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Limb salvage versus Pirogoff amputation in infected open ankle fracture: decision- making and outcomes. A case report

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Case Report

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Abstract

Introduction:

Management of open ankle fractures in frail elderly patients with diabetes remains highly challenging, particularly in the presence of soft tissue defects and infection, where limb salvage is often not feasible and functional outcomes after major amputation are poor.

Case presentation:

We report the case of an 84-year-old woman with an open ankle fracture-dislocation complicated by extensive soft tissue loss and Pseudomonas aeruginosa infection. Despite repeated debridements, progressive necrosis and infection led to failure of limb salvage. Reconstructive options were contraindicated due to severe comorbidities. After interdisciplinary evaluation and shared decision-making, a Pirogoff amputation was performed with retrograde intramedullary fixation. At 8-month follow-up, the patient achieved full weight-bearing ambulation with complete soft tissue healing.

Conclusion:

Pirogoff amputation represents a valuable limb-preserving alternative to transtibial amputation in selected geriatric patients with complex infected open ankle fractures. It may allow early mobilisation and preservation of functional independence when conventional reconstructive strategies are not feasible.

Introduction

Open ankle fractures in elderly patients are severe injuries associated with high morbidity and mortality. Comorbidities such as diabetes mellitus, peripheral arterial occlusive disease, and long-term corticosteroid use significantly increase the risk of wound complications and infection [1–3]. Reported infection rates range from 20% to 60%, depending on the study population, and are further increased in patients with insulin dependence, peripheral polyneuropathy and women over 90 years old [4–8].

Management is particularly challenging, as standard osteosynthesis is often not feasible due to poor bone quality, compromised soft tissues, and limited healing potential. Alternative strategies such as primary tibiotalocalcaneal (TTC) arthrodesis may facilitate early mobilisation, but are associated with high complication rates in this population [9,14].

In cases with severe soft tissue damage and infection, transtibial amputation is often considered the standard treatment. However, this approach may delay functional recovery and limit mobility in very elderly patients. The role of limb-preserving techniques such as Pirogoff amputation remains insufficiently explored.

We present a case of an open ankle fracture-dislocation with extensive soft tissue defect and early infection, treated with Pirogoff amputation and retrograde intramedullary fixation, enabling soft tissue preservation and early functional recovery.

Case presentation

An 84-year-old woman, living independently in a single-level home, sustained an open fracture-dislocation of the left ankle following a low-energy fall. Prior to the injury, she was ambulatory with a rollator and functionally independent. Her medical history included compensated chronic renal insufficiency, type II diabetes mellitus (non-insulin-dependent), diabetic neuropathy, arterial hypertension, morbid obesity (BMI 44.06), and chronic venous insufficiency with recurrent ulcers of the left lower leg previously treated with split-thickness skin grafting.

On admission, clinical examination revealed an open bimalleolar fracture-dislocation with an approximately 20 cm medial wound and severely compromised surrounding soft tissues (Fig. 1). Capillary refill was normal and motor function preserved; sensory assessment was limited due to diabetic neuropathy. Closed reduction was not achievable in the emergency department, even under analgosedation. [Insert Fig. 1 here]

After administration of intravenous antibiotics (initially cefazolin), the patient was transferred to the operating theatre for urgent surgical management. Initial treatment consisted of radical debridement and tibiotalar transfixation, followed by temporary vacuum-assisted closure (Fig. 2, Fig. 3). [Insert Fig. 2 and 3 here]

Despite a patent three-vessel arterial supply on ultrasound, soft tissue conditions progressively deteriorated. Reconstructive options were evaluated in consultation with the national plastic surgery service. Based on intraoperative findings and clinical evolution, coverage with a free muscle flap (e.g., latissimus dorsi flap with split-thickness skin graft) was considered technically unfeasible. Furthermore, due to the patient’s severe comorbidities—including diabetes mellitus, chronic renal insufficiency, arterial disease, and morbid obesity—such extensive microsurgical reconstruction was considered absolutely contraindicated.

