Surgical Correction of Dorsally Angulated Distal Radius Malunions With Fixed Angle Volar Plating: A Case Series

Kevin J. Malone, MD, Thomas D. Magnell, MD, D. Carl Freeman, PhD, Martin I. Boyer, MD, Jeffrey D. Placzek, MD

From the Department of Orthopaedic Surgery, William Beaumont Hospital, Royal Oak, MI; the Department of Biological Sciences, Wayne State University, Detroit, MI; and the Department of Orthopaedic Surgery, Washington University, St. Louis, MO.

Purpose: To report our experience using a fixed-angle volar plate in conjunction with a corrective osteotomy and cancellous bone graft for the treatment of distal radius malunions with dorsal angulation in 4 patients.

Methods: Four consecutive patients had a volarly based opening wedge osteotomy with a fixed angle volar plate and cancellous bone grafting for the treatment of a dorsally angulated distal radius malunion. Data collected retrospectively included a visual analog pain scale, grip strength, range of motion, radiographic parameters, and each patient's subjective functional outcomes as measured by the Disabilities of the Arm, Shoulder, and Hand questionnaire. Motion, strength, and radiographic values were compared with the contralateral arm for each patient.

Results: The average time from initial fracture to corrective osteotomy was 346 days. The average length of follow-up evaluation was 13.5 months. The flexion–extension arc of motion increased an average of 21° to a value of 84% of the contralateral side; the pronation–supination arc of motion increased an average of 20° to a value of 98% of the contralateral side. The average tilt of the radius improved from 26° extension to 2° extension; the average radial inclination improved from 22° to 24°; the average ulnar variance excluding the 1 patient who had a distal ulna resection improved from 5 mm to 1 mm. The average retrospective Disabilities of the Arm, Shoulder, and Hand score improved from 30 to 7; the average retrospective visual analog pain scale score improved from 4.5 to 1. The average grip strength increased from 20 to 29 kg, which corresponded to 73% of the contralateral extremity.

Conclusions: The rigid characteristics of fixed angle volar plates can provide an alternative to the traditional techniques of distal radius osteotomy including structural bone grafting and dorsal plate fixation or external fixation. In addition these plates are strong enough to allow for early postoperative motion. (J Hand Surg 2006;31A:366–372. Copyright © 2006 by the American Society for Surgery of the Hand.)

Type of study/level of evidence: Therapeutic, Level IV.

Key words: Fixed angle plate, malunion, osteotomy, radius, volar plate.

Surgical correction of distal radius malunions with residual dorsal displacement can be a difficult procedure. The traditional treatment method includes the use of iliac crest autologous structural bone grafts inserted from a dorsal osteotomy and supported by dorsal plates and/or external fixation devices.[1–8] This procedure has inherent risks and morbidity associated with the harvesting of structural allografts and with the placement of the dorsal plates that may need to be removed.

The availability of fixed angle volar plates with an anatomic contour has provided surgeons with more options for the treatment of acute distal radius frac-

tures.[9–11] To date there are no studies looking at the use of these plates in surgical correction of dorsal malunion although its use has been mentioned in several review articles.[12,13]

This article reports our experience using a fixed-angle volar plate in conjunction with a corrective osteotomy and cancellous bone graft for the treatment of distal radius malunions with dorsal angulation in 4 patients.

Materials and Methods

Patient Selection

From 2000 to 2003 we performed 4 consecutive corrective osteotomies using the volar approach for dorsally angulated malunion of distal radius fractures. These patients were all male with an average age of 57 years (range, 16–76 y). Two of the fractures involved the dominant extremity. One fracture was treated initially by closed reduction and percutaneous pinning and the other 3 fractures were treated by closed reduction and short arm cast immobilization. At the time of corrective osteotomy all of the initial fractures had healed and the average time from initial fracture was 346 days (range, 87–894 d). At the time of data collection the average length of follow-up evaluation was 13.5 months (range, 9–23 mo).

Indications

The decision to have a corrective osteotomy was based on the patients' subjective complaints of pain, deformity, and loss of motion in addition to radiographic evidence of more than 15° of residual dorsal angulation at the fracture site.

Implant

The plate used in this study was the SCS/V plate (Avanta Orthopaedics, San Diego, CA). A recent biomechanical study showed this plate to be the most rigid of several distal radius plates tested.[14] This plate also has shown favorable results in the clinical setting of acute distal radius fractures.[15]

Surgical Technique

The technique is similar to the one described by Smith and Henry[13] for acute distal radius fractures. Access to the volar radius was achieved between the flexor carpi radialis and the flexor pollicis longus muscles and then completed by releasing the radial and distal borders of the pronator quadratus. The brachioradialis muscle was released from the radial styloid to make reduction attempts easier. The dorsal periosteal sleeve was elevated from the metaphysis. After exposure the template for the plate was placed on the volar surface of the distal radius parallel to the joint on an anteroposterior fluoroscopic image and held in place with K-wires. After this the distal fixation points for the plate were predrilled into the subchondral bone using the plate template and fluoroscopy. The position of the template recreates the radial inclination and the directions of the holes in the subchondral bone allow the plate to recreate volar tilt. Next the osteotomy was completed from the volar aspect of the radius using an oscillating saw. This was performed at the previous fracture site and the plane of the saw cut was perpendicular to the shaft of the radius. After the cut was completed the distal fragment was mobilized by further release of the dorsal periosteum. The tines of the plate then were inserted into the predrilled holes in the distal fragment. In situations in which there was enough dorsal angulation at the malunion site it was possible to create the osteotomy with the tines of the plate already placed in the predrilled subchondral holes, thereby reducing the chance of compromising the fixation to the distal fragment. Once the osteotomy was complete and the plate was fixed to the distal fragment the plate was used as a joystick and the distal fragment was brought to the desired position by bringing the proximal portion of the plate to the shaft of the radius and stabilizing it with a cortical screw (Fig. 1). Thus we used the anatomic contour and rigidity of the plate to aid with the reduction maneuver and to restore volar tilt and radial inclination. The first screw was placed in the sliding hole to allow for further adjustments of radial length, which was adjusted based on the radiologic assessment of the contralateral extremity. After the remaining proximal screws were placed the cancellous bone graft was applied to the osteotomy site from the radial side of the flexor carpi radialis approach (Fig. 2). All patients received cancellous bone graft during the procedure. Two patients received autologous iliac crest bone graft, 1 patient received crushed cancellous allograft, and 1 patient had a distal ulna resection for ulnar impaction symptoms and the distal ulna was used as a source for the bone graft. The decision to use allograft or iliac crest autologous graft was based on patient preference. Postoperatively the wrist was immobilized in a volar splint.

Postoperative Care

On the patient's first postoperative visit 3 to 5 days after surgery the splint was removed and the wound was examined. A new removable splint was fashioned. The patients returned 2 weeks after surgery for stitch removal and were instructed to begin removing the splint for self-directed gentle range-of-motion exercises. None of the patients was enrolled in any