

Case Report

Bone transport combined with locking plate and bone grafting for treatment of nonunion of the ulna: a case report

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Abstract: Study design: Nonunion complicating ulna fracture surgery in one patient. **OBJECTIVE:** To treat nonunion of the ulna using bone transport combined with locking plate and bone grafting. **Methods:** A 54-year-old male patient developing nonunion of the ulna 3 years after left ulna fracture surgery was included in this study. Bone transport combined with locking plate and bone grafting was applied to treat the patient, with the purpose of achieving the goal of bone healing at the site where nonunion occurred. **Results:** Postoperative imaging data of the patient suggested bone healing at the site where nonunion and bone transport (by osteotomy) occurred. The patient had no special chief complaints and his forearm rotation functions were normal. **Conclusion:** Bone transport combined with locking plate and bone grafting can provide a new option for treatment of nonunion of the ulna.

Keywords: Nonunion, bone transport, ulna fracture, locking plate

Introduction

Nonunion is a common late complication in patients with fractures and its incidence is about 5%-10% [1]. By far, there are few guidance literatures on treatment of nonunion following surgery of forearm fractures worldwide, especially literatures related to the treatment of nonunion following surgery of ulna fractures [2-4]. Nonunion commonly results from the following several causes: 1. The loss of a great deal of bone and soft tissue in the injured parts; 2. Gunshot wounds; 3. After primary or secondary tumor resection; 4. Bone defects caused by osteomyelitis; 5. Failure of the first time of fracture fixation [5].

Bone transport technology has been widely used in the treatment of patients with lower limb bone defects, and can achieve favorable outcomes, which is an effective means for treatment of large bone defects [6], but rarely reported for treatment of patients with ulna nonunion. We aimed at probing into the therapeutic effects of applying bone transport tech-

nology to treatment nonunion of the ulna through introduction of this case after applying bone transport combined with locking plate and bone grafting to treat one patient with nonunion following ulna fracture surgery.

Case report

A male patient aged 54 years old, admitted to the hospital due to three months of left forearm pain 3 years after left ulna fracture surgery. The patient had left forearm pain with limited mobility due to a fall 3 years ago and was diagnosed as left ulna fracture. He developed postoperative accompanying infection after receiving "open reduction and internal fixation as well as bone grafting for left ulna fracture" at a local hospital and received reoperation to remove the plate; after regular changes of dressing and external fixation (**Figure 1**) following healing of infection, the fracture did not heal 5 months later; then the external fixation apparatus was removed and the patient was injected with bone marrow fluid and plaster fixation, but there was still no fracture healing. The patient



Figure 1. A. After external fixation; B. Three months after external fixation; C. Five months after external fixation.



Figure 2. Anteroposterior and lateral images of the left radius and ulna prompted: discontinuity of cortical bone in the middle left ulna, with visible low-density translucent fracture line shadow and increased adjacent bone density.

felt left forearm ache and the anteroposterior and lateral film of his left radius and ulna (**Figure 2**) prompted: discontinuity of cortical bone in the middle left ulna, with visible low-density translucent fracture line shadow and increased adjacent bone density. The patient was admitted to the hospital due to nonunion of the left ulna.

Physical examination

There was a scar about 7 cm in length in the dorsal distal left forearm, 90° pronation and 80° supination of the forearm and finger mobility feasible and radial artery touchable.

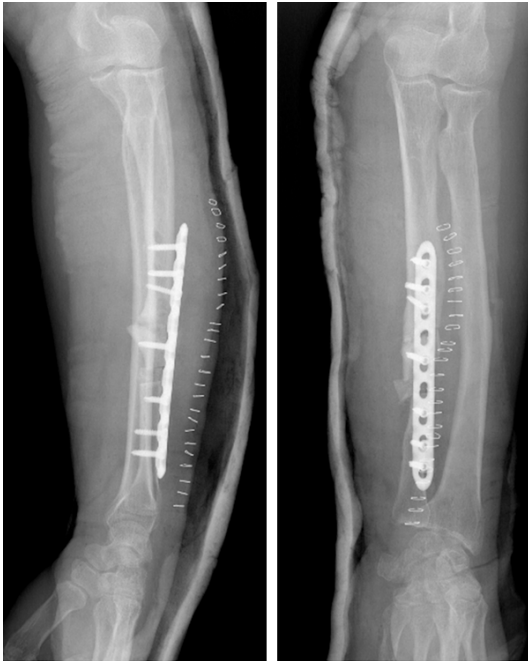


Figure 3. The anteroposterior and lateral images of the left radius and ulna prompted: contraposition and alignment of the broken end were basically neat after surgery of left ulnar nonunion.



