Pirogoff Amputation for a Bilateral Traumatic Lower-extremity Amputee: Indication and Technique

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Abstract: Although only a small portion of all lower-extremity amputations in the United States are of traumatic origin, almost half of all living amputees have sustained traumatic amputations. This particular epidemiology is explained by the younger age, and thus longer life expectancy, of traumatic amputees. In this group especially, restoration and lifelong maintenance of ambulation and mobility is essential. The authors present the case of a bilateral traumatic lower-leg amputee whose management included a Pirogoff amputation. Although this amputation technique is not widely used, the authors believe it greatly facilitated stump and soft tissue management in this case and allowed for improved mobility. The indication for and technique of Pirogoff amputation are described, and a brief overview of amputation techniques in the foot is provided. [Orthopedics. 2014; 37(6):397-401.]

Case Example

A 52-year-old homeless man was run over by a train, sustaining bilateral traumatic amputations. On arrival to the emergency department, a left-sided transfemoral amputation was seen as well as a right-sided traumatic Chopart amputation (Figure 1). Once the patient had been stabilized according to Advanced Trauma Life Support guidelines, he underwent bilateral wound debridement resulting in a left-sided surgical midthigh guillotine amputation and a right-sided open debrided Chopart amputation. Forty-eight hours later, the left stump was clean and amenable to closure with formal myodesis and split-thickness skin grafting of skin-deficient wound areas. On the right side, the Chopart level amputation had anterior soft tissue deficiencies exposing the talar head in the missing talonavicular joint and the calcaneus in the avulsed calcaneocuboidal joint (Figures 2-3). In addition, there was an epifascial full-thickness tissue defect extending from the mid-
calf region to above the knee, precluding possible use of a local pedicled flap for stump coverage and potentially complicating coverage in a below the knee amputation. The patient was referred to the Hand Microvascular Service for assessment of soft tissue coverage options for the right-sided stump and calf defects.

Because of the intact hindfoot on the right side, the decision was made to salvage the right leg for prosthetic-free ambulation using a modified Pirogoff amputation technique. This involved talar excision and formal tibial and calcaneal osteotomies as described below. The rotational apposition of the 2 resulting osteotomy surfaces placed the calcaneal tuber into a direct axial weight-bearing position and approximated the remaining soft tissues anterolaterally, outside the weight-bearing zone. The osteotomy was compressed using two 7.3-mm headless compression screws. This allowed for tension-free fascial closure and skin grafting of the soft tissue defect without the need for higher-level tissue transfer. The resulting tibiocalcaneal fusion and soft tissue defect healed uneventfully, and the patient was rehabilitated to full ambulation of the right leg wearing a custom shoe.

**Technique**

The patient was positioned supine on a radiolucent table with a bolster elevating the ipsilateral buttock. A sterile tourniquet was applied to the right thigh, allowing later skin graft harvest from this side. Under tourniquet control, the traumatic wound was sharply debrided using a modified fishmouth incision, similar to elective Pirogoff amputation for forefoot necrosis. The authors debrided the traumatic wound down to healthy wound edge margins, which were found to be well bleeding after tourniquet release. The exposed talus was removed using sharp excision and a pointed tenaculum for distal and planter traction of the talus (Figures 4A-B). Care was taken to protect the tibialis posterior neurovascular bundle, which nourishes and innervates the heel pad via the medial calcaneal vessels and inferior calcaneal nerves.

With the talus removed, subperiosteal dissection exposed the distal tibia and allowed an overview of the remaining ankle mortise. Two K-wires were drilled into the subchondral distal tibia, perpendicular to the long axis of the tibia, to define the proximal osteotomy plane (Figure 4C). Wire positioning was verified using fluoroscopy and intraoperative visual assessment. The tibial osteotomy was performed using a sagittal saw with Hohmann retractors protecting the soft tissues. The distal flaring of the tibia was preserved to facilitate later shoe fitting and retention. On the calcaneal side, 2 K-wires were advanced into the calcaneus just distal to the posterior articular facet and the sustentaculum tali (Figure 4D). The K-wire orientation was chosen to allow subsequent calcaneal dorsiflexion of approximately 60°, aligning the 2 planes for a tibiocalcaneal fusion. This position was temporarily held with tenaculums, followed by insertion of crossed, threaded guidewires placed with clini-
cal and radiographic verification. Two 7.3-mm cannulated, partially threaded screws were implanted and countersunk, compressing the osteotomy site (Figures 4E-F). Dorsiflexion of the tuber calcanei and the attached plantar skin approximated the wound edges and allowed direct wound closure, leaving only a small anterior epifascial defect that was covered with a split-thickness skin graft (Figure 5).

