endoscopic guided tibiotalocalcaneal arthrodesis is a valid option after an infected pilon fracture osteosynthesis. Patients with comorbidities such as diabetes are more likely to experience major complications. In case of infection we recommend surgery in two steps. A debridement is needed to eradicate infection. After recovery of soft tissues, placement of an intramedullary nail helps to obtain a stable fixation. The endoscopic guided approach minimizes new soft tissue damage and favours wound healing.

References


