

T-Pin[®]

Distal Radius Fixation System



Operative Technique

T-Pin®

Abstract

Distal radius fractures are among the most common fractures treated by orthopaedic surgeons. Numerous techniques and implants have been devised to stabilize these fractures. The T-Pin® (Union Surgical, LLC, Philadelphia, Pennsylvania) is a novel instrument designed to stabilize extraarticular distal radius fractures utilizing minimal surgical dissection. The T-Pin® allows for early active wrist range of motion promoting earlier return to functional activities. This article presents the instrumentation, the techniques of insertion and extraction, and postoperative care of the T-Pin® for the treatment of extraarticular distal radius fractures.

Historical Perspective

Fractures of the distal radius are one of the most common fractures treated by orthopaedic surgeons. Owen stated that distal radius fractures represent 1 in 6 fractures in patients older than 50 years of age.¹ Various procedures and fixation techniques have evolved to treat this common fracture based on many considerations. These factors include the patient's age, bone quality, ability of the patient to tolerate the procedure, and the type of fracture. Treatment modalities have included immobilization as originally described by Colles², pins in plaster, external fixation, percutaneous pinning with casting, and open reduction with internal fixation with a number of different implants.

Since Abraham Colles described the comminuted and displaced distal radius fracture in 1814, orthopaedic surgeons have sought to stabilize the fracture after reduction³. Many fractures treated in plaster have a tendency to redisplace⁴. For this reason, percutaneous pinning evolved as a relatively simple fixation method for extraarticular fractures prone to redisplacement with cast treatment alone. Various methods of pinning have been developed.



Figure 1. Various lengths of the T-Pin®

The described techniques include two pins placed through the radial styloid⁵; two crossed pins, one inserted at the radial styloid just dorsal to the first extensor compartment and the second inserted on the dorsal ulnar aspect of the distal radius between the 4th and 5th extensor compartments^{3,6}; 3 to 4 intrafocal pins within the fracture site⁷; transulnar oblique pinning in which a threaded wire is inserted in the distal ulna and passed obliquely through the distal ulna to the distal radius so that it engages the radial styloid fragment⁸; one radial styloid pin and a second across the distal radioulnar joint⁹; and multiple trans-ulnar to radius pins, including the distal radioulnar joint¹⁰. Despite improved maintenance of reduction with pinning, many of these series report 25% to 33% of patients having a significant loss of reduction.

The T-Pin® is a new type of threaded pin designed specifically to treat acute distal radius fractures.

The T-Pin® technique has the advantages of short operative time, being relatively inexpensive, having utility for patients with medical conditions for whom general anesthesia poses a greater risk, and of allowing early active wrist motion. The T-Pin® is threaded and affords better purchase of the fracture fragments than commonly used smooth pins (Fig. 1). Currently, we are undergoing a prospective multicenter study to further evaluate the efficacy of the procedure.

Indications/ Contraindications

The main indication for use of the T-Pin® is an unstable extraarticular dorsally displaced distal radius fracture. (Fig. 2A,2B)

This technique is useful for active patients because it is a relatively brief procedure and allows for a quick return of function. The brief nature of the procedure, especially the limited incisions (1-2 cm) required to insert the pins, makes this procedure useful in the elderly and medically unstable populations because it can be performed under local anesthesia with intravenous sedation.

The contraindications to this procedure include intraarticular fractures having displacement and/or severe comminution. Low-demand patients who have fractures amenable to treatment by immobilization alone would also not be considered candidates for this procedure.



Figures 2A,B
Preoperative ex-
ample of a typical
fracture amenable
to the T-Pin®



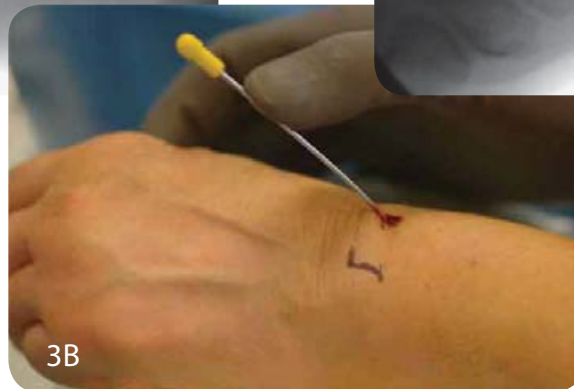
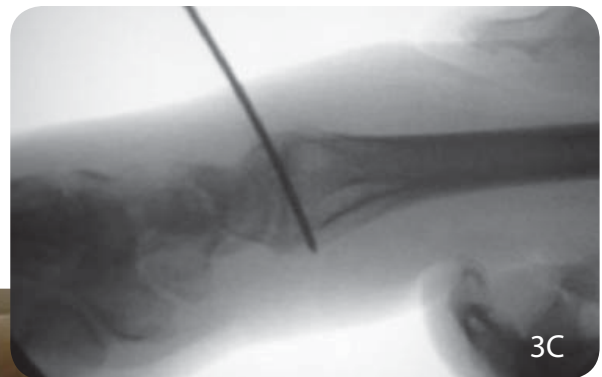
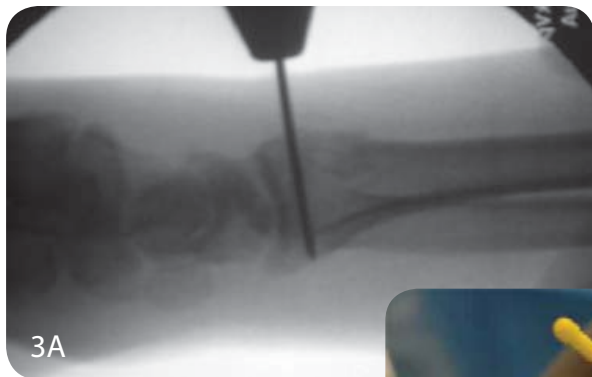
Surgical Technique

