

CASE REPORT**Rehabilitation of a Patient with Pirogoff Amputation and Two-year Follow-up: A Case Report**

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Background: Pirogoff amputation is a calcaneal amputation invented by Nicolás Pirogoff that involves partial preservation of the calcaneus. **Case:** A 59-year-old woman was diagnosed with left Lisfranc and Chopart joint fracture-dislocation 9 months after a fall. The patient underwent debridement together with Pirogoff amputation and surgery to place an Ilizarov external fixator. Five months later, the patient was transferred to a rehabilitation hospital. Because of inadequate bone fusion, for 3 months after the amputation the patient underwent gait training with a patellar tendon weight-bearing orthosis to avoid loading the amputated side. After fusion of the bone, the patient was able to walk using a Syme prosthesis and a cane. Three months after discharge from the rehabilitation hospital, the patient was diagnosed with hallux osteomyelitis of the other foot that was associated with the exacerbation of hallux valgus. The patient underwent hallux correction surgery. Three and a half months after the second hospital admission, the patient was again admitted to the rehabilitation hospital. At the end of the rehabilitation program, the patient was able to walk using a cane and a prosthesis. **Discussion:** Appropriate orthotic treatment and care of the non-amputated limb are of great importance in patients who have undergone a partial foot amputation.

Key Words: amputation; hallux valgus; osteomyelitis; prostheses and implants; rehabilitation

INTRODUCTION

Pirogoff amputation is a calcaneal amputation invented by Nicolás Pirogoff in 1864 that partially preserves the calcaneus.¹⁾ The procedure is recommended for patients with necrosis distal to the Lisfranc and Chopart joints with preserved blood flow in the calcaneus.²⁾ The advantages of the Pirogoff amputation include minimizing the leg length difference by rotating the calcaneus, decreasing pain levels due to the presence of intact fat pads supporting the calcaneus and body weight bearing, and ensuring better prosthesis compatibility.²⁾ As a result, a large number of amputees can relatively easily move indoors without the use of a prosthesis.^{3,4)} However, the rehabilitation process following Pirogoff amputation has been rarely reported.

Here, we report a patient with Pirogoff amputation who un-

derwent rehabilitation with a prosthesis, and we discuss the care of the non-amputated limb after corrective surgery of hallux osteomyelitis. This study conforms to all CARE guidelines⁵⁾ and reports the required information accordingly. Written informed consent was obtained from the patient for publication of this case report and the accompanying images.

CASE

The patient was a 59-year-old woman who had previously undergone surgery for malignant melanoma on the right heel. The patient was a housewife living with her family in a two-story house and was not under treatment for any other condition. The patient was a non-smoker and did not consume alcohol.

Nine months before the first admission to the acute hospital,

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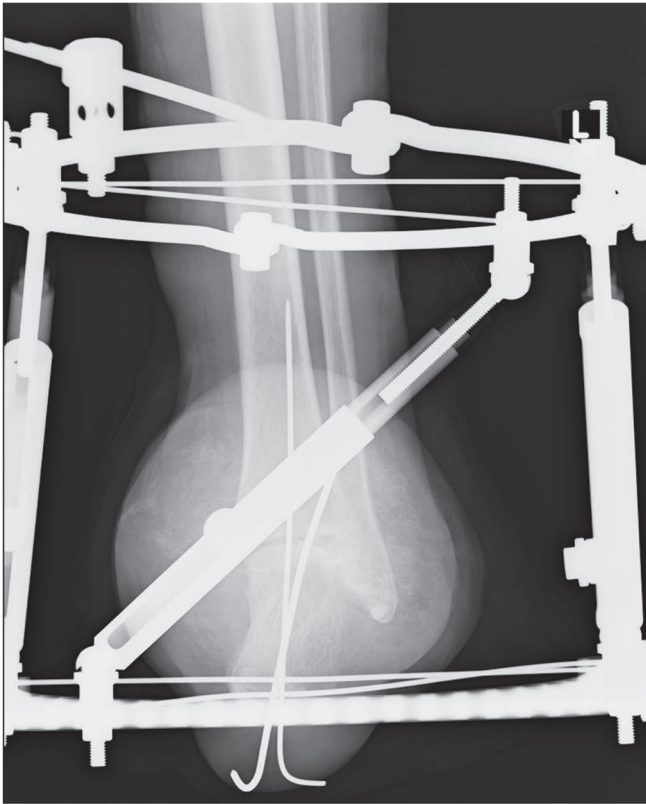


Fig. 1. Radiographic image after Pirogoff amputation and Ilizarov external fixator surgery.

