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Original article

Should distal radioulnar joint be fixed following volar plate fixation of distal radius fracture with unstable distal radioulnar joint?

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ABSTRACT

Background: Distal radioulnar joint (DRUJ) instability often accompanies distal radial fractures. The goal of this study was to investigate whether DRUJ should be fixed to prevent recurrent DRUJ instability in distal radius fracture patients with unstable DRUJ following open reduction and volar plate fixation of the radius.
Methods: A retrospective chart review was performed on forty-nine consecutive patients presenting distal radius fracture who were diagnosed with distal radioulnar instability after radius fixation with volar plate. Group one consisted of 24 patients whose DRUJs were fixed in neutral for 6 weeks with 1~2 Kirschner wires (8 cases combined with casting), whereas group two consisted of 25 patients without DRUJ fixation. All patients had radiographic evaluation of their wrist and DRUJ for stabilities and underwent functional evaluation using modified Gartland and Werley demerit scoring system (GW score).
Results: All patients were followed-up for an average of 15 months (12–24 months) after surgery. No significant difference was noted between the two groups with respect to gender, age, fracture types and damage types (no noteworthy medical comorbidities in either group). At the latest follow-up, patients in both groups had comparable grip strength, wrist motion, and visual analogue scale (VAS) and GW scores. Only one patient (2.4%) demonstrated DRUJ chronic instability, but did not require any additional surgery.
Conclusion: The results suggest that in patients with distal radius fractures, fixation of unstable DRUJs in neutral for 6 weeks does not have an advantage over non-fixation.
Level of evidence: III.

1. Introduction

Distal fracture of the radius is one of the most common types of bone fractures [1–4]. DRUJ belongs to the family of pulley joints, and it is composed of the sigmoid notch of the distal radius and the ulnar head distal. Because of the curvature, differences of the sigmoid notch of the distal radius and the ulnar head articulates, the joint surfaces are not matched. Therefore, while spinning, rolling or sliding, joint movement happens between the sigmoid notch of the distal radius and the ulnar head articulates, and relative to the neutral position, the ulnar head slides to the dorsal side about 2.8 mm in supination position and slides to palmar side about 5.4 mm in pronation position [5]. In such situation, soft tissue plays an important role in stability. The soft tissue includes interosseous membrane of forearm (IOM), radial radioulnar joint capsule, triangle fibrocartilage complex (TFCC), pronator quadratus (PQ) and musculus extensor carpi ulnaris (ECU). The triangle fibrocartilage (TFC) is the articular discus formed between the mouth-shape nest and the sigmoid notch of the distal radius, extending to the base of ulna styloid. The center of TFC is composed of cartilage, known as joint dish and play a role in bearing. Layer cartilage is composed of palmar and dorsal radioulnar ligament at the edge and bears tension load. Tendinous sheath of extensor carpi ulnaris, radioulnar ligament and triangle fibrocartilage are collectively referred as TFCC and attached on the radioulnar styloid to maintain the continuity of distal radioulnar joint. TFCC plays a vital role in the stability of DRUJ.

Distal radius fracture and surrounding soft tissue damages often lead to distal radioulnar joint instability. The incidence of DRUJ instability was reported to be 10–19% after distal radius fracture

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[6,7]. Failure to recognize and treat DRUJ instability often lead to chronic wrist pain and loss of forearm rotation capability [8–11]. The current literature [7,12–14] suggests that after distal radius fixation, unstable DRUJ should be immobilized in neutral or supination to prevent future instability. However, there is little evidence to support the efficacy of this intervention. And there is report showing that repair of the ruptured triangular ligament in extraarticular fractures of the distal radius is not better than conventional treatment in Colles' fracture [15]. The purpose of our study was to determine whether fixation of unstable DRUJ in neutral has any advantages versus non-fixation after excellent reduction and fixation of distal radius fracture with volar plates.

2. Materials and methods

2.1. Patient enrolment

We performed a retrospective chart review to identify all patients who were treated for distal radius fracture from January 2007 to June 2010. Institutional review board approval was obtained before the start of the study. Inclusion criteria were as follows:

- displaced distal radius fracture with closed reduction failure or unstable fractures, which would be fixed with open reduction and internal fixation;
- unstable DRUJ diagnosed during surgery;
- no prior wrist surgery;
- age from 18 to 90 years old.

