Cannulated Self-Drilling, Self-Tapping Pins for Displaced Extra-articular Distal Radius Fractures

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Displaced unstable extra-articular radius fractures are common and frequently treated with open reduction and internal fixation with a fixed-angle volar plate. Although this treatment yields good results, it might be more invasive than necessary for management of this often relatively simple fracture. In this article, we present the technique of using a cannulated self-drilling, self-tapping (CSDT) construct that can be employed in a minimally invasive fashion. The CSDT offers a minimally invasive alternative to volar fixed-angle plating for unstable extra-articular distal radius fractures. It also can be useful in isolated displaced radial styloid fractures. Placed appropriately, implants rarely have to be removed. The CSDT also allows for early motion and rapid return to activities with anticipated satisfactory range of motion and function. *(J Hand Surg Am. 2018;43(3):294.e1-e5. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Cannulated self-drilling, distal radius fractures, tapping pins, volar fixed-angle plating.

Online Exclusive

INTRODUCTION

Distal radius fractures are the most common fractures treated in the emergency department and by orthopedic surgeons.[1–3] Over 640,000 distal radius fractures occur in the United States. Despite being one of the most common fractures treated in orthopedic surgery, there is no consensus as to the reference standard for treatment. Current trends for unstable displaced distal radius fractures in active individuals have favored volar fixed-angle plating.[4] However, there is a wide range of treatment methods, depending on the needs of the individual patient and quality of the bone. Whereas volar fixed-angle plating has been shown to be effective,[5,6] it may be more than is needed for extra-articular displaced distal radius fractures. The purpose of this technique description is to introduce a minimally invasive procedure that has advantages over the more extensive exposure needed for volar plating yet provides better stability than Kapandji pinning alone.

Minimally invasive percutaneous pinning is a common treatment option in the spectrum of modalities used to treat distal radius fractures.[7–9] Advantages of minimally invasive percutaneous pinning include increased stability compared with cast alone and that it keeps the soft tissue envelope intact compared with open reduction and internal fixation. Percutaneous K-wire fixation or the Kapandji pinning technique uses 2 to 4 intrafocal K-wires that aid in reduction and act as radial and dorsal buttresses. One notable downside to this technique, however, is that several series reported a 25% to 33% loss of reduction particularly in osteoporotic bone.[8]

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Received for publication May 4, 2017; accepted in revised form December 14, 2017.

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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0363-5023/18/4303-0025$36.00/0
https://doi.org/10.1016/j.jhsa.2017.12.011

FIGURE 1: **A** Anteroposterior radiograph of distal radius fracture and **B** lateral radiograph of distal radius fracture.

Another option is the T-Pin (Union Surgical, LLC, Philadelphia, PA), a cannulated self-drilling, self-tapping (CSDT) device designed to treat extra-articular distal radius fractures.[10] The procedure requires minimal surgical dissection. It provides better stability than K-wires alone because threads in the distal fragment make this a fixed-angle construct. As a result, patients experience early return to active wrist range of motion (ROM) and functional activities.

FIGURE 2: Cannulated self-drilling, self-tapping pin.

INDICATIONS AND CONTRAINDICATIONS

Indications for the use of this system include unstable, extra-articular, dorsally displaced distal radius fractures. It can also be used for simple displaced radial styloid fractures; however, the focus of this technique article is on extra-articular distal radius fractures. This technique is useful in both active patients and infirm patients because it is minimally invasive and can be performed under local anesthesia with intravenous sedation. The ideal fracture is a displaced extra-articular fracture with no volar