Concomitantly, infectious disease assessment revealed a high risk of treatment failure due to Pseudomonas aeruginosa infection (including resistant strains), suspected biofilm formation on implanted material, and limited antibiotic options. Inflammatory markers showed an initial decrease followed by a secondary rise (CRP nadir 60 mg/L with subsequent progression), supporting ongoing infection.

Given the high risk of septic complications associated with prolonged and repeated surgical procedures, amputation was recommended as the safest therapeutic option. Delayed amputation was intentionally chosen to allow for demarcation of non-viable tissue, repeated infection control through serial debridements, and thorough interdisciplinary decision-making.

Different amputation levels were considered, including transtibial and transfemoral amputation. However, due to the presence of chronic ulcers at the lower leg and the risk of impaired stump healing, these options were considered suboptimal. The patient explicitly refused a major amputation, expressing a strong desire to maintain her independence and continue caring for her dog.

After shared decision-making involving the patient and her family, a Pirogoff amputation was selected as a limb-preserving alternative with the aim of enabling early weight-bearing without the need for a prosthesis.

Surgical technique

On day 20, a modified Pirogoff amputation was performed. Following resection at the level of the metatarsophalangeal joints, a dorsomedial approach allowed circular exposure and resection at Chopart joint level. Talectomy was performed, and the distal tibial surface was prepared. The calcaneus was rotated 90° and advanced to achieve tension-free coverage of the soft tissue defect.

Definitive fixation was achieved using a retrograde intramedullary tibial nail (12 mm × 315 mm) (Fig. 5). A temporary vacuum dressing was applied. [Insert Fig. 5 here]

Postoperatively, a hematoma required surgical evacuation on day 5. Microbiological findings later confirmed persistent infection, and antibiotic therapy was adjusted accordingly.

Four weeks after amputation, the pre-existing chronic ulcer was successfully covered using an autologous split-thickness skin graft.

At 8-month follow-up, the patient was fully weight-bearing with a rollator. Soft tissues had completely healed, and radiographs confirmed consolidation of the arthrodesis (Fig. 6). [Insert Fig. 6 here]

Clinical course and timeline

- Day 0 (07/11/2020): Debridement + transfixation + VAC
- Day 4, 7, 13: Serial debridements due to progressive necrosis
- Day 7: Detection of Pseudomonas aeruginosa (two phenotypes)
- Day 13: Antibiogramme reception and antibiotic escalation to meropenem
- Progressive necrosis of toes and metatarsal region (Fig. 4)
- 19/11/2020: Interdisciplinary evaluation (including national plastic surgery service)
- Day 20: Pirogoff amputation performed
- Post-op Day 5: Revision surgery for hematoma evacuation
- +4 weeks: Split-thickness skin graft for chronic ulcer
- 8 months: Full weight-bearing with rollator, complete healing (Fig. 6)

[Insert Fig. 4 here]

Discussion

This case describes an open ankle fracture-dislocation in a very elderly patient with multiple comorbidities, complicated by progressive soft tissue necrosis and infection, ultimately treated with a Pirogoff amputation allowing early weight-bearing and functional recovery.

The management of such injuries represents a major clinical challenge, particularly regarding the decision between limb salvage and amputation. With the aging population, the incidence of osteoporotic ankle fractures continues to rise, ranking third among geriatric fractures in the United States [16]. Epidemiological data from Finland and other studies confirm a marked increase in ankle fractures in elderly women, especially those over 80–90 years of age [8,17–19].

In this population, diabetes mellitus plays a critical role. It is associated with more severe fracture patterns, delayed healing, and increased complication rates, particularly in poorly controlled disease [20–24]. The combination of advanced age, open fracture, and diabetes mellitus significantly increases the risk of infection and amputation [25]. These factors were all present in our patient and contributed to the rapid deterioration of local soft tissues despite repeated surgical debridement.

Limb salvage strategies, including internal fixation and soft tissue reconstruction, are often limited in this context. Although flap coverage has been described, most commonly using anterolateral thigh flaps [27], its applicability in frail patients with multiple comorbidities remains restricted. In our case, reconstructive surgery was contraindicated due to the patient's overall condition and the extent of tissue damage.