the patient experienced pain in her left foot after a fall. However, the patient did not seek medical help at that time. However, her left lower leg was affected by edema, which worsened over time. Three months before the first admission to the acute hospital, the patient was examined for possible causes of the edema. Hypertension, diabetes mellitus, and collagen disease, which can cause peripheral vascular disease, were ruled out by blood tests. One month before the first hospital admission, the patient was diagnosed with a left Lisfranc and Chopart joint fracture-dislocation based on a computed tomography (CT) scan. Four weeks after the CT-based diagnosis, the patient was admitted to hospital with persistent left lower extremity pain and a plantar medial abscess. The patient underwent debridement together with a Pirogoff amputation and surgery for application of a Ilizarov external fixator (**Fig 1**). As part of the Pirogoff amputation, the necrosed talus was removed and the calcaneus was rotated 90° and connected to the tibia. Ilizarov fixation was implemented to improve the fixation of the tibia and calcaneus. Four months later, the Ilizarov external fixator was removed and cannulated cancellous screw fixation between the calcaneus and tibia and between the calcaneal and peroneal was performed.



Fig. 2. Anteroposterior radiographic image showing bone fusion at the tibio-calcaneal arthrodesis 6 months after the Pirogoff amputation.

First Admission to the Rehabilitation Hospital

Five months after the first admission to the acute hospital, the patient was transferred to a rehabilitation hospital. At admission, the motor strengths of the hip flexors were 4/4, knee extensions were 4/4, and the knee flexors were 4/4. The patient had no phantom limb pain, and the difference in residual leg length was 2 cm. The patient was independent in self-care and use of a wheelchair and underwent physical therapy and occupational therapy for 2–3 h per day, focusing on muscle strengthening, balance training, gait training, and activities of daily living training. Because of inadequate bone fusion, the patient underwent gait training with a patellar tendon weight-bearing orthosis to avoid loading the amputated side for 3 months after amputation. The patient started with a few meters of parallel bar walking with the patellar tendon weight-bearing orthosis. Subsequently, the patient was able to walk a short distance with the patellar tendon weight-bearing orthosis and a cane, although she used a wheelchair for long distances indoors. When bone fusion was confirmed (**Fig. 2**), the amputated side tolerated full loading and the patient was able to walk using the Syme prosthesis (**Fig. 3**). At the patient's request, barefoot walking training was not provided, and the patient was fitted with a prosthesis at home



Fig. 3. A Syme prosthesis for Pirogoff amputees.

due to the fear of loading the amputated side. As gait training progressed, pain in the right hallux valgus started to occur. The patient was advised to wear a corrective metatarsal abduction orthosis for pain relief. At the end of the rehabilitation program, the patient was able to walk using the prosthesis and a cane and could perform household activities such as cooking and laundry as usual with no problems. Four months after admission to the rehabilitation hospital, the patient was discharged.

However, 1 month after discharge from the rehabilitation hospital, blisters appeared on the patient's right hallux, between the digits of the second and third toes and the heel, and these gradually led to ulcer formation. The patient was diagnosed with hallux osteomyelitis associated with exacerbation of the hallux valgus. Three months after discharge from the rehabilitation hospital, the patient was re-admitted to hospital with hallux osteomyelitis. The patient underwent debridement and metatarsophalangeal joint arthrodesis with steel wire fixation.

Second Admission to the Rehabilitation Hospital

Three and a half months after the second hospital admission, the patient was again admitted to the rehabilitation hospital. On readmission, motor strength of the hip flexor was 5/5, knee extension was 5/5, and the knee flexor was 5/5. The patient underwent physical therapy and occupational therapy for 2–3 h per day that focused on muscle strengthening, balance skills training, and walking training with bilateral crutches. One month after readmission to the rehabilitation hospital, the patient underwent a steel wire extraction procedure (**Fig. 4**) and was allowed full weight-bearing on the right lower limb. The patient was then able to walk with a cane and a prosthesis. An insole was created to support the right medial longitudinal arch. Three months after the

