Salvage of Distal Radius Nonunion With a Dorsal Spanning Distraction Plate

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Treatment of nonunion after previous instrumentation of distal radius fractures represents a reconstructive challenge. Resultant osteopenia provides a poor substrate for fixation, often necessitating wrist fusion for salvage. A spanning dorsal distraction plate (bridge plate) can be a useful adjunct to neutralize forces across the wrist, alone or in combination with nonspanning plates to achieve union, salvage wrist function, and avoid wrist arthrodesis in distal radius nonunion. *(J Hand Surg Am. 2014;39(5):981–984. Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Distal radius fracture, distal radius nonunion, bridge plate.

Distal radius fractures are the most common fracture of the upper extremity, and the overwhelming majority of these injuries are adequately managed by either closed reduction or open reduction and internal fixation (ORIF) as indicated by the fracture pattern and clinical situation.[1] Although nonunion after osteosynthesis of distal radius fractures is rare, it represents a significant clinical challenge owing to compromise of the resultant bone stock, which is often osteopenic and a poor substrate for fixation. One treatment option that has been described for complex distal radius fractures is utilization of a dorsal distraction plate either alone or in conjunction with other methods of osteosynthesis to achieve union.[2] We describe its use for the treatment of distal radius nonunion.

INDICATIONS

Patients who have previously failed treatment for a distal radius fracture with resultant nonunion can be treated with a dorsal distraction plate. The original fracture is typically from a high-energy mechanism in a young patient or a fragility fracture with extensive comminution and bone loss. Resultant nonunion with osteopenia as well as distal fractures and fractures with severe shortening that cannot be reduced and rigidly fixed with nonspanning techniques alone are eligible for a dorsal distraction plate to aid in maintenance of reduction and allow for stable fixation to achieve union.

CONTRAINDICATIONS

Dorsal distraction plating for distal radius nonunion is contraindicated in those patients with resultant radiocarpal arthrosis that precludes salvage of the radiocarpal joint. Distal radius nonunions that are amenable to rigid internal fixation without spanning the radiocarpal and midcarpal joints should undergo internal fixation alone to allow for early wrist motion.

SURGICAL ANATOMY AND TECHNIQUE

The procedure is typically performed with sedation and regional anesthesia under tourniquet control on a radiolucent table. Incisions are made over the third metacarpal, third dorsal compartment, and forearm. This provides access for the dorsal neutralization plate placement as well as visualization of the nonunion site. A 4-cm incision is made over the shaft of the long metacarpal and the extensor tendon is retracted

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TABLE 1. Patient Characteristics

Patient	Sex	Age (y)	Mechanism	Open/Closed	Articular Involvement	Presentation	Initial management
1	F	86	FFSH	Closed	N	Nonunion	DLP
2	M	38	MVC	Open	Y	Nonunion	VLP
3	F	48	Fall from height	Open	N	Nonunion	Ex fix
4	F	66	MVC	Open	N	Nonunion	Ex fix
5	F	70	FFSH	Closed	Y	Nonunion	VLP
6	F	73	FFSH	Closed	Y	Nonunion	VLP
7	F	74	FFSH	Open	N	Nonunion	Ex fix
8	F	51	FFSH	Closed	Y	Nonunion	CRPP

CRPP, closed reduction percutaneous pinning; Ex fix, external fixation; FFSH, fall from standing; MVC, motor vehicle collision; DLP, dorsal locking plate.

exposing the metacarpal shaft. This incision is used for the most distal aspect of the plate and must be large enough to place 3 bicortical screws into the metacarpal shaft. At the dorsal aspect of the distal radius, a second 4-cm incision is made just ulnar to Lister's tubercle to open the third compartment. The extensor pollicis longus tendon is transposed radial to Lister's tubercle, and the fourth compartment is elevated ulnarly from the joint capsule to allow placement of the plate on the floor of the fourth compartment. A 2-cm segment of the posterior interosseous nerve is excised. A third incision is then made at the dorsal radial aspect of the radius, at least 4 cm proximal to the fracture between the brachioradialis and the tendons of the second dorsal compartment. Care is taken to find and protect the superficial branch of the radial nerve emerging from underneath the brachioradialis prior to plate placement. A Freer or small Cobb elevator is then passed from the proximal incision to the distal incision, ensuring a clear track is present for passage of the plate. The fracture is visualized through the dorsal approach to the distal radius and the nonunion is debrided. The plate is then inserted from distal to proximal, taking care not to impinge the finger extensors. We recommend using a 12- or 14-hole dynamic compression plate. A nonlocking screw is placed in the second to last screw in the metacarpal shaft to align the plate centrally on the metacarpal, while still allowing for some change in alignment of the plate if needed for fracture reduction. Once the proximal aspect of the plate has been centered on the radial shaft, traction is applied with wrist supination and a serrated clamp is used to provisionally affix the plate to the radius. Supination is used because it counteracts the tendency of the distal segment to malrotate into pronation. Fluoroscopy is used to confirm that appropriate radial length and volar inclination are achieved, as well as used to ensure the plate is centered on bone and the carpus has not been overdistracted (radiocarpal space, $>$ 5 mm). Clinical examination should confirm that forearm rotation and passive finger flexion are not limited. Limitation in finger flexion suggests overdistraction. Three bicortical nonlocking screws are placed through the plate into the radial shaft, and the distal 2 additional screws are placed into the metacarpal. Supplementary fixation, including Kirschner wires, can be used to improve reduction and augment fixation; additional bone graft may be placed into the metaphyseal defect at this time. A volar approach is undertaken at this point if necessary to either buttress the distal radius or aid in articular reduction. If appropriate bone stock is available, a nonlocking screw may be placed through the dorsal spanning plate into the distal radius to augment fixation and maintain reduction.

REHABILITATION AND POSTOPERATIVE CARE

After surgery, the patient is placed into a short-arm volar splint and digit motion is initiated immediately. If concomitant injuries require assistive ambulatory devices, the patient is allowed to platform weight-bear through the forearm. When fracture consolidation is demonstrated radiographically, the plate is removed. Progressive wrist motion is then initiated under the supervision of a hand therapist, and the patient is allowed active, active assisted, and passive wrist and finger motion without restriction.

CLINICAL CASES

We have used this technique in 8 patients with an average age of 68 years (range, 52−86 y) (Table 1). Initial injury was open in 4 of 8 patients with an intra-articular component in 4 of 8. Nonunion was confirmed by computed tomography (CT) scan in all patients. Initial fracture management consisted of volar fixed-angle locking plate (VLP) application in