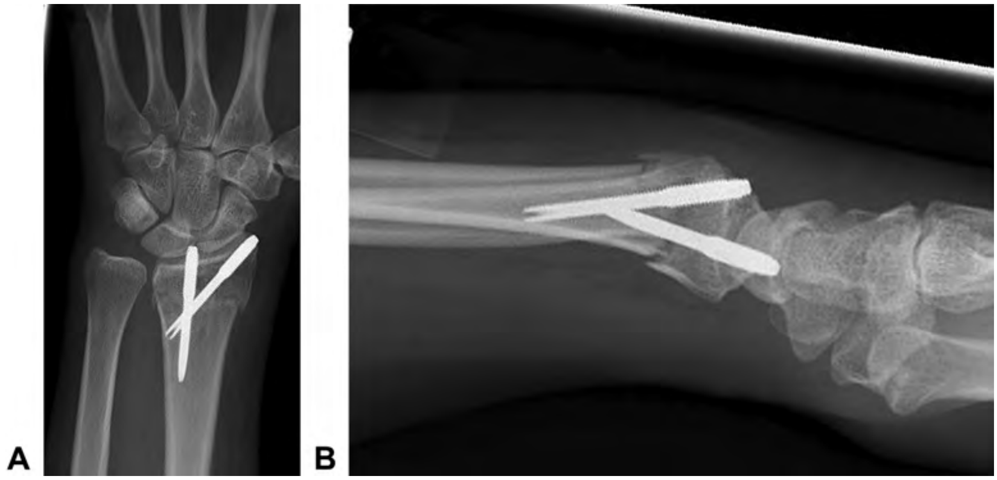

FIGURE 3: **A** Anteroposterior postoperative radiograph of distal radius fracture and **B** lateral radiograph of distal radius fracture.

comminution and an intact distal ulna (exclusive of ulna styloid fractures) because both the volar cortex and ulna can act as buttresses in addition to the CSDT pins. It is contraindicated in complex intra-articular fractures with displacement and in low-demand patients who have fractures amenable to treatment by immobilization alone.

SURGICAL ANATOMY

The distal radius has an articular surface that is triangular, with the apex of the triangle at the tip of the radial styloid. The dorsal cortex can be thought of as being composed of 2 surfaces, one radial and one ulnar to Lister's tubercle. The dorsal cortex is thin and often is comminuted when fractured, which leads to a higher risk of dorsal tilt of the distal fragment especially in extra-articular fractures. The volar side of the distal radius, which is covered by the pronator quadratus, is a flat surface that makes a curve distally. The volar cortex is much thicker than the dorsal cortex and frequently is less comminuted when it fails.

The column theory describes 3 columns of the distal radius: radial, intermediate, and ulnar. The radial column is on the lateral side of the radius. It is defined as the area starting at the radial styloid and extending to the base of Lister's tubercle. This column includes the scaphoid fossa and serves as a radial osseous buttress and insertion site for the radiocarpal extrinsic ligaments. The second column is the intermediate column. It includes the lunate facet and the sigmoid notch that articulates with the surface of the ulnar head. The volar surface of the lunate facet is where the teardrop marks the insertion of the short radiolunate ligament, the strongest ligament in the wrist. The ulnar part of the palmar radius is known as the calcar of the wrist and carries the maximal load. The ulna column involves the distal ulna, which bears approximately 20% of the axial load experienced across the wrist.

In extra-articular fractures, there can be disruption of all 3 columns, disrupting normal loads experienced by the distal radius and eventually leading to instability of the carpus in an effort to compensate for the dorsal angulated distal radius fracture. The CSDT system allows appropriate reduction of these extra-articular fractures while minimally violating the soft tissue envelope.

SURGICAL TECHNIQUE

Before surgery, the patient undergoes a preferred regional block of the operative upper extremity. The extremity is then prepped and draped in the usual sterile fashion and exsanguinated with a tourniquet inflated to 250 mm Hg. Good fluoroscopic visualization is mandatory. The steps are:

1. Good closed reduction is maintained by Kapandji pinning.
2. Place CSDT guide pins through a small 1-cm incision. The guide pins are placed through the lip of the dorsal radius or radial styloid. The surgeon may place 2 guide pins both through the dorsal distal radius or one through the dorsal lip lunate fossa and radial styloid.
3. Guide pins should be adjacent but not through the opposite cortex.
4. Accurately measure guide pin length.
5. Place the CSDT device over the guide pin and drill in 90% of the way.
6. Remove the guide pin.
7. Fully insert the CSDT device, usually by hand.
8. Check the position under fluoroscopy.
9. Break off the driver with a specialized tool.

FIGURE 4: Image of the wrist 3 months after surgery, after it had united.

10. Remove the Kapandji pins once the second CSDT device is in place.
11. Close small wounds and apply volar orthosis.

POSTOPERATIVE MANAGEMENT

An initial well-padded, volar short-arm resting orthosis is applied that allows for immediate finger ROM. The patient is instructed in the recovery room regarding proper care of the orthosis, elevation, and digital active ROM, and is prescribed appropriate medications for pain. At the first postoperative visit (10 days to 2 weeks) sutures are removed and the patient is fitted with a custom removable forearm-based rigid wrist orthosis that can be removed for bathing and exercises. Under the guidance of an occupational therapist, active digit ROM is maintained and active assist, active and gentle passive wrist ROM is initiated. Six weeks after surgery, we instruct the patient to taper off using the brace, begin strengthening, and slowly return to all activities as tolerated.

