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Case Report

Pirogoff amputation for foot osteomyelitis: a case report and review of literature

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ABSTRACT

Deciding the level of amputation is influenced by healing potential of the stump and preservation of the limb length to optimise the mobility and energy requirement for walking. In 1854, the Russian surgeon Nikolay Ivanovich Pirogoff introduced a technique of foot amputation in which the heel is preserved and used as a base. The forefoot, midfoot, talus, distal part of the calcaneus, and distal tibial articular cartilage are removed. The plantar skin flap is left attached to the calcaneus, which is rotated 90 dorsally to create a sensate weight-bearing surface with minimal loss of leg length. Since the intact heel pad creates the plantar aspect of the stump, the patient is able to bear full weight on the limb, after bone-healing has occurred, with or without a prosthesis. We present a case of a patient who underwent an amputation with the Pirogoff technique following a traumatic compound Lisfranc's injury and subsequent its progression to osteomyelitis of forefoot and midfoot. Eight months after the procedure, the patient was able to bear weight on the left lower extremity and was fitted with a definitive prosthesis with a long silicon liner. She was able to walk without pain or the aid of crutches. The rating according to the 100-point Taniguchi scale was 75 points, which indicated a very good result. This case adds to the body of evidence supporting the Pirogoff amputation as a valuable reconstructive option in challenging post traumatic severe forefoot injuries with osteomyelitis. The patient was informed and duly consented for publication of the data.

Keywords: Lower limb amputations, Pirogoff amputation, Foot osteomyelitis

INTRODUCTION

The Pirogoff amputation technique was described by the Russian surgeon Nikolai Pirogoff in 1854.[1] The technique is reported for the cases to treat irreparable midfoot trauma, ischemia or infections.[2-4]

Using this technique, the heel pad and the sensation of the sole of the heel are preserved and a tibio-calcaneo osseous continuity is achieved, thus providing energy efficient mobilisation without a prosthesis for a short distance mobilisation in home.

It also produces a less limb shortening which makes the prosthesis fitting easier.[6,7]

Purpose of this case report is to report our experience of this technique of amputation in recalcitrant midfoot and forefoot osteomyelitis and its successful outcome.

CASE REPORT

Twenty-four-year-old woman presented to the clinic with persistent discharging sinus over dorsum of Right foot since last eight months.

She had met with a road traffic accident-Run over her right foot by speeding bike, one and half years prior to the presentation. She had a open Lisfranc's injury with lateral malleolus fracture (Figure 1) then and which was treated immediately in a tertiary care teaching hospital with debridement and stabilisation with K wires and external fixation (Figure 2).

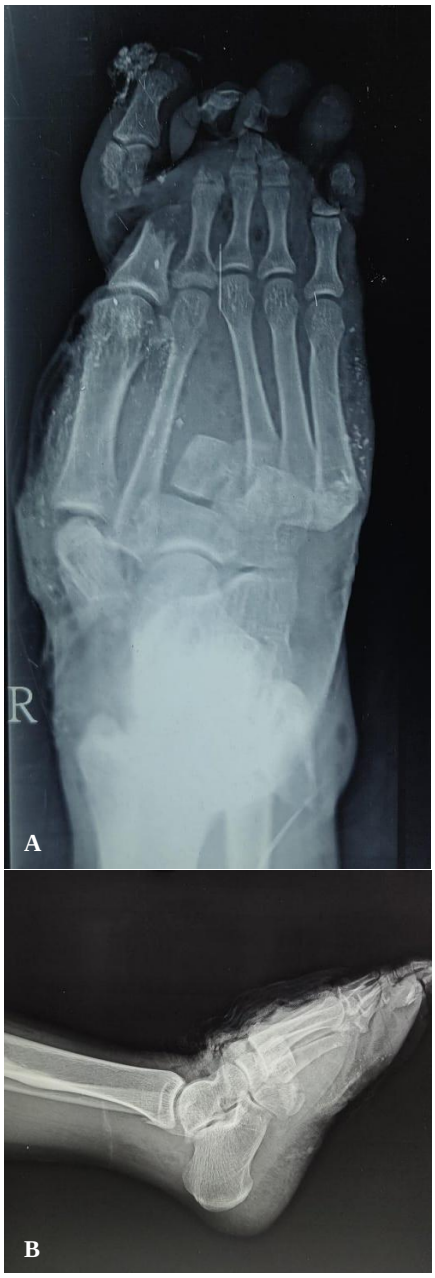

Figure 1 (A and B): Primary injury.