Patients are placed supine on the operating table. Typical anesthesia for the case is conscious sedation with a local field block and fracture hematoma block. We use bupivacaine 0.5% without epinephrine. A tourniquet is then applied to the operative extremity and the extremity is prepped and draped in a sterile fashion. The limb is exsanguinated, and the tourniquet is inflated to 250 mm Hg. Our typical tourniquet time is approximately 20 minutes.

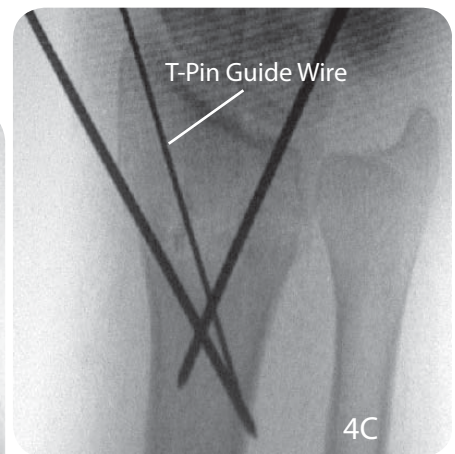
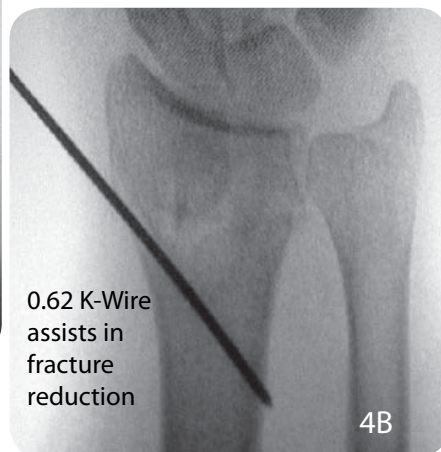
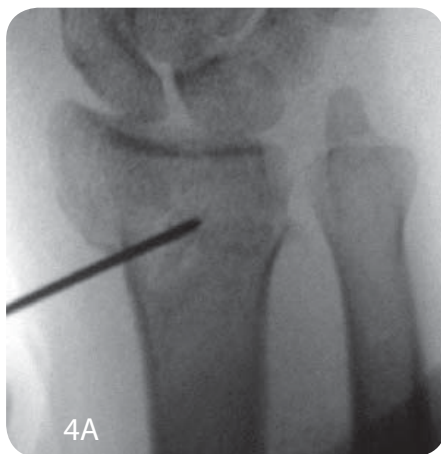
Under fluoroscopic guidance, closed reduction of the fracture is performed. A size 0.62 Kirschner wire can be placed percutaneously into the distal fragment to use as a joystick to regain the normal anatomical volar tilt. (Fig. 3) Alternatively, a Kapandji pinning technique can be used to temporarily secure a reduction while the T-Pin® is placed. (Fig. 4)

Figures 3A,B,C

Size 0.62 Kirschner wire can be placed percutaneously into the distal fragment to use as a joystick to regain the normal anatomical volar tilt.



Note: The 0.62 K-wire is used to assist in fracture reduction. Figure 3 does not depict the T-Pin guide wire.



