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Case Report

Bone and soft tissue reconstruction with tendon balance in severe foot trauma

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ABSTRACT

In severe foot trauma, it is difficult to determine the level of amputation when the crush injury is severe. We report a case of amputation near Lisfranc that achieved forefoot amputation-like results by using bone and soft tissue reconstruction while considering tendon balance. The patient was a 40-year-old male. The patient's left leg was caught in a garbage truck and sustained a crush injury. The second to fifth metatarsals were amputated at the diaphysis, and a high degree of instability of the Lisfranc joint was observed. A high degree of contamination was detected in the patient's wound, and the second to fifth toes were amputated at the Lisfranc joint during the initial treatment. The ends of the tibialis anterior, tibialis posterior and peroneus longus were preserved. On day 5 in the hospital, Lisfranc joint fixation of the hallux, amputation of the first metatarsal and reconstruction of the peroneus brevis were performed. On day 13, extensor hallucis longus tendon transfer and free anterolateral thigh flap were performed. On day 80, the patient was able to walk in regular shoes or non-orthopedic shoes. One year after reconstructive surgery, the patient had an average SAFE-Q score of 86.2 and mild varus deformity of the foot remained. In cases of severe foot trauma, the aim of reconstruction should be partial forefoot amputation whenever possible.

Introduction

In severe foot trauma, amputation is the treatment of choice when the crush injury is severe and the foot is difficult to salvage, however, determining the level of amputation is also challenging [1,2,3]. The outcomes of lisfranc and copart amputations are poor, whereas the outcomes of forefoot amputations are good. The reason for this is because in the latter, the longitudinal and transverse arches are preserved and the tendon attachments involved in ankle internal/external rotation and low dorsiflexion remain [3,5]. The more proximal Syme and Pirogof amputations do not result in an isolated equinovarus deformity, but leg length is shortened and there is no ankle mobility. This also includes the problem that orthotics are required and the patient will have difficulty walking barefoot.

We report one case of traumatic foot amputation in which we performed peroneus brevis tendon reconstruction and extensor hallucis longus tendon transfer to prevent isolated equinovarus deformity.

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Case

The patient was a 40-year-old male. The patient was injured during work when his left foot became caught in the rotating disk of a garbage truck. The patient's second to fifth toes were amputated at the metatarsal diaphysis and connected only by the extensor digitorum longus. A high degree of instability of the lisfranc joints was observed in the first to fifth toes. There were no bone injuries in the hindfoot. The patient was highly contaminated, dorsal foot skin and subcutaneous soft tissue were missing due to degloving injury, but blood flow and sensation in the heel pad and plantar of the hallux were preserved (Fig. 1). The peroneus brevis tendon was damaged and ruptured, but the ends of the peroneus longus and tibialis anterior tendons remained. We performed an emergency debridement on the same day which preserved the hallux, but the second to fifth toes were disarticulated at the Lisfranc joint (Fig. 2). We used negative pressure wound therapy for skin and soft tissue defects. On day 3 in the hospital, a second look was performed and there were no signs of infection and the wound was relatively good. On day 5, the hallux was amputated at the level of the first metatarsal diaphysis and the Lisfranc joint was fixed. The peroneus brevis tendon was reconstructed with the resected extensor hallucis longus tendon and fixed to the cuboid bone (Fig. 3). On day 13, the remaining extensor hallucis longus tendon was transferred to the lateral cuneiform bone and the dissected end was covered with a 16.0 × 6.0 cm free anterolateral thigh flap (Fig. 4). The recipient vessels were the anterior tibial artery and its companion vein. On day 40, full-thickness skin grafting and full weight-bearing gait training began after the wound had healed. On day 60, the patient was discharged from the hospital on crutches and was able to walk with regular shoes on day 80. Six months after surgery, the patient underwent a debulking surgery of flap. The mean SAFE-Q scores at 3, 6, and 12 months post-injury were 68.7, 82.9, and 86.2 respectively. 12 months after the injury, the ankle joint range of motion was 15/15 dorsiflexion, 60/35 plantar flexion, 0/0 internal rotation and 20/20 external rotation on the healthy/affected side, which was relatively good, but there was mild internal rotation in the standing position (Fig. 5).