The plantar skin flap with heel pad and posterior tibial neurovascular bundle were spared by the injury.

She is a healthy woman with no medical co morbidities. Subsequently necrosis of all the toes needed amputations at metatarsophalangeal joints, The skin loss over dorsum Right forefoot was treated with split thickness skin grafting. The skin graft take-up was good but there were two persistently discharging sinuses over dorsum of the foot at midfoot and forefoot junction These were treated were with limited debridement and prolonged antibiotics without success. Xray's showed significant osteolysis of the midfoot and forefoot (Figure 3).

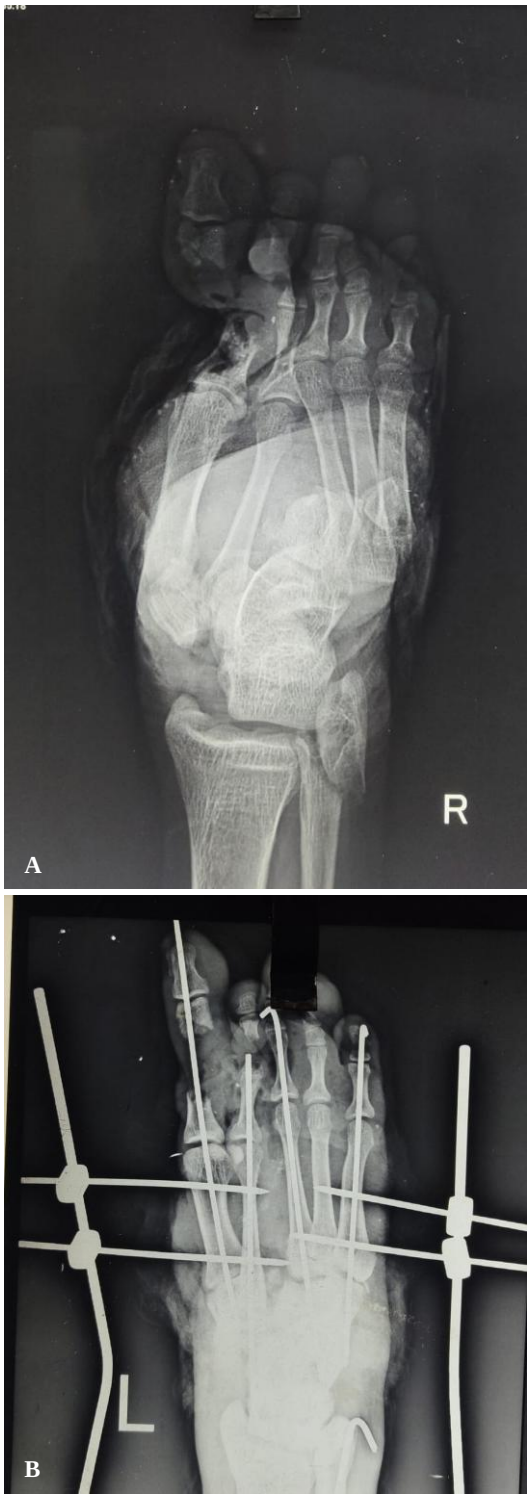

Figure 2 (A and B): Primary post op.

As the patient was young and healthy, the most distal amputation level where adequate vital skin coverage could

be achieved was chosen. After the detailed discussion about pros and cons of amputation levels of Symes, below knee and Pirogoff, patient consented for a Pirogoff amputation.

