

Reconstruction of the First Metatarsophalangeal Joint by Vascular Anastomotic Transplantation of Fibula Small Head: A Case Report

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Abstract

Foot injury with soft tissue and bone defects is very common, and it is very difficult to reconstruct the irreparable first metatarsophalangeal joint in clinical work. In this paper, partial fibular head free transplantation was used to reconstruct the articular surface defect of the first metatarsal head and restore the first metatarsophalangeal joint in a clinic case. After 18 months of follow-up, the patient achieved satisfactory first metatarsophalangeal joint function.

Keywords: The first metatarsal head; Partial fibular head free transplantation; Metatarsophalangeal joint

Introduction

The first metatarsophalangeal joint plays an important role in maintaining the normal function of the foot [1,2]. How to deal with the trauma of the first metatarsophalangeal joint is very challenging for the majority of primary hospitals, and improper handling will leave patients with obvious foot dysfunction [3,4]. At present, metatarsophalangeal joint replacement may be considered as the first option in some developed countries to reconstruct the first metatarsophalangeal joint [5,6], especially for elderly people. However, materials for metatarsophalangeal joint reconstruction are not always available in most areas of China; metatarsophalangeal joint arthroplasty is not the first choice for young patients with high mobility requirements [7]. Therefore, it is necessary to explore a clinical technique for repairing the first metatarsophalangeal joint without special materials. This paper reports a case of reconstruction of the articular surface defect of the first metatarsal head with partial free fibula microcephaly grafting.

Case Presentation

A 23-year-old male patient, crushed by a heavy block on the right foot for 3 hours, was admitted to the hospital on November 29, 2009. He was a worker on a construction site, without any underlying health problem. Physical examination showed: obvious swelling of the right foot, 5.0 cm×3.5 cm of the longitudinal wound on the tibial side of the first metatarsophalangeal joint, exposed fracture end inside the wound margin with peripheral margin contusion, no active bleeding, and no obvious pollutants. The bone rub sensation and abnormal activity were checked for the 1-4 metatarsal bone, the fifth metatarsophalangeal joint was dislocated and elastic fixed, the toe flexion and extension were limited, and the peripheral blood and sensation were normal. X-ray of the right foot showed: distal comminuted fracture of the first metatarsal of the right foot, first metatarsal head defect, overlapping displacement fractures of the right 2-4 metatarsal; dorsal dislocation of the right fifth metatarsophalangeal joint (**Figure 1**).



Figure 1: Anteroposterior and oblique X-ray of the patient's right foot in the emergency room.

According to the injury history, physical examination and radiological examination of this patient, the admission diagnosis included: 1, open comminuted fracture of the first distal metatarsal of the right foot with bone defect; 2, fractures of 2,3,4 right middle metatarsal; 3. Dorsal dislocation of the fifth right metatarsophalangeal joint. After completing the relevant preoperative examination, the emergency surgery under epidural anesthesia was performed, which included: " debridement of the first distal comminuted fracture, internal fixation of the k-wire needle for the first metatarsophalangeal joint, open reduction plate internal fixation of the comminuted fracture of the 2-4 middle metatarsal, and closed reduction of the right 5th metatarsophalangeal joint dislocation." The postoperative X-ray showed excellent reduction and fixation of the right 2-4 metatarsal fracture ends and the fifth metatarsal joint, and the distal right first metatarsal end and the first metatarsal head defect (**Figure 2**).



Figure 2: Anteroposterior and oblique X-ray of the patient's right foot after the emergency surgery.

Postoperative treatment included pain relief therapy, postoperative antibiotics, and elevation of the affected limb. One week after the operation, the right foot swelling subsided and a second-stage surgery under epidural anesthesia was conducted for the purpose of reconstruction of the first metatarsal head reconstruction of the right foot. The patient was placed on the operating room table in the supine position after satisfactory induction of anesthesia. A tourniquet is applied to the upper thigh of the operative extremity, and that extremity is prepped and draped in a sterile fashion. The right small head of the fibula is centered through a lateral arc incision of about 10.0 cm. Cut through the skin and the subcutaneous tissue, the common peroneal nerve was exposed on the medial margin of the biceps tendon and protected under direct vision during the surgery. Then cut off the small fibula of the biceps tendon, flip over to the proximal end, pull the lateral head and plantarsal muscles to the inside to expose the inferior lateral knee artery and the accompanying action veins. The length of the retained vascular pedicle is about 2.5 cm proximally. And we cut the small head of the fibula with a narrow bone knife at the distal end of the small fibular head according to the required length of the bone graft and the area of the articular surface defect (**Figure 3**). The biceps tendon was reattached to the remnant of the fibula and repaired to the periosteum. After reducing the transplanted fibula small head with the distal end of the first metatarsal and the proximal hallux toe, it was cross fixed with a K-wire needle. Vascular anastomosis was performed under the microscope: the first metatarsal artery to the inferior lateral knee artery; the dorsal foot vein to the inferior lateral knee vein.