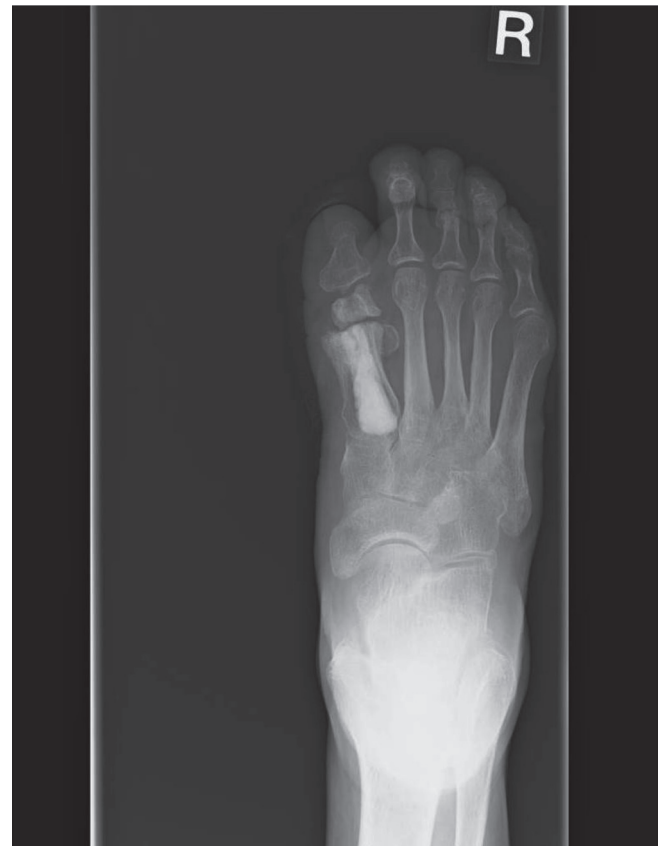


Fig. 4. Radiographic image of the non-amputated limb after first metatarsophalangeal joint arthrodesis.

second admission to the rehabilitation hospital, the patient was discharged. No worsening of her symptoms have been evident thus far, and the patient is functioning well.

DISCUSSION

In this study, we demonstrate the importance of appropriate orthotic treatment and care of the non-amputated limb in a patient who underwent a partial foot amputation. The patient described here was using a Syme prosthesis after Pirogoff amputation and a few months later underwent surgery for hallux osteomyelitis of the other foot. After two hospital-based rehabilitation periods, the patient regained gait ability. No peripheral arterial disease or other factors necessitating multiple surgeries were present. The role of the non-amputated limb is important for the patient's balance and walking ability. In such cases, an appropriate prosthesis and comprehensive rehabilitation are of key importance.

Prostheses are often used by patients after the Pirogoff amputation. In a previous report, however, one amputee was

able to walk without the use of a prosthesis with a complication risk comparable with those related to a Syme or a transtibial amputation.⁶⁾ The advantages of the distal amputation over the Syme amputation include decreased energy consumption during gait due to reduced lower limb length discrepancy, stability of the amputation area, and lower friction with the prosthesis.⁷⁾ In the current case, the discrepancy in residual leg length was 2 cm, which was similar to the discrepancy reported in a previous study.²⁾ Long-distance walking without a prosthesis is not recommended in patients after a partial foot amputation because shock absorption at the heel does not occur during the initial contact, there is no plantar flexion control of the ankle joint, and skin damage is highly probable. Our patient leads an active lifestyle with plenty of outdoor walking, and therefore finds the prosthesis indispensable.

Patellar tendon weight-bearing orthoses are useful for rehabilitation following the Pirogoff amputation. Our patient was able to shift to a prosthetic gait promptly after the confirmation of bone fusion. Gait training using a patellar tendon weight-bearing orthosis proved to be highly effective. It has been reported that intensive training for lower limb amputees promotes functional performance in patients.⁸⁾ However, one previous study reported the occurrence of osseous union between the distal tibial surface and the calcaneum at 2–5 months after amputation.⁹⁾ The use of a patellar tendon weight-bearing orthosis was effective in the current case, although the confirmation of bone fusion was time-consuming. To date, no detailed reports on the effectiveness of rehabilitation in prosthesis-using patients after the Pirogoff amputation have been published.

Care of the non-amputated limb is also important following a partial foot amputation. A systematic literature review revealed that the length of the single stance period of the amputated limb decreases after a partial foot amputation.¹⁰⁾ Hallux valgus is a common foot deformity with a prevalence of 23% in the adult population and 36% in people aged 65 years or more.¹¹⁾ We believe that increased activity while wearing the Syme prosthesis led to exacerbation of metatarsal pain and ulceration. Increased load on the non-amputation limb might have been the cause of blisters and ulceration of the metatarsal area. Later, these skin lesions occurred in association with hallux osteomyelitis. Therefore, it is necessary always to provide proper care of the non-amputated limb.

In conclusion, appropriate orthotic treatment and care of the non-amputated limb are of great importance in patients who undergo a partial foot amputation. The prosthesis should be fabricated in a way that enables outdoor walking. In the

future, the long-term outcomes and gait biomechanics in patients after Pirogoff amputation should be compared with those parameters in patients undergoing other types of leg amputation.¹²⁾

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CONFLICTS OF INTEREST

None of the authors involved in the creation of this case report has any competing interests. This project was not funded by any organization, and there is no financial incentive for any of the authors.

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