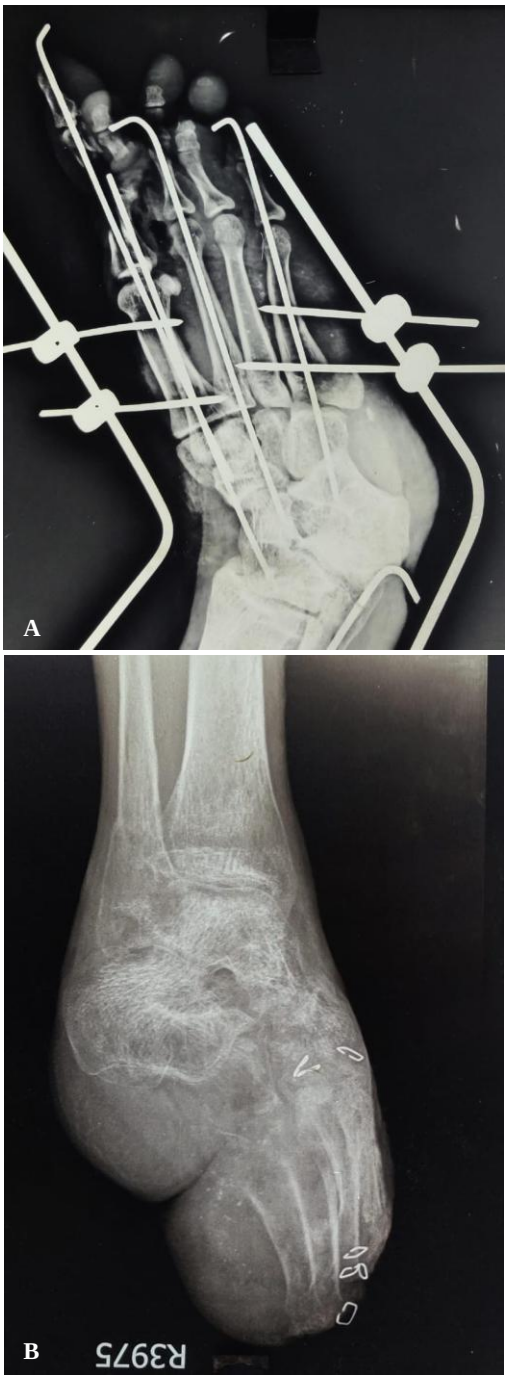

Figure 3 (A and B): Pre-op.

Pirogoff amputation was performed. Bloodless field was created by application of thigh tourniquet having a pressure of 250 mm of Mercury A skin incision was made distal to the talonavicular joint on the dorsal aspect of the foot and was continued in a fish-mouth shape to the plantar aspect at the level of the calcaneocuboid joint to form the skin flaps. The dorsal incision was deepened to dissect the superficial and deep peroneal nerves and the extensor digitorum and hallucis longus tendons. These nerves and tendons were cut sharply. The dorsalis pedis artery was ligated. From the plantar incision, the tibial nerve and the sural nerve were dissected as proximally as possible and cut sharply. The posterior tibial artery was ligated. The plantar fascia, flexors, and long plantar ligament then were incised.

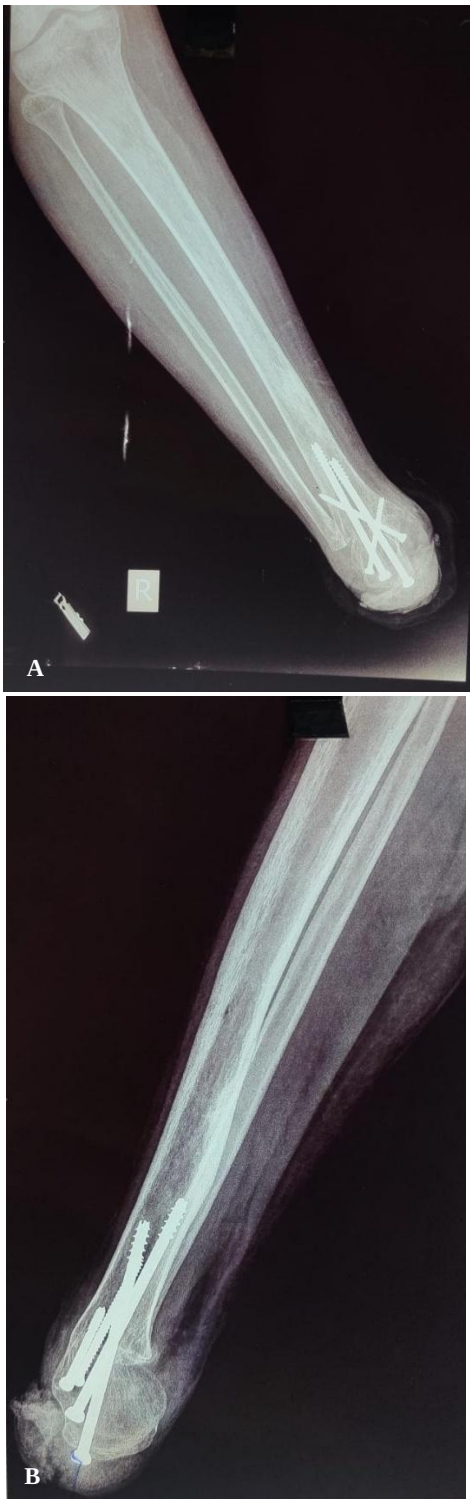

Figure 4 (A and B): Post op 6 months.

