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A comparison of minimally invasive approach *vs* conventional approach for volar plating of distal radial fractures

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ABSTRACT

Background: The aim of this study was to introduce and to evaluate the functional results of volar plating of distal radial fractures through a longitudinal minimally invasive approach.
Methods: From January 2010 to January 2013, 157 patients with distal radial fractures were randomly allocated to group A (n = 83; 49 men, 34 women; mean age: 42 (18–67)) and B (n = 74; 46 men, 28 women; mean age: 41 (22–65)), including type A2, A3, B3, C1, and C2 fractures, based on AO Foundation and Orthopaedic Trauma Association Classification. Patients in group A were treated through a 1.5- to 2-cm longitudinal incision, and patients in group B were treated through the conventional flexor carpi radialis approach. All fractures were treated with a locking volar plate. The functional results were compared with range of motion, grip and pronation strengths for each fracture type.
Results: After a follow-up of 2 years, similar measurements were noted on range of motion and grip strength in both groups. Regarding pronation strength, group A was superior to group B ($p < 0.05$).
Conclusions: Minimally invasive volar plating of distal radial fractures is a safe and reliable technique, resulting in better pronation function and appearance.
Level of Evidence: Level I, Therapeutic study

Introduction

Distal radius is the most common fracture site in upper limb.[1,2] The fractures account for approximately 1/6 of all fractures.[3] Unstable distal radius fractures are often treated surgically using a T-shaped locking plate via a 6–8 cm volar approach.[3] Recently, minimal approaches have been advocated.

A minimally invasive technique is that it is a less intrusive or destructive surgery.[4] Chmielnicki et al[5] treated the distal radius fractures by volar plating via a transverse 2–3 cm incision, with sparing the pronator quadratus (PQ). Postoperatively, the patients experienced minimal scar pain and rapid recovery of grip strength. The rotational motion was almost undisturbed. However, the transversal incisions carry a risk of iatrogenic injury to the palmar cutaneous branch of the median nerve. In addition, when difficulties arise, lengthening the incision is difficult. In order to avoid the disadvantages, we developed a small longitudinal approach.

The objective of this report is to introduce minimally invasive volar plating of distal radial fractures with preserving the PQ. We also conducted a comparison between the technique and the conventional technique.

Materials and methods

The study was approved by the Institutional Review Board of the hospital involved. Informed consent was obtained from each patient.

From January 2010 to January 2013, 304 consecutive patients with distal radial fractures were collected from our hospital (Fig. 1A and B). Eligibility criteria for the study were as follows: age ≧18 or <70 years old; a closed distal radial fracture; AO/OTA (AO

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Foundation and Orthopaedic Trauma Association) Classification type A2, A3, B3, C1, and C2 fractures; and the need for volar plating. B1 fractures were excluded because the fracture may be treated with pins; B2 fractures were excluded because a dorsal approach is more appropriate; C3 fractures were excluded because the fractures are too complex to be treated through a small approach. Patients were also excluded if they had one of the following: decline to participate; open fractures; the use of a dorsal approach; fixation with K-wires or screws alone; fixation with an external fixator; combined carpal fractures and/or dislocations or ulna fracture-dislocations; old fractures over 14 days; multiple fractures; pathological fractures; need for aid of arthroscope; uncooperative adults, such as dementia patients; or an associated infection or underlying diabetes, rheumatoid arthritis, or gout. Patients with combined ligament injuries shown on preoperative magnetic resonance images were also excluded.

Thus, a total of 182 patients were included in the study. The patients were randomly allocated to group A (via volar minimally invasive approach) and B (via conventional flexor carpi radialis approach) using a pseudorandom number generator. Immediately after fracture fixation, we excluded patients (2 in group A; 3 in group B) with distal radioulnar joint instability that was confirmed by physical examination. In group A, we converted the small incision to the conventional incision in 2 patients due to difficult reduction (type C2). The two patients were excluded. In group B, we excluded 6 patients whose PQ could not be repaired. We excluded patients who were lost to follow-up (2 in group A; 5 in group B) and who could not complete the entire follow-up (3 in group A; 2 in group B). Pre- and post-operative assessments were performed by one senior orthopaedic surgeon (XS). He was blinded after assignment to the interventions, and he did not involve in the treatments. Patient allocation ratio was approximately 1:1. All operations were performed by the same senior orthopaedic surgeon (XZ). Consort flow is shown in Fig. 2.