Transtibial amputation is commonly considered the standard approach in such situations. However, functional outcomes remain poor in elderly patients. Previous studies have shown that patients rarely regain their preoperative level of function after below-knee amputation, particularly in the presence of cognitive impairment or frailty [26]. This was a relevant concern in our patient, who was previously independent and strongly motivated to maintain mobility.

In this context, the Pirogoff amputation represents a valuable alternative. First described in 1854, it preserves the calcaneus and heel pad, allowing for a stable, weight-bearing stump [28–31]. Compared to more proximal amputations, it offers several advantages, including minimal limb length discrepancy, reduced energy expenditure during walking, and lower risk of pressure-related complications [28,30,32–34]. Preservation of the calcaneal fat pad enables pain-free weight-bearing, while retention of the malleoli may improve prosthetic fitting if required [31,35].

In the present case, the choice of Pirogoff amputation was guided by both clinical and patient-related factors: the unsuitability of reconstructive options, the high risk of infection persistence, the presence of compromised soft tissues at the lower leg level, and the patient's explicit wish to preserve independence. The procedure allowed effective coverage of the soft tissue defect and resulted in satisfactory functional recovery with full weight-bearing at follow-up.

Take home messages and clinical implications:

- Open ankle fractures in elderly patients with diabetes represent a high-risk entity with limited reconstructive options.
- Early interdisciplinary evaluation is essential to guide treatment strategy.
- Limb salvage may not always be feasible or beneficial in frail patients.
- Pirogoff amputation can be a valuable alternative to transtibial amputation in selected cases, particularly when preservation of weight-bearing capacity is a priority.
- Patient preferences and pre-injury functional status should play a central role in decision-making.

Summary

Open ankle fractures in frail elderly patients with diabetes are associated with high complication rates and limited reconstructive options. When amputation is required, Pirogoff amputation with retrograde intramedullary fixation may represent a limb-preserving alternative to transtibial amputation, allowing early weight-bearing and maintenance of functional independence in selected patients.

Declarations

Ethics and Consent to Participate

Not applicable

Consent to publish

Written informed consent could not be obtained due to the patient's death in 2023 from causes unrelated to the condition described. The report has been fully anonymized, and no identifiable information is included. Written informed consent was obtained from the patient's next of kin for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Data availability

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Competing interests

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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Authors' contributions

Gemma Feliu de la peña Vilarroig and Torsten Gerich are co-authors of this manuscript.
Gemma Feliu de la peña Vilarroig was responsible for manuscript preparation, literature review, editing, and the submission and publication process.
Torsten Gerich was the treating physician and primary surgeon and contributed substantially to the clinical management of the patient and the manuscript.
Tom Gryson contributed to the literature search and supported the review of relevant scientific publications.
All authors read and approved the final manuscript.

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Credit must be given to Zohlen who already described the technique presented here in 1951 [36]

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Figures

Figure 1



Figure 1

06.11.2020, day 0

Open dislocation fracture of the left ankle with transverse complication wound. Pre-existent soft tissue compromise following diabetes mellitus and chronic venous insufficiency



Figure 2

A: 06.11.2020, day 0. Initial X-ray with locked lateral translation of the talus. Even under analgo-sedation, reduction was not possible in the emergency room

2B: 23.11.2020, day 17. In addition to the tibio-metatarsal transfixation, a dorsal transfixation with Kirschner wires was required to maintain ankle stability from day 0. For the intermittent surgical procedures, the Schanz screws were left in place; mobile components were exchanged