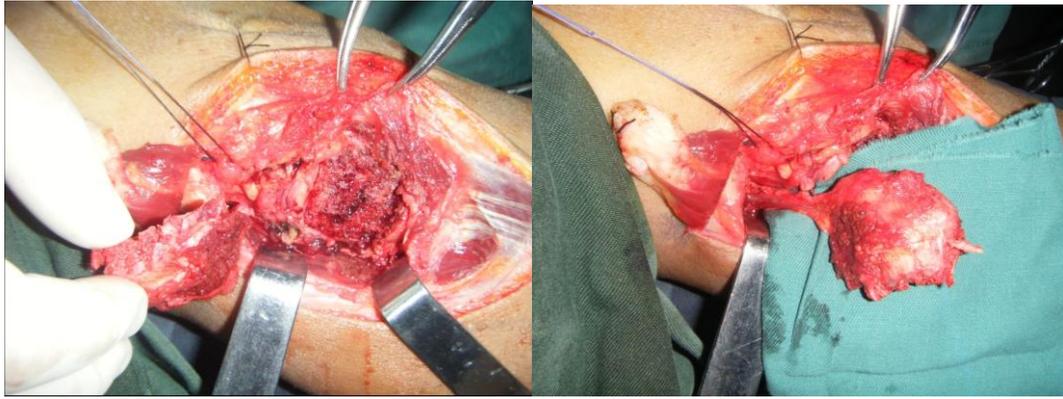


Figure 3: Intraoperatively exposed and excised part of the fibula's small head.

After operation, the papaverine was used to dilate blood vessels and low molecular weight heparin was used to prevent thrombosis, and the right lower limb was fixed with gypsum in the functional position. The k-wire needle at the 5th metatarsophalangeal joint was removed three weeks after surgery, and the k-wire needles at the first metatarsophalangeal joint were removed 6 weeks after surgery. After that the patient was allowed to walk with weight bearing, and X-Ray showed that the right first metatarsophalangeal joint space is well restored, and the reconstructed metatarsal head is in good shape, without bone resorption (**Figure 4**); and the 2,3 and 4 metatarsal plates were removed 8 months after surgery. After 18-month follow-up, the right lower limb was normal and the flexion and extension activity of the first-5 metatarsophaleal joints of the right foot was good (**Figure 5**).



Figure 4: Anteroposterior and oblique X-ray of the patient's right foot 8 months after the surgery.



Figure 5: The pictures of the patient's feet 18 months after surgery.

Discussion

Multiple metatarsal fractures caused by foot rolling injury, composite tissue defect and foot damage are common clinically, with the first metatarsal head defect in some case [8,9]. The maintenance of the foot arch shape and its normal function requires normal structure of the ligaments, muscles, especially the integrity of the foot bone [10]. Medial longitudinal arch forearm support point, the first metatarsal head is particularly important in ensuring the stability of the plantar support, weight walking, and bounce [12]. Due to the loss of bone mass, it is difficult to fuse the first metatarsophalangeal joint and arthrodesis also affects foot activity. Artificial metatarsophalangeal joint replacement is suitable for elderly patients, and it is not suitable for those with high requirements for weight-bearing walking function [13]. There is a risk of postoperative prosthesis loosening and prosthesis fracture [14,15].

During the treatment of this patient, we have accumulated some experience: 1, the fibula head of the superior tibiofibular joint is similar to the first metatarsal head shape, anastomotic vessels containing joint part of the fibular head transplantation is suitable for the reconstruction of the first metatarsal head. 2. When the small head of the fibula is cut surgically, the total peroneal nerve should be exposed and protected under the direct vision to avoid injury. 3. When exposing the inferior lateral artery of the knee and the accompanying vein to the proximal end, the length of the vascular pedicle should be calculated according to the affected area, which is beneficial to anastomosis with the blood vessels in the affected area. 4. When cutting the fibula head, osteotomy should be performed to harvest enough fibula joint surfaces and matching the base joint surface of the near hallux in the

receiving area. 5. After the cutting of the fibula, the biceps tendon was reattached to the supply area of the fibula, overlapping the periosteal and the surrounding fascia, and strengthening the suture to repair the stability of the knee. Start flexion and extension exercise after four weeks of plaster fixation in valgus position, and the weight bearing was gradually protected after six weeks. 6. After the small head of the free fibula is moved to the receiving area and matched with the articular surface of the distal hallux and the first metatarsal, the distal first metatarsal and the distal hallux were interfixed with the Kirschner wire needle, and the second proximal toe was fixed with the transverse Kirschner wire needle. After six weeks after surgery, the internal fixation Kirschner wire needle was removed, and starts the passive flexion and extension exercise of the first metatarsal and phalangeal joint, which was conducive to the small head joint surface of the fibula and the base joint surface of the proximal phalanges.

Conclusion

Partial fibular head free transplantation is suitable to reconstruct the articular surface defect of the first metatarsal head and could restore the first metatarsophalangeal joint in clinic practice. This procedure may provide an option for the clinical treatment of first metatarsal head defects, rather than a replacement for other treatment options such as joint replacement or joint fusion.

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