DISCUSSION

The Pirogoff amputation was initially described by Pirogoff in 1854 as an amputation technique that preserves a sensate and weight-bearing stump that can be easily fitted with a custom shoe without the need for prosthetics.5 Despite possible advantages in terms of ambulation with minimal to no leg length discrepancy and early functional rehabilitation, the Pirogoff amputation has not been widely used. Only recently have some articles discussed the technique for traumatic and vasculopathic amputees.3,6,7 The current case is, to the authors’ knowledge, the first description of the Pirogoff technique for a bilateral traumatic amputee.

Traumatic amputations as well as mangled lower-extremity trauma can necessitate a formal completion amputation at a more proximal functional level. Common amputation levels for foot trauma include the Lisfranc amputation, which disarticulates the foot at the tarsometatarsal level. Here, the bases of the 2nd and 5th metatarsals should be preserved to maintain the plantar transverse arch and the insertion of the peroneus brevis tendon.1 Proximal to this level is the Chopart amputation, which runs through the talonavicular and calcaneocuboid joints. This amputation pattern resembles the traumatic avulsion amputation seen in the current case. The Chopart...
Amputation can destabilize the musculotendinous balance of dorsal and plantar flexors and can result in plantar flexion deformity. The Syme amputation disarticulates the ankle joint and places the intact heel pad underneath the tibia. This amputation level can be seen as comparable in length and weight-bearing status to the Pirogoff amputation, but it lacks the required osteotomies for the latter technique. The Syme amputation has been described as having the least energy expenditure requirements among the lower-extremity amputations.8

Similar to the Syme amputation, the Pirogoff amputation requires an intact heel pad as well as an uninjured tibialis posterior neurovascular bundle. Several reports have described good to excellent outcomes in more than half of all amputees.6,9-11 Described complications included infections and stump necrosis, which are more common in vasculopathic patients. Although not relevant in the current case of a bilateral amputee, leg length discrepancies have been described because the Pirogoff technique does not allow for the prosthetic length compensation of other lower leg amputation techniques. This appears to be a minor problem: In a literature review of 65 patients with a Pirogoff amputation, only 1 had a discrepancy of more than 3 cm.6

Few modifications to the original technique have been described. However, the osteotomy angle, which had originally been described as 90°, is now recommended to be less than 70° to better center the heel pad in the weight-bearing axis.3 Wound healing problems were seen using cast fixation as described by Pirogoff. Newer techniques employ external fixators, including Ilizarov frames, as well as internal fixation methods, as demonstrated in the current case.6,12

Using the Pirogoff amputation, the authors were able to address several problems presented by this case. The soft tissue defect of the traumatic Chopart level injury was covered using direct closure and skin grafting only. A higher-level amputation such as a below the knee amputation with higher energy expenditure demands was not necessary. Conversion to a below the knee level amputation could have posed additional problems with early prosthetic fitting in this homeless patient and would have potentially complicated stump closure due to the proximal degloving calf injury of this patient. In this case, a primary tibiocalcaneal fusion and soft tissues healed uneventfully (Figures 6-7).

**Conclusion**

This case example and brief literature review has demonstrated the potential benefits of using the Pirogoff technique for traumatic amputations of the foot. To the authors’ knowledge, this is the first description of the Pirogoff amputation for a bilateral traumatic amputee. In this case, the Pirogoff amputation allowed for direct soft tissue closure of the traumatic midfoot amputation at a highly functional level.

**References**

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