Patients were excluded if:

- they were given conservative closed reduction or external fixation bracket treatment for distal radius displacement fracture;
- fracture time was more than a month;
- an accompanying distal ulna fracture or the base of ulnar styloid fracture were reduced and internally fixed;
- patients with multiple injuries whose trauma severity score was more than 16 points;
- had a follow-up period of less than 12 months.

From the records between January 2007 and June 2010, we identified three hundred and thirty-two patients who were treated for distal radius fracture in our institute. Based on the inclusion and exclusion criteria, forty-nine patients were enrolled for our study. The forty-nine study subjects were comprised of thirty-five women and fourteen men with mean age of 59 years (in range of 32–82 years). Forty-eight patients had closed fractures, and one patient presented with a Gustillo type I open fracture [16]. In thirty-five patients, the mechanism of injury involved a fall on outstretched hand accompanied with hand pronation. Traffic accidents were responsible for the injury in five patients, and in nine patients, tumble during sports led to injury. This study was approved by the Medical Ethics Committee of local hospital.

2.2. Surgical procedures

According to Ring et al. [17], we measured and defined 5 mm or greater ulnar-positive variance as DRUJ instability. The DRUJ stability was further confirmed by the surgeon using the piano key test with volar and dorsal stress applied onto the DRUJ when the forearm was in supination, pronation, or neutral rotation. The examination was performed in the operation room immediately after the distal radius fixation and at all subsequent follow-up visits. Although no objective measurements were made, the contralateral limb was subject to the same range of motion and the piano key test was performed to assess any obvious baseline deficit.

All surgical procedures were performed using a Henry approach, distal radius fractures were reduced and fixed with a 3.5- or 2.4-mm volar locking compression plate and anatomical reduction was confirmed with plain radiography.

The forty-nine patients were categorized into two groups based on the surgeon's preference for postoperative treatment. Group one consisted of twenty-four patients whose DRUJ were fixed in neutral for six weeks with 1∼2 Kirschner wires (among them, eight patients combined with along arm cast), and group two consisted of twenty-five patients that were treated without fixation.

2.3. Follow-up evaluation

During the early follow-up period, on average, all patients had follow-up at two, six, and twelve weeks after surgery. Subsequent follow-ups were more variable but were based on a six-month, one-year, and two-year schedule. Patients were followed-up for a mean of sixteen months (in range of 12–24 months).

All patients were required to take wrist X-ray in lateral position after surgery and at their last follow-up visit to compare the ulnar deviation angle, volar tilting angle, radius height and ulnar variation to evaluate fracture healing and DRJU alignment.

We compared wrist function and the degree of DRUJ instability between the two groups. One author, who was blinded for the radiographic results, examined all patients. Wrist function was evaluated by grip strength, range of wrist motion, range of forearm extension, flexion, supination and pronation, and Sarmien to improved Gartland-Werley scoring system (GW score) [18].

Grip strength was measured using a Jamar dynamometer (Sammons Preston, Bolingbrook, Illinois) with the elbow flexed to 90° and the forearm in neutral rotation. Range of wrist and forearm motion was measured using a goniometer. According to the subjective and objective standards, GW score was divided into different functional levels: score 0∼2 is excellent, 3∼8 is good, 9∼20 is mild and 21 is bad. Specific evaluation indices include evaluation of deformity, subjective and objective evaluation, and evaluation of complications. Evaluation of deformity: one point for ulna styloid protuberance, two points for residual back side tilt or disappear of hand-ulnar deviation, and three points for reverse radial partial deformity. Subjective evaluation: zero point for optimal condition such as no pain, no sports limitation and no disability; two points for good condition such as occasional pain, mild exercise limitation and no disability; four points for fine condition such as occasional pain, partial sports limitation, wrist weakness, no disability and mild interference on daily life; six points for poor condition such as pain, sports limitation, disability and obvious interference of daily life. Objective evaluation: five points for stretch less than 45°, three points for ulnar deviation less than 15°, two points for supination or pronation less than 50°, one point for palmar flexionless than 30°, radial deviation less than 15°, cyclovergence induces, distal radioulnar joint pain, or grip strength less than 60% of that of the health side. Complications:

- osteoarthritis: one point for mild osteoarthritis, three points for mild osteoarthritis with pain, two points for moderate osteoarthritis and four points for moderate osteoarthritis, three points for severe osteoarthritis and five points for severe osteoarthritis with pain;
- nerve complications: one point for mild median nerve pressure, two points for moderate pressure and three points for severe pressure;
- finger movement disorders: one point for inability of fingers to touch palm, and two points for finger stiffness.