En Bloc Joystick Reduction of a Comminuted Intra-articular Distal Radius Fracture: A Technical Trick

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Abstract

A patient with a 1-month-old intra-articular distal radius fracture (treated closed in a splint) presented with an unacceptable degree of pain and stiffness caused by shortening and dorsal angulation of the distal radius. The fracture was comminuted with 4 or 5 distinct fragments, several involving the articular surface. Surgical correction was attempted. During the procedure, it was noted that, though the distal radius was shortened and angulated, there was actually acceptable congruity of the articular surface itself, despite the intra-articular nature of the fracture. Bone quality was poor and healing incomplete. Thus, we were concerned the currently congruous articular surface would fall apart with manipulation. Given this situation, we used a unique scaffolding technique with Kirschner wires placed in perpendicular fashion to both hold the articular surface intact and manipulate it en bloc. This technique is a simple way to turn a complex fracture into an easily reduced 2-part fracture.

Reduction of comminuted fractures is difficult, as reducing one piece often displaces another. It can also be difficult to hold multiple articular surface fragments together without violating the articular surface with hardware. Numerous techniques have been used to help hold comminuted articular surfaces together. One technique is scaffolding, in which parallel screws or pins are placed just below the articular surface to provide a stable base.

In the case reported here, we used a similar scaffolding technique to hold an articular surface reduced and to allow for an easier and more stable reduction. This approach was relatively simple, took a short amount of time, and made a potentially difficult reduction easy. The patient provided written informed consent for print and electronic publication of this case report.

Case Example and Surgical Technique

A 28-year-old man presented to our clinic with a left-sided distal radius fracture sustained and treated closed 1 month earlier. The fracture was comminuted with 5 intra-articular fragments. As expected with a 1-month-old injury, there was significant callus around the fracture fragments. The articular surface appeared relatively congruous, despite the intra-articular comminution. However, the surface was noticeably displaced with shortening and dorsal angulation as a whole. On examination, the patient noted an unacceptable degree of pain and limited range of motion about the wrist, likely secondary to displacement of the articular surface. We thought we could improve the patient's outcome by surgically reducing the articular surface to restore proper length and alignment of the distal radius.

The initial operative plan was to reduce and fix the fracture through a dorsal approach. The fracture site was reached through the third dorsal compartment (with transposition of the extensor pollicis longus) and under the fourth compartment. During dissection and débridement, it was noted that the bone, despite its young age, was quite soft, and the fracture site more unstable than anticipated. We were concerned that, though the articular surface was well aligned relative to itself, any manipulation of these fracture fragments might cause them to fall apart, lose their alignment, make the case significantly more difficult, and reduce the likelihood of an ideal outcome. At that point, we thought that, if we secured and reinforced the distal segments with Kirschner wires (K-wires), manipulating the distal segment into alignment would be easier.

In the technique, 3 K-wires are inserted radial to ulnar in parallel fashion to secure the articular fragments. Another set of K-wires is then placed perpendicular and just proximal to the first set. These dorsal-to-palmar placed wires are then used to manipulate the distal segment into alignment (**Figures 1A, 1B**). As the dorsal-to-palmar wires are manipulated, they abut the row of radial-to-ulnar wires, which create a "rebar" reinforcement that allows an "en bloc" motion of the distal segment. A laparotomy pad strap is placed around the dorsal-palmar wires and is traction-pulled. This allows even force to be applied across all wires in the construct

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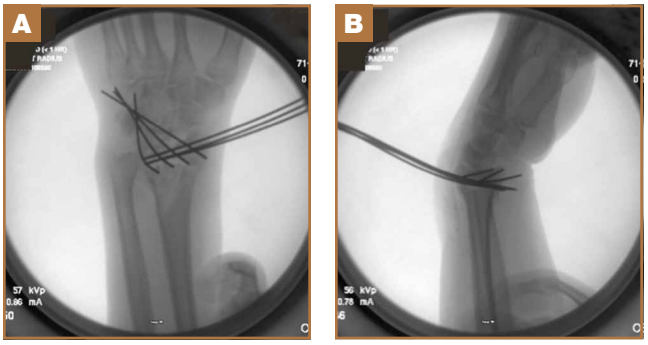

Figure 1. (A) Anteroposterior and (B) lateral radiographs show reduction of comminuted articular surface en bloc into near anatomical position.

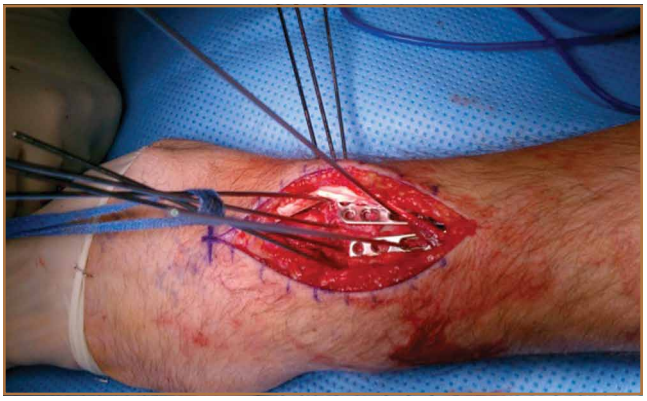

Figure 2. Technique demonstrated, with laparotomy pad strap used to hold reduction.