After disarticulation at the Chopart joint, the interosseous talocalcaneal ligament was incised deep in the sinus tarsi to remove the talus. A tibial osteotomy was performed just proximal to the subchondral bone until bleeding cancellous bone was visible, and the distal articular surface was removed. An oblique osteotomy including posterior facet of the calcaneus was created 2 cm proximal to the calcaneocuboid joint. Distal 1.5 cm of lateral malleolus and articular cartilage of medial malleolus was removed. The plantar skin flap is left attached to the calcaneus, opposing cancellous surfaces of the distal tibia and calcaneus were temporarily stabilised with two 1.6 mm cross k wires. Definitive stabilisation was done with four partially threaded cancellous screws a-two 6.5 mm and two four mm, across Tibi calcaneal interface. Skin was closed with interrupted sutures.

At three weeks, superficial wound necrosis of plantar skin flap was seen without deep infection or deep necrosis, which was treated with protective sterile dressings.

Over a period of six months the plantar skin flap becomes healthy. At twenty-four weeks after the procedure, osseous consolidation was noted radiographically (Figure 4). Eight months after the surgery, the patient was able to bear weight on the left lower extremity. She was fitted with a definitive prosthesis with a long silicon liner and was able to walk without pain or the aid of crutches.

The rating according to the 100-point Taniguchi scale was 75 points, which indicated a very good result.[5]

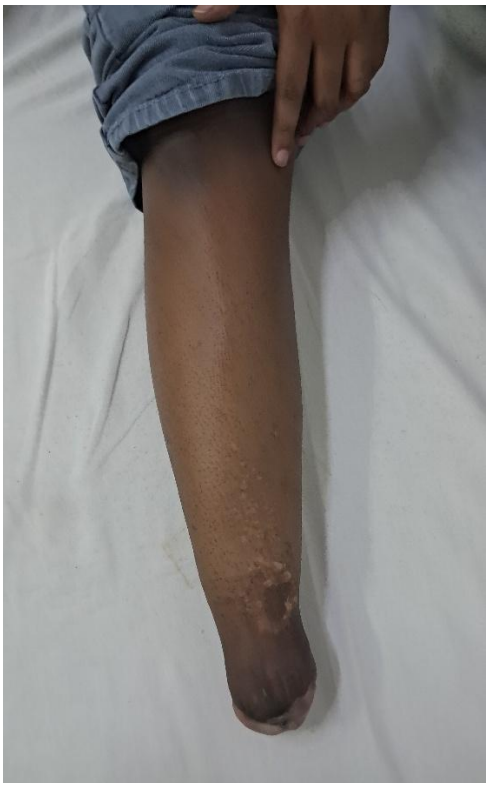

Figure 5: Amputation stump.

DISCUSSION

Although modified Pirogoff amputation has been reported to achieve favorable long-term functional outcomes with trauma and diabetic foot patients, there have been no reports of outcome of Pirogoff amputation involving forefoot and midfoot osteomyelitis.[4,8]

This patient had sequlae of compound Lisfranc's injury of the right foot, she was not able mobilise herself because of the midfoot and forefoot osteomyelitis with osteopenia, osteolysis and resistant ongoing infection. The skin cover on the dorsum of the foot was with a thin split thickness graft. She wanted to join her duties as a nurse and repeated attempts of control of the osteomyelitis had failed. She had consultations with two other Orthopaedic Consultants outside and had been advised to undergo Syme's and Below knee amputation.

We offered her Pirogoff amputation to help her achieve her goal of becoming a productive working individual after extensive discussion.

Lower limb amputations can be catagorised into distal (minor) and proximal (major). Distal amputations preserve the tibial weight-bearing stump, while proximal ones do not. The Pirogoff, modified Pirogoff, Boyd, Syme, Lisfranc, and Chopart are all considered distal or minor amputations. Trans-tibial (below the knee) and trans-femoral (above the knee) are examples of proximal or major amputations.[9]

Preserving the stump as distally as feasible results in significantly less energy consumed in walking than transtibial amputation, contributing to patient mobility and independence.[10-12]

Compared to Syme amputation Pirogoff amputation offers better results because of the following reasons:

Limb length discrepancy

As Syme's amputation is associated with significant limb length discrepancy (approximately 4-5 cm) which can make walking barefoot difficult. The Pirogoff amputation minimizes this discrepancy, with reported mean discrepancies around 2.5-2.8 cm (range 1-5 cm), making it easier for patients to walk without a prosthesis.[15-17]

Stump stability and weight-bearing

The tibio-calcaneal bony fusion in Pirogoff amputations provides added stability to the flap and creates a full weight-bearing stump.This stable stump and minimized discrepancy make it easier for patients to walk without a prosthesis.[15-17]