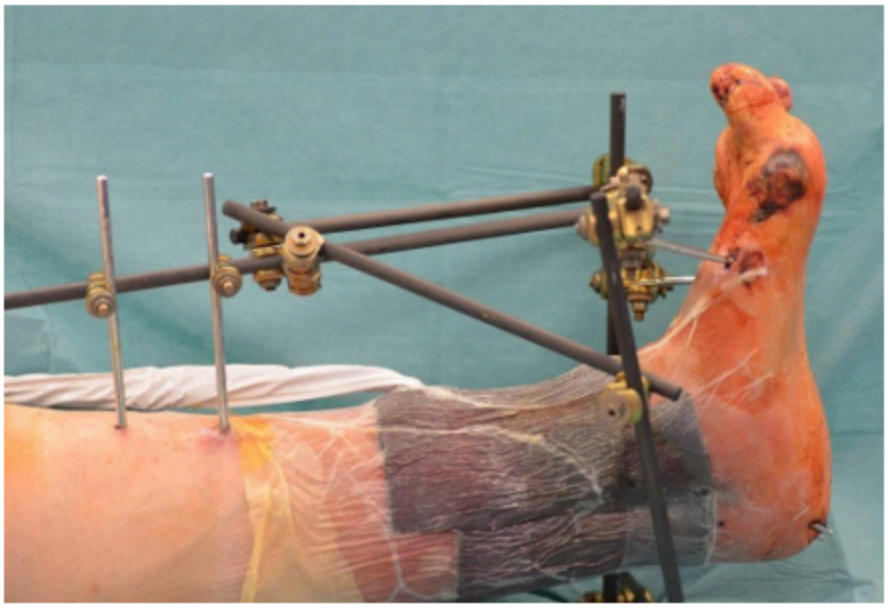
Figure 3



Figure 3

10.11.2020, day 4. Soft tissue defect after debridement. The soft tissues were temporarily covered with a vacuum system. On day 13, du cultures from day 7 turned out positif to pseudomonas aeruginosa.

Figure 4



2



Figure 4

19.11.2020, day 13. As a result of the soft tissue damage with pre-existing micro- and macroangiopathy, there was further deterioration of the peripheral circulation with incipient necrosis of the 2nd toe and at the tarsometatarsal joint II; continuous evidence of pseudomonas aeruginosa