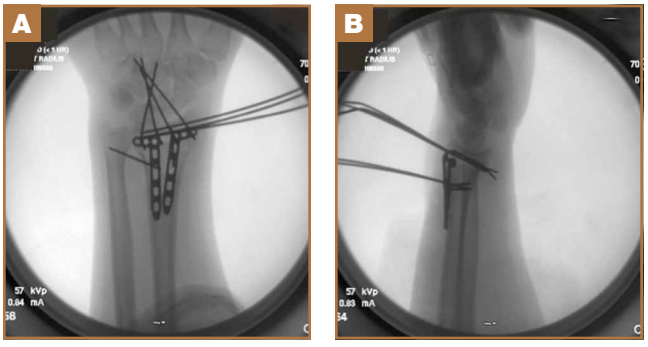

Figure 3. (A) Anteroposterior and (B) lateral radiographs show placement of lateral and intermediate column plates while reduction is being held. Kirschner wires are placed distal enough to allow placement of plates while assistant holds reduction.

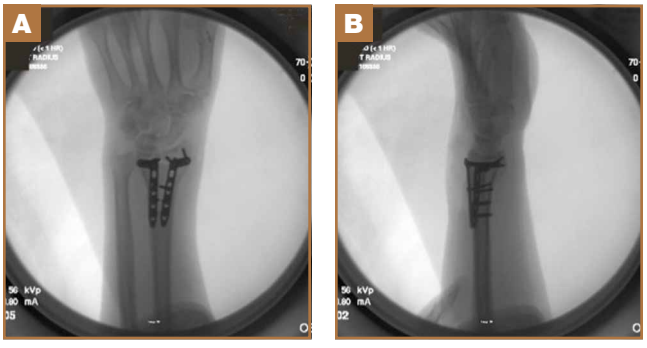

Figure 4. (A) Anteroposterior and (B) lateral radiographs show final product with pins removed.

holding reduction and keeps the assistant's hands out of the field and out of fluoroscopic imaging (**Figure 2**).

Once alignment is established, standard K-wires can be placed—through the styloid, through the ulnar corner, or intrafocally—to stabilize the fracture. Alternatively, plating techniques can be used, which is what we did with this patient. We placed the wires as distal as possible in the subchondral bone to allow for more stable manipulation of the articular surface and placement of internal hardware without obstruction by the K-wire construct (**Figures 3A, 3B**).

After internal fixation is secured, the K-wires are removed, and the wound closed (**Figures 4A, 4B**).

We used this technique to secure the comminuted articular fragments and reduce them to the remainder of the radius. Our patient had an uneventful postoperative course and declined further follow-up after healing.

Discussion

There are many well-known techniques for helping reduce and stabilize a displaced nonunion of the distal radius fracture. Various patterns of K-wire fixation of comminuted fractures have been described, including crossing wires through the radial styloid,[1] ulnar-radial pinning,[2] and dorsal-radial pinning.[3] Dorsal pinning has also been used, with pins placed through the flexor carpi radialis tendon[4] to help stabilize dorsal fracture fragments. Most of these techniques, though providing stable fixation of comminuted fracture fragments, require the fragments to be adequately reduced before K-wire placement. In our patient's case, the main concern was how to adequately reduce the articular surface without disrupting the several articular fragments already in good alignment. We thought that attempting a closed reduction, or even significant manipulation after open dissection, would cause the currently acceptable but tenuous reduction of the articular surface to fall apart. After achieving reduction, we performed internal fixation with columnar plates. However, we could have considered one of the aforementioned methods for final fixation.

In a well-described technique by Kapandji,[5] a distal radius fracture is managed with K-wires placed dorsally through the fracture site to effect a volar and distally based reduction (intrafocal pinning). Our technique is similar only in that K-wires are used for reduction; instead of pushing against bone segments, we use K-wires to push against other embedded K-wires used as a reinforcing scaffold. Our technique uses a simple construct to turn an unstable multipart fracture into a more stable construct. If the articular surface is not reduced,

this technique should not be used until adequate reduction has been achieved. The same K-wires used to stabilize the articular surface during reduction can also be used as the embedded scaffold, if desired.

For maximum stability, each set of parallel wires should be spaced to diffuse any force applied across the entire fragment, not focally on one area. The perpendicular set of wires should be in immediate contact, or as close as possible, to the initial set of wires. This guarantees that, when torque is applied to the wires—when they are being used as a joystick—torque is actually applied to the first set of wires, not directly to the potentially unstable fracture fragments.

Careful placement of the scaffolding should also be planned to ensure that internal fixation plates have adequate space to be laid down and secured with the wires in place, holding the reduction. In our patient's case, the laparotomy strap was used to apply the volar tilt on the wires to allow for evenly applied force across all K-wires, free line of sight for fluoroscopic imaging, and work space for placing the plates without having the assistant's hand in the way. However, manual manipulation is certainly effective, and should be used if more than one direction of force is needed to maintain proper reduction.

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This paper will be judged for the Resident Writer's Award.