Heel pad issues

In Syme's amputation, the plantar fat pad is dissected from the calcaneus and has a high incidence of heel pad

instability and skin problems often due to devascularization of the heel pad Pirogoff aims to reduce these complications as heel pad of the calcaneum is not dissected.[15-17]

Prosthesis fitting

Preservation of the part of the medial and lateral malleolus in Pirogoff makes it easier for a prosthesis to be fitted, with less friction and with more rotational stability as both malleoli are in place.[8]

The other option advised was of below knee transtibial amputation, however compared to below knee amputation (Transtibial), Pirogoff amputation creates a weight-bearing stump, allowing patients to ambulate short distances without wearing their prostheses.[11] A transtibial amputation typically requires a prosthesis for ambulation. Preserving limb length with distal amputations like Pirogoff requires less energy for walking compared to transtibial amputation.[11] Even when a BKA stump might be considered a better option for ambulation, patients may choose limb salvage operations like Pirogoff to preserve remaining limb length and also to prevent major amputations.[18]

In comparison with other distal amputations like Boyd amputation:

Both Boyd and Pirogoff are designed to give better results than Syme. Both involve tibio-calcaneal bony fusion for stability and minimize devascularization of the flap.[5,6] Both preserve part of the malleoli, which can aid in prosthesis fitting.

A retrospective analysis of a large series of 123 patients of distal amputation by Andronic et al in 2019 found no significant statistical difference in survivorship or overall functional outcome between the modified Pirogoff and Boyd procedures.[18] The key difference is the treatment of the calcaneus. In Boyd's operation, the talus is resected and a transverse osteotomy of the calcaneus is performed; the calcaneus is not rotated. In Pirogoff, the calcaneus is cut at an angle and rotated (originally 90 degrees) to fuse with the tibia, thus Boyd results in more leg length loss than Pirogoff .and needs more plantar skin to close the wound. This is a disadvantage in cases of severe forefoot necrosis.[13,21]

The key factors influencing the successful outcome are heavily dependent upon vascular status, location of the infection and patient status. A crucial and essential requirement is the presence of a patent posterior tibial artery (PTA), assessed by palpable pulse, Doppler signal, or angiography.[20] An ankle-brachial index (ABI) typically > 0.7 is needed to support wound healing, although some sources suggest > 0.5 is adequate.[22]

Infections must be limited to the forefoot and not extend proximally beyond the midfoot level. Patient nutritional status (e.g., serum albumin >30 g/L or >2.5 g/dL) and adequate hemoglobin (> 10 g/dL) are important for wound healing.[13]

Andronic in his review of 123 cases of Pirogoff amputation reported a very good or good function could be achieved in 85 (69%) patients at an average follow-up of 45 months (range, 10-300 months).[18] The average time to ambulation with prosthesis was 12.7 weeks, and the mean time to bone fusion was 17.2 weeks. The mean survivorship (absence of more proximal amputation) was 77% (range 46-100%)

In one study, more than half of the patients of Pirogoff amputations underwent a transtibial or a transfemoral amputation. However, in this cohort, patency of the posterior tibial artery was present in only 60% of the patients preoperatively.[23]

Nather et al and Andronic et al have reported 100% survivorship of their respective series of 13 and 6 patients when patency of PTA was established.[14,18]

The index patient fulfilled the all above mentioned criteria.

Patients postoperative period was marked by superficial and partial thickness necrosis of the stump which was treated with only sterile dressings.

Eventually healthy skin coverage was achieved at six months and bony healing of the tibio calcaneal interface was observed at the same time.

At 8 months post-operatively, the patient was ambulating with a custom-made prosthesis, demonstrating good gait mechanics and minimal reliance on assistive devices. The patient reported high satisfaction with the functional outcome, highlighting their ability to return to work without any assisting devices.

CONCLUSION

The outcome observed in our patient supports the Pirogoff amputation as a viable option for selected cases of severe foot injury with forefoot and midfoot osteomyelitis in a young patient. The procedure provided a highly functional, end-weight-bearing stump, facilitating excellent prosthetic ambulation and a high level of patient satisfaction. The preserved limb length and proprioception contributed significantly to the patient's functional recovery. The judicious selection of the Pirogoff amputation, coupled with meticulous surgical technique and comprehensive rehabilitation, proved instrumental in achieving a favorable long-term outcome for this patient. This case adds to the body of evidence supporting the Pirogoff amputation as a valuable reconstructive option in challenging post traumatic severe forefoot injuries with osteomyelitis.

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