Discussion

This case demonstrates two points. Foot amputations that take into account tendon balance can prevent isolated equinovarus deformity and have good outcomes in trauma cases. Unlike more proximal amputations, there is no difference in leg length, so walking barefoot is easier and walking with regular shoes is more stable.

In the case of a standard lisfranc amputation, tendons involved in dorsiflexion and external rotation, such as the tibialis anterior and peroneus longus/peroneus brevis tendons, are severed, and cannot counteract the movement of the achilles tendon, resulting in isolated equinovarus deformity. To prevent isolated equinovarus deformity, Christopher et al. reported that good results were obtained by transferring the tibialis anterior, peroneus longus, peroneus brevis, and extensor digitorum longus tendons of lisfranc amputations of diabetic foot [6].

In the case we present, the tibialis anterior and peroneus longus were preserved, and the extensor hallucis longus and peroneus brevis were reconstructed, but the final result was mild internal rotation. Had the lisfranc joint of the fifth toe been preserved during the initial treatment, reconstruction of the peroneus brevis tendon would not have been necessary and the internal rotation may have been prevented. Also, in the case we present, we found skin and soft tissue defects on the dorsum of foot, and soft tissue reconstruction by free flap surgery was essential. Salvage with free flap for a mangled foot is controversial, but if leg length cannot be preserved, the patient's walking ability is reduced and orthotics become necessary [1,2,4,7]. In addition, there are reports that the failure to preserve leg length can lead to impaired body image, depression and reduced quality of life [4]. In the case we present, the patient was able to walk barefoot without orthotics and with regular or non-orthopedic shoes. The SAFE-Q scores at 12 months after the operation was good, suggesting that preservation of leg length was the appropriate treatment.

Conclusion

In a case of severe foot trauma near the lisfranc joint, in which the level of the amputation was uncertain, we performed tendon reconstruction/transfer and bone and soft tissue reconstruction while taking into account tendon balance, and we were able to achieve a good outcome with a forefoot amputation-like case.

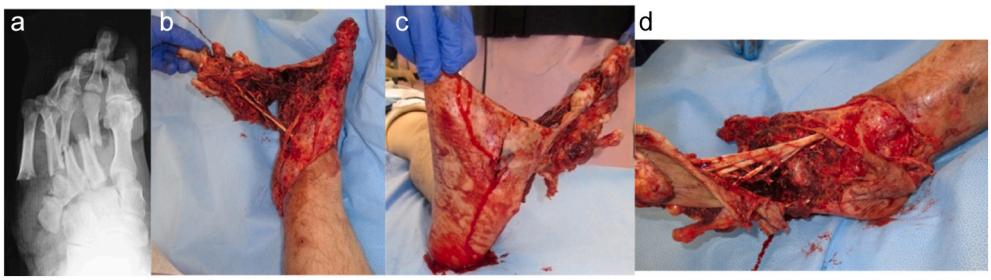

Fig. 1. a: A-P X-ray of the foot. b/c/d: initial appearance of the foot in the operating room.

Fig. 2. a/b: appearance of dorsal and plantar surfaces of the foot.

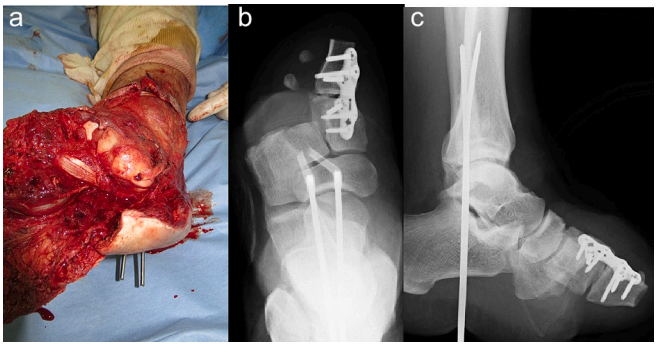

Fig. 3. a: appearance after peroneus brevis tendon reconstruction (peroneous brevis tendon to the cuboid bone). b: A-P X-ray of the foot after fixation of Lisfaranc joint. c: lateal X-ray of the ankle.