Figure 5 a



Figure 5 b

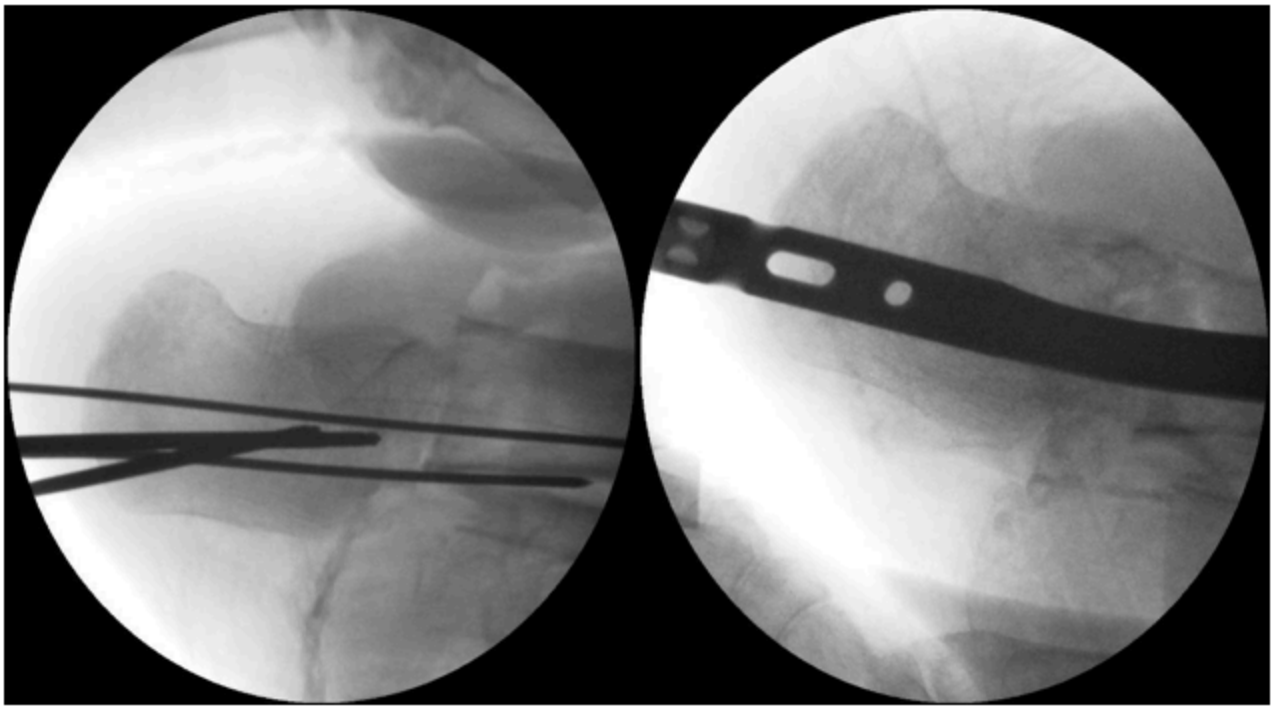


Figure 5

a 26.11.2020, day 19. Resection of the distal articular surface of the calcaneus was followed by rotation of the calcaneus. The mobilised sole of the foot completely covered the anteromedial soft tissue defect

b After temporary alignment and stabilisation with Kirschner wires, intramedullary osteosynthesis was performed with a retrogradely inserted Tibia Expert Nail (DePuy-Synthes)

Figure 6

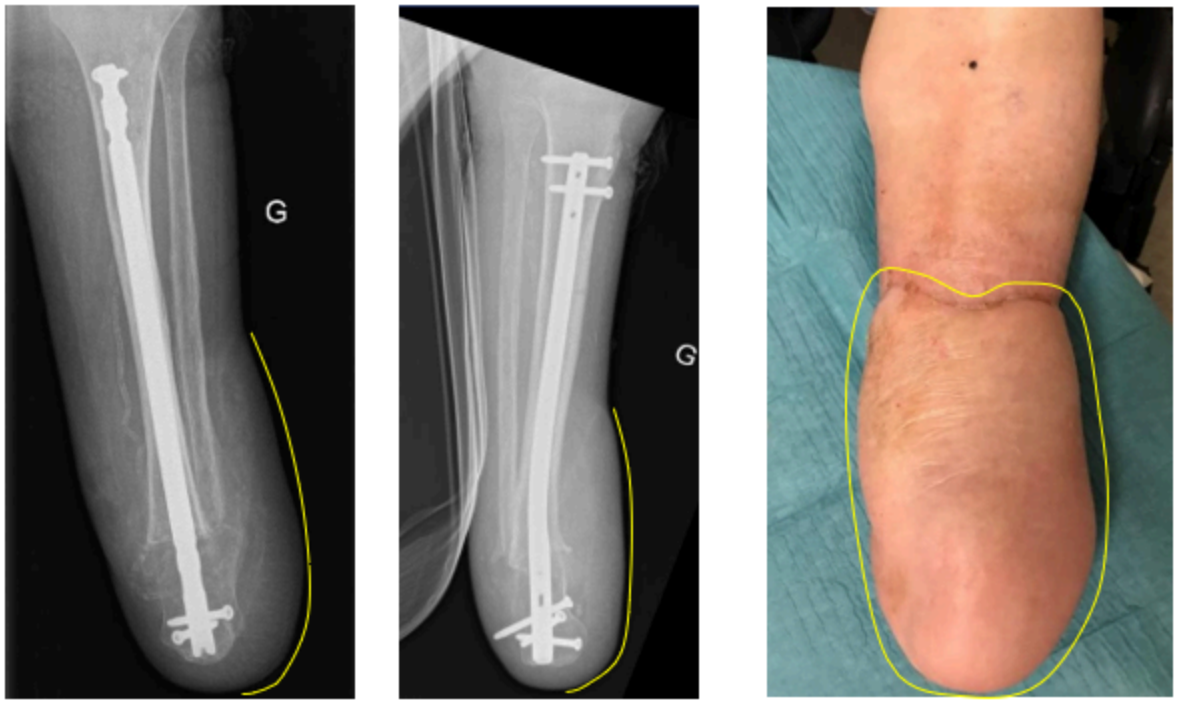


Figure 6

07.2022, 8 months. The patient was living in her home environment again. An orthopaedic adjustment of the footwear had to be corrected several times due to pain. She covers short distances in the house without shoes and can resume light activities in the garden. The yellow marking describes the area covered by the sole of the foot, representing almost 50% of the anterior tibia surface