PEARLS AND PITFALLS

A good reduction with the temporary Kapandji pinning is mandatory. Poor reduction and poor preliminary fixation will result in a less than optimal final reduction with the threaded pins. The measurement of the drilled guide pin is also important. If the measurement is inaccurate the CSDT pin will be too long or too short. A too-long pin means the threaded pin will need to be removed and a too-short pin may result in less than optimal stabilization. Another pitfall of the procedure is over-advancing the CSDT pin, because once backed up, fixation again will be less than optimal. Finally, the guide pin should be removed before full seating of the threaded pin because it can become incarcerated.

COMPLICATIONS

The most noteworthy complication we experienced is loss of reduction owing to a technical error. The patient was an elderly patient with poor bone and the threaded pin was over-advanced; when it was backed up the fixation became less than optimal and the fracture eventually lost its reduction.

CASE ILLUSTRATION

A 38-year-old woman fell on an outstretched left wrist and sustained the fracture shown in Figure 1A and B. Three days after the fall she underwent closed reduction and placement of 2 CSDT pins (Fig. 2). Postoperative radiographs are displayed in Figs. 3A and 3B; at that time, the patient began active ROM exercises and was given a volar removable orthosis. The orthosis was discontinued after 6 weeks. Figure 4 shows the wrist 3 months after surgery, after the fracture had united. Three months after surgery, the patient returned to full activities. Figure 5A and B show radiographs of the radius after union. At final follow-up the patient had 65° active extension and

FIGURE 5: **A** Final anteroposterior radiograph of distal radius fracture after union and **B** final lateral radiograph of distal radius fracture after union.

flexion, a Patient-Rated Wrist Evaluation score of 4, and a Disabilities of the Arm, Shoulder, and Hand score of 0. She was highly satisfied.

The CSDT technique is a less invasive alternative for stabilization of displaced extra-articular distal radius fractures. Patients sustain minimal secondary trauma from the surgery and are generally rendered stable enough to begin active ROM at the first post-operative visit. When attention is paid to pin length, no secondary surgery is necessary for pin removal.

ACKNOWLEDGMENTS

We acknowledge Joseph J. King for his assistance in the preparation of the manuscript.

REFERENCES

1. Chung KC, Shauver MJ, Birkmeyer JD. Trends in the United States in the treatment of distal radial fractures in the elderly. *J Bone Joint Surg Am*. 2009;91(8):1868–1873.
2. Larsen CF, Lauritsen J. Epidemiology of acute wrist trauma. *Int J Epidemiol*. 1993;22(5):911–916.
3. Nellans KW, Kowalski E, Chung KC. The epidemiology of distal radius fractures. *Hand Clin*. 2012;28(2):113–125.
4. Koval KJ, Harrast JJ, Anglen JO, Weinstein JN. Fractures of the distal part of the radius: the evolution of practice over time. Where's the evidence? *J Bone Joint Surg Am*. 2008;90(9):1855–1861.
5. Horst TA, Jupiter JB. Stabilisation of distal radius fractures: lessons learned and future directions. *Injury*. 2016;47(2):313–319.
6. Hove LM, Lindau T, Hølmer P. *Distal Radius Fractures: Current Concepts*. Heidelberg, Germany: Springer; 2014.
7. Dy CJ, Wolfe SW, Jupiter JB, Blazar PE, Ruch DS, Hanel DP. Distal radius fractures: strategic alternatives to volar plate fixation. *Instr Course Lect*. 2014;63:27–37.
8. Kapandji A. Treatment of non-articular distal radius fractures by intrafocal pinning with arum pins. In: Saffer P, Cooney WP, eds. *Fractures of the Distal Radius*. Philadelphia, PA: Lippincott Williams & Wilkins; 1995:71–83.
9. Naidu SH, Capo JT, Moulton M, Ciccone W, Radin A. Percutaneous pinning of distal radius fractures: a biomechanical study. *J Hand Surg Am*. 1997;22(2):252–257.
10. Taras JS, Zambito KL, Abzug JM. T-pin for distal radius fracture. *Tech Hand Up Extrem Surg*. 2006;10(1):2–7.