Via mini-approach (group A)

Operation was performed under brachial plexus anesthesia and under upper arm tourniquet control. A longitudinal incision was made between the flexor carpi radialis and radial artery. The incision was 1.5–2.5 cm in length, beginning from the proximal wrist crease (Fig. 3A). The flexor carpi radialis was retracted ulnarward, and the radial artery was retracted radioward. The volar periosteum was incised longitudinally. The periosteum beneath the PQ was raised by pushing a periosteal elevator on the volar surface of radius. The fracture was reduced under direct visualization and fluoroscope. The length of the radius was restored by gent traction. If the fracture lines or parts progressed under PQ, reduction could be achieved by forceps. The fracture was provisionally stabilized with K-wires. If there was a volar-ulnar fragment, it could be easily exposed by radial traction of flexor carpi radialis and ulnar traction of the incision. The hole between the radius and PQ was created by using a periosteal elevator. A volar plate (T-shaped plate for type A2, A3, B3 fractures, Suzhou Sunan Zimmered Medical Instrument Co., Ltd., China; distal radius versatile plate for type C2 and C3 fractures, Zimmer Inc., USA), 7–8 cm in length, was slid into the incision and placed on the volar surface of radius, beneath the PQ muscle. Bone grafting was performed as needed. Correct positioning was confirmed by fluoroscopy. The plate was fixed with distal locking screws. Under fluoroscopic guidance, a 0.8 cm long longitudinal skin incision was made just over the conjunction between the two most proximal plate holes. By blunt dissection, the holes were visualized through the septum between the flexor carpi radialis and palmaris longus. Two locking screws were fixed in the holes (Fig. 3B). Additional K-wires were used to fix the small fragments as needed. Once fracture reduction and implant positioning had been accepted on radiographs (Fig. 4A and B), the additional K-wires were removed and the incision was closed (Fig. 4C). After surgery, the wrist and forearm were placed in a removable ball-peen splint that permits gentle active exercises. The splint was completely removed after 4 weeks, and progressive motion was continued until bone union was solid.

Certain surgical pearls were critical. First, a joy stick technique was helpful for reduction. Second, if there was remaining displacement of the dorsal fragments, we often made drill holes just penetrating the volar cortex, and provisionally stabilized the volar fragments to the plate with shorter locking screws. Once the

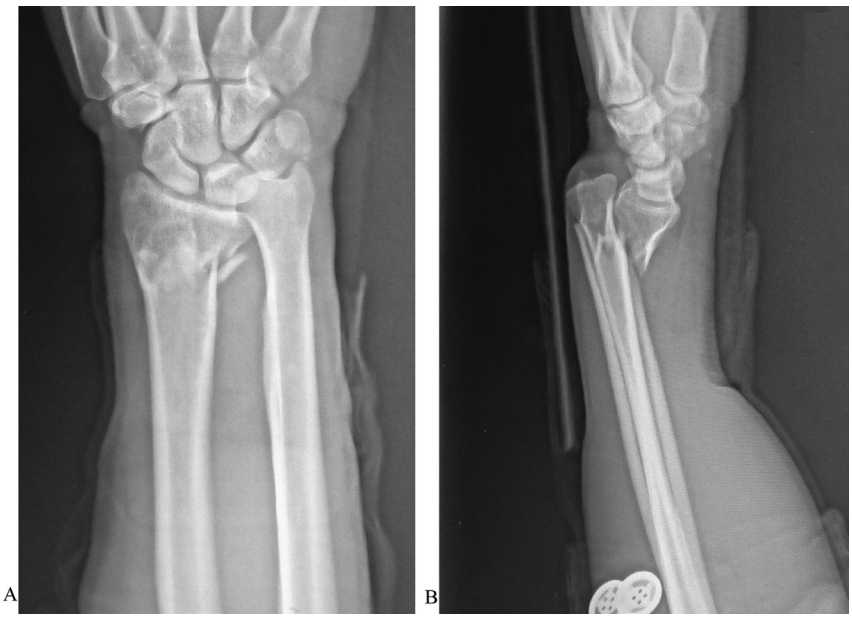

Fig. 1. A. A distal radial fracture on posteroanterior view. B. Lateral view.

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