Case Reports and Series

Reconstruction of the first metatarsophalangeal joint by vascular anastomotic transplantation of fibular 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 metatarsal head 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 clinical case. After 18 months of follow-up, the patient achieved satisfactory first metatarsophalangeal joint function.

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 fibular head grafting.

Case presentation

A 23-year-old male patient was crushed by a heavy block on the right foot for 3 h. Physical examination showed: obvious swelling of the right foot, 5.0 × 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 abnormal activity was observed for the 1–4 metatarsal bones, the fifth metatarsophalangeal joint was dislocated, the toe flexion and extension were limited, and the peripheral vascular 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 metatarsals; dorsal dislocation of the right fifth metatarsophalangeal joint (Fig. 1).

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 fractures and the fifth metatarsal joint, and remaining bone defect of first metatarsal head (Fig. 2).

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. The right fibular head is centered...
through a lateral arc incision of about 10.0 cm, the common peroneal nerve was exposed on the medial margin of the biceps tendon and protected under direct vision during the surgery. The length of the retained inferior lateral knee artery and the accompanying veins pedicle is about 2.5 cm proximally. And we cut off the fibular head with a narrow bone knife at the distal end of the fibular head according to shape of the bone defect of first metatarsal head (Fig. 3). The biceps tendon was reattached to the remnant of the fibula and repaired to the periosteum. After resetting the transplanted fibular head to the bone defect area of the first metatarsal, it was cross-fixed with K-wire needles. Vascular anastomosis was performed under the microscope: the first metatarsal artery to the reserved artery of the graft; the dorsal foot vein to the concomitant vein.

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 first metatarsal 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 experiences: First, the fibular head of the superior tibiofibular joint is similar to the first metatarsal head shape, anastomotic vessels of the fibular head transplantation is suitable for the reconstruction of the first metatarsal head. Second, when the fibular head is cut surgically, the common peroneal nerve should be exposed and protected under the direct vision to avoid injury. Third, 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. Forth, osteotomy of the fibular head should be performed to harvest enough fibula joint surface and to match with the base joint surface of the near hallux in the receiving area. Fifth, after the cutting of the fibula, the biceps tendon should be reattached to the supply area of the fibula, overlapping the perios-teal and the surrounding fascia to repair the stability of the knee. After four weeks of plaster fixation in valgus position, flexion and extension exercise of knee was conducted, and the protected weight bearing was allowed after six weeks. Last, the reconstructed first metatarsophalangeal join and the second proximal toe was interfixed with crossed Kirschner wire needles. Six weeks after surgery, the internal fixation Kirschner wire needles were removed, and passive flexion and extension exercise of the first metatarsal and phalangeal joint was performed, which was conducive for rematch between the joint surface of the fibular head 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.

IRB approval

The study has acquired a copy of the letter granting approval from the institutional review board. All the authors agree to provide for the protection of the rights and welfare of the participants that participate in this research, and also agree to submit any significant changes in the procedures of your project to the IRB for prior approval.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed Patient Consent

Complete informed consent was obtained from the patient for the publication of this study and accompanying images.

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References


