Arthroscopic Reduction of Comminuted Intra-Articular Distal Radius Fractures With Diaphyseal-Metaphyseal Comminution

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Purpose In the setting of severely comminuted diaphyseal-metaphyseal fractures of the distal radius, arthroscopic reduction of the joint surface is difficult and often results in shortening and collapse. Yet, several authors have shown the benefits of arthroscopy in articular distal radius fractures. We present a method that safely allows a combination of arthroscopic reduction and rigid fixation and describe the outcomes in a small group of patients.

Methods Four consecutive patients with severely comminuted diaphyseal-metaphyseal articular fractures of the distal radius were treated using the stable reference fragment technique. For all cases, we used an extra-long volar locking plate applied to the diaphysis of the radius. Preoperative computed tomography scanning was used to identify the largest articular fragment. This reference fragment was reduced and stabilized with locking pegs or screws to the volar plate under fluoroscopic guidance. The articular reduction continued arthroscopically, using the reference fragment as a guide. Once the articular reduction was complete, the comminuted metaphysis was addressed and secured to the plate.

Results All patients achieved excellent clinical and radiological results. Flexion-extension averaged 124° and pronation-supination averaged 174°. One patient showed minor signs of radiocarpal osteoarthritis on radiographs at 3 years.

Conclusions By securing the reference fragment before addressing the metaphyseal comminution, a stable platform was created. Thus, intra-articular reduction was achieved while maintaining extra-articular alignment. Although the results were excellent, the number of cases was small. *(J Hand Surg Am. 2014;39(5):835–843.* *Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Arthroscopy, wrist, articular distal radius, comminuted fractures.

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Received for publication November 15, 2013; accepted in revised form February 5, 2014.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

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0363-5023/14/3905-0001$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2014.02.013

Intra-articular fractures of the distal radius with comminution of both the diaphysis and metaphysis pose a particular reconstructive challenge because they have a tendency to shorten and collapse. Residual intra-articular stepoff and gap are common.[1,2] Recent literature supports a clinical benefit when arthroscopy is used for intra-articular distal radius fractures,[3–8] particularly with high-energy injuries,[9,10] but it does not address the situation in which there is severe extra-articular comminution. We

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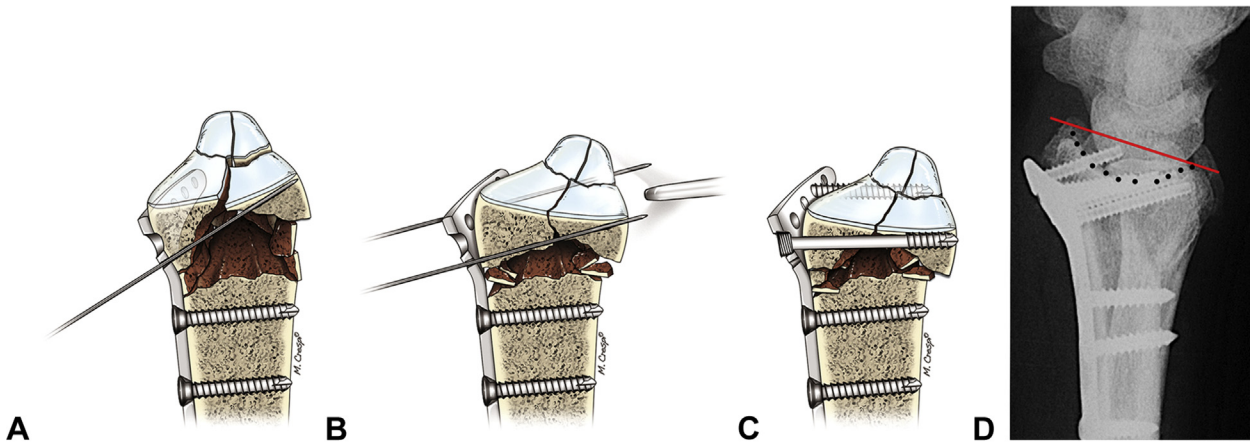

FIGURE 1: A–C Placement of K-wires through the metaphyseal bone may cause loss of reduction during the arthroscopic reduction, ending in a good articular reduction and an extra-articular malunion. **D** Paradigmatic clinical example belonging to the first author (F.d.P.).

explored the use of arthroscopy in less severe degrees of metaphyseal comminution and occasionally experienced undetected loss of extra-articular reduction while arthroscopically performing the intra-articular reduction (Fig. 1).

To overcome the situation in which congruity of the joint is achieved at the expense of the extra-articular reduction, we devised a technique that safely allows use of the arthroscope even in the most comminuted diaphyseal cases by creating a stable reference fragment to guide the rest of the reduction.

The purposes of this study were to detail the surgical technique and to present clinical and radiological outcomes with a minimum of 1-year follow-up in a small group of patients with intra-articular fracture and a high degree of diaphyseal-metaphyseal comminution.

MATERIALS AND METHODS

Between 2009 and 2012, the first author (F.P.) treated 4 consecutive patients with intra-articular comminuted diaphyseal-metaphyseal fractures of the distal radius with this technique. Two fractures were closed injuries and 2 were open injuries; 1 of the latter required emergent revascularization. One fracture was referred at 6 weeks with a persistent radial shortening of 1.5 cm although the patient had been treated with an external fixator. The rest were treated within a week of injury.

The average age was 45 years (range, 31–61 y) (Table 1). Two patients had injuries that occurred at work, 1 was a home accident, and 1 was a motorcycle accident. Preoperatively, the patients were evaluated with standard radiographs (posteroanterior and lateral) as well as computed tomography. All were treated with the technique described subsequently.

At the latest follow-up visit (mean, 3 y; range, 1–4 y), patients were evaluated by the first and third authors for range of motion with a handheld goniometer, grip strength with a Jamar Dynamometer (Clifton, NJ), and pain with an 11-point (range, 0–10 points) visual analog scale. The Patient-Rated Wrist-Hand Evaluation and Disability of the Arm, Shoulder, and Hand questionnaires were administered. Radiographic assessment included standard posteroanterior and lateral radiographs.

Our institution does not require institutional review board approval; however, all patients were aware of the treatment aims and understood the risks and benefits of the procedure. Informed consent was obtained for each patient.

Surgical technique

We used a flexor carpi radialis approach to expose the radius. After a preliminary reduction to restore the length of the radius, an extended volar locking plate (DVR; Depuy, Warsaw, IN) was provisionally applied and stabilized to the intact diaphysis of the radius by inserting a screw into the proximal elliptical hole on the stem of the plate. Then, the largest articular fragment(s), which we refer to here as the reference fragment(s), was identified by computed tomography scan and was reduced and secured to the transverse component of the plate with provisional K-wires inserted through the auxiliary holes of the plate. Once adequate reduction of the reference fragment was confirmed with fluoroscopy, it was rigidly secured to the plate by 1 or 2 locking pegs or screws to construct a bridging column that was resistant to shortening and collapse during the rest of the procedure. Reduction of the reference fragment had to be perfect in the coronal and sagittal planes because it served as the cornerstone for accurate reduction of the remaining articular fragments. If the reference

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