Figure 4. Anteroposterior and lateral images of the left radius and ulna at postoperative 1.5 months.

Surgical treatment

After the success of brachial plexus anesthesia, left iliac bone was removed in preparation for bone grafting and a longitudinal incision about 15 cm in length was made on the dorsal



Figure 5. Anteroposterior and lateral images of the left radius and ulna at postoperative 3 months.



Figure 6. Anteroposterior and lateral images of the left radius and ulna at postoperative 6 months.

left forearm to fully expose the ulna and measure ulna length. A swing saw was used to remove hyperplastic bone at nonunion until normal bone with blood supply. The bone defect was about 2.5 cm. Bone cortex was cut off obliquely at 3 cm to the distal end of the defect and distracted slowly to the proximal end of the defect along the bone axis to link the defect ends of bone. The distal bone segment was implanted into the ilium through the transport gap and was given the locking compression bone fracture plate (Synthes, 9 holes) for locking compression to maintain the ulna length. The patient continued to receive plaster exter-



Figure 7. Anteroposterior and lateral images of the left radius and ulna at postoperative 8 months.

nal fixation in the left forearm after surgery and the anteroposterior and lateral film of his left radius and ulna (**Figure 3**) prompted: contraposition and alignment of the broken end were basically neat after surgery of left ulnar nonunion.

Postoperative follow-up

At postoperative 1.5 months (**Figure 4**), 3 months (**Figure 5**), 6 months (**Figure 6**) and 8 months (**Figure 7**), internal fixation was observed on the throne on the X-ray film, with bone healing at the site where ulna nonunion and bone transport (by osteotomy) occurred. The VAS pain score obtained during the last time of postoperative follow-up was 1 point, with normal function of forearm rotation and no pain or other chief complaints.

Discussion

The forearm bone shaft fracture is often considered as an intra-articular fracture [7] due to the special anatomical relationship between

the radius and ulna, so its requirement for anatomical reduction is higher than any other bone shaft fractures, to restore bone stability of and the function of forearm rotation [8]. With the development of orthopedic surgery and improvement in internal fixation appliances, the cure rate of forearm fractures is significantly elevated, but nonunion after forearm fracture surgery remains one of the challenging problems facing orthopedic surgeons. Restoration of blood supply in the fracture end and increasing osteoplastic vitality in the fracture end are crucial to the treatment of fracture nonunion.

The patient receiving plate internal fixation for treatment of the ulnar fracture for the first time developed postoperative infection and after 3 months of treatment by external fixation following removal of the internal fixation apparatus, the fracture line was insignificantly absorbed and hardening bone emerged in the fracture end with bone nonunion. Since the patient had a history of surgical fixation twice and previously received bone grafting and bone marrow

fluid injection, it was considered that the effects of routine surgery to remove hardening bone tissue to normal bone with blood supply combined by autologous iliac grafting and locking plate might be unsatisfactory. Bone transport, the most important part of the Ilizarov technique, is mainly used in treatment of lower limb defects, but rarely reported in upper limb defects. Therefore, bone transport in the Ilizarov technique was applied to treat the bone defect about 2.5 cm in length forming after removal of hardening bone tissue to normal bone with bloody supply. Osteotomy was performed at proper length in the distal end of nonunion and then skew ring osteotomy was applied instead of Ilizarov ring osteotomy, during which adjacent and bone marrow blood supply was protected. After elimination of bone defects by bone transport, bone grafting was conducted at the site of osteotomy, in combination with locking compression plate to fix the ulna and maintain ulnar length. In this case, altering the direction of osteotomy during bone transport, increasing the area of fresh cancellous bone at the end of osteotomy and implanting autologous ilium can be conducive to bone healing at the end of osteotomy. Meanwhile, normal bone at the two ends of original nonunion was connected to increase the possibility of healing. Postoperative follow-up also confirmed full healing at ulna nonunion and healing at the site of bone transport (osteotomy). The case report provides some reference to studies on treatment of ulna nonunion, confirming that bone transport of ulna nonunion can also obtain satisfactory results.

Disclosure of conflict of interest

None.

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