Figures 4A,B,C. Kapandji pinning used to secure reduction prior to the T-Pin® for distal radius fixation



Figures 5A,B
Most common T-Pin® placement pattern: 2 radial styloid pins



Figures 6A,B
Alternate T-Pin® placement pattern: radial styloid and dorsal ulnar pins



Figures 7A,B
A single T-Pin® is useful for isolated radial styloid fractures

Typically, for the younger patient with good bone stock, 2 T-Pins can be placed at the radial styloid alone through a single incision. (Fig. 5)

Alternatively, two 1-2 cm longitudinal incisions are made: 1 at the distal aspect of the radial styloid between the first and second dorsal extensor compartments, dorsal to the abductor pollicis longus / extensor pollicis brevis tendons and the second between the fourth and fifth dorsal extensor compartments at the ulnar dorsal corner of the radius. (Fig. 6)

A single pin is useful for isolated radial styloid fractures. (Fig. 7)

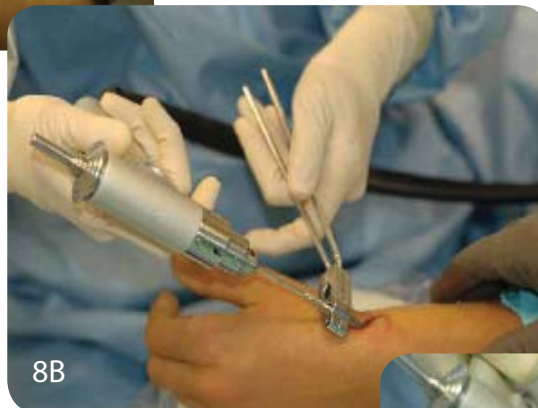
Union Surgical

The soft tissues are bluntly dissected to bone for safe placement of guide wires. At the incision over the radial styloid, the first dorsal extensor compartment is routinely released to facilitate pin placement. Dissection is carried down to visualize the pin insertion site, and adjacent extensor tendons are protected by retraction or by use of the tissue protection guide provided on the tray. The fracture is initially stabilized with smooth 1 mm guide wires at the aforementioned insertional sites and placement is adjusted under fluoroscopic guidance. A technical point to note is that the guide wire will deflect off the inner cortices and bend whereas the more rigid T-Pin® will not; therefore, guide wire insertion should stop when cortical contact is made.

A measuring guide is then applied along each guide wire indicating the length of the T-Pin® required. The pin tray supplies pin lengths from 40 mm to 70 mm in 5 mm increments. *To avoid having the guide pin kink and bend near the tip, we back out the guide wire 10 mm after measuring its depth and prior to T-Pin® placement.*



Figures 8A-C
T-Pin® insertion over
the guide wire utilizing
split soft tissue
protector



The cannulated T-Pin® is secured onto the power driver and inserted over the guide wire. (Fig. 8) The T-Pin® is driven along the guide wire until the trailing threads are nearly flush with the bone. The split issue protector opens to allow removal for final seating of the pin without having to disengage the driver. The surgeon disengages the power driver and removes the guide wire, leaving only the T-Pin® in place. The break-off driving mechanism of the pin is easily removed by bending the smooth shaft by hand.



Figures 9A,B
Stability of the fixation is checked under fluoroscopy

Stability of the fixation is checked under fluoroscopy. (Fig. 9)
The tourniquet is deflated and the skin closed with nylon sutures. The postoperative dressing includes sterile gauze and a volar splint.

Complications

Potential complications include infection, loss of reduction, nerve irritation, tendon rupture, and pin migration.

Rehabilitation

The postoperative dressing is a plaster volar short arm splint which allows for unrestricted finger range of motion. Following the usual instructions of elevation, icing and splint care, the patient returns for a follow-up visit on postoperative day 1 to 3. At this first postoperative visit the patient is fitted with a custom molded, removable forearm based static wrist splint, which can be removed for bathing and exercises. Therapy is initiated under the guidance of a hand therapist for active and passive digital range of motion, edema control, and gentle wrist active range of motion. (Fig. 10)

For severely osteoporotic bone, wrist range of motion is deferred until 2-3 weeks postoperatively. By initiating wrist range of motion on or before the third postoperative day, we feel it is possible to restore a greater degree of motion and quicker restoration of function compared to results achieved from delayed initiation of range of motion.

At 2 weeks postoperative, sutures are removed and the patient is advanced to a program of active, active assisted, and gentle passive wrist extension and flexion. Initial recommended wrist range of motion limits are 30° of extension and 30° of flexion. At this point, the patient may also begin pain-free light resisted grip exercises.



Figures 10A-C
The minimally invasive nature of the procedure is demonstrated here by the limited incisions (10A). Range of motion is initiated at the first postoperative visit (10B,C).

Generally, the pins do not require removal and are left in place. Some patients; however, desire removal. Pins are removed with a removal tool designed to fit the flutes in the distal threads of the T-Pin®, which is included in the pinning tray. (Fig. 11)

A 4.0 mm hollow mill is useful for cleaning scar tissue or bone from the distal threads of the T-Pin® to allow easy placement of the removal tool. Once full fracture healing has occurred after the pin has been removed as assessed by no tenderness from palpation at the fracture site an unrestricted program of range of motion and strengthening can begin. The protective splint is discontinued at this time.



Figures 11 A,B
T-Pin® removal instruments

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