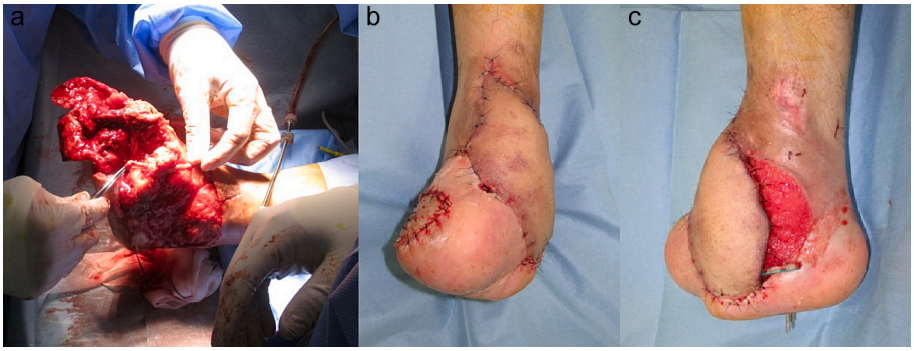

Fig. 4. a: appearance after extensor hallucis longus tendon to lateral cuneiform. b/c: appearance after free anterolateral thigh flap.

CRediT authorship contribution statement

Tatsuhiko Muraoka: Writing – original draft, Writing – review & editing. **Kentaro Futamura:** Writing – review & editing. **Masahiro Nishida:** Writing – review & editing. **Ryo Sato:** Writing – review & editing. **Takashi Ogawa:** Writing – review & editing. **Masayuki Hasegawa:** Writing – review & editing. **Kanako Tsuihiji:** Writing – review & editing. **Yoshihiko Tsuchida:** Supervision.

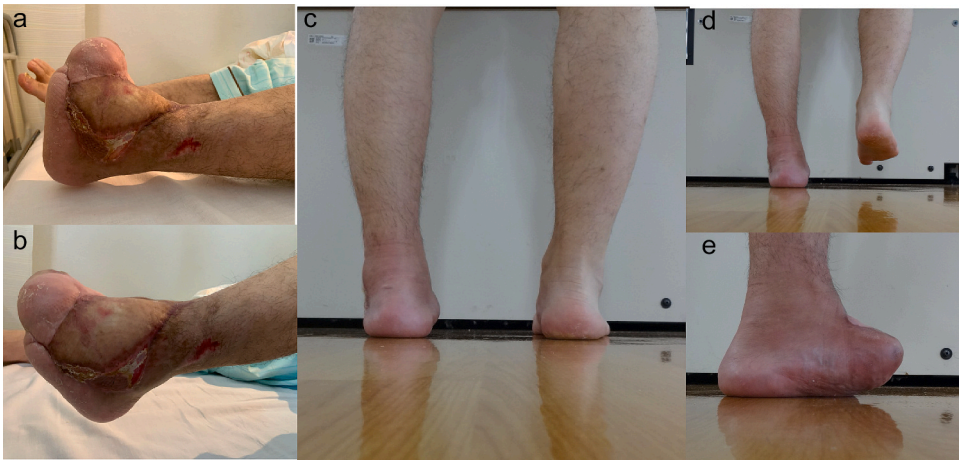

Fig. 5. a: dorsi flexion, b: planter flection, c: load potision, d: Standing on one leg on the affected limb, e: Grounding at load position.

Declaration of competing interest

The authors declare that they have no conflict of interest.

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