

Controlling the Critical Corner:

Case Examination of the Use of the Avulsion Hook Plate in Treating Complex Distal Radius Fractures

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Introduction

This report details the author's use of a 0.8 mm Avulsion Hook Plate (AHP) from the Acumed Hand Fracture System (Acumed LLC, Hillsboro, OR, USA) with a volar distal radius (VDR) plate from the Acumed Acu-Loc® 2 Wrist Plating System.



Background

Distal radius fractures (DRF) are the commonest fractures that present to an emergency department (ED). The vast majority can be treated nonoperatively with simple splints or Plaster of Paris casts. With the introduction of locking plate technology at the turn of the millennium, there was a major shift toward the use of volar locking plates (VLP) and the development of anatomical plates, allowing this to become the standard operative treatment.

While VLP remains the standard treatment for most fractures that require operative intervention, there are certain, more complex, fracture patterns that may be better treated with alternative methods.

One such technique is the use of fragment-specific fixation or the use of multiple small, anatomic plates to address individual fracture fragments. Another technique is the use of plates, screws, or wires as adjuncts to address individual fragments not controlled by the VLP. A third approach is to use a volar plate as a template and a dorsal plate as a secondary buttress plate.¹

The concept of fragment specific fixation is initially described in 1996 by Rikli and Regazzoni in a paper introducing their “3-column theory”,² and further developed by Medoff who identified the specific individual fragments important in a DRF.³

Rikli, with Brink, recently expanded on the 3-column theory by further dividing the intermediate column into volar and dorsal corners. They stressed that the displaced “corner” with which the lunate moves should be considered “key” and should be the first fragment to be reduced and fixed.⁴ The volar ulnar fragment is said to be the “critical corner” since it is the keystone of both the radiocarpal and radioulnar joints, and displacement of this fragment can result in altered mechanics of both joints.^{5,6} Furthermore, this fragment is the origin of the short radiolunate ligament which is a key stabilizer of the radiolunate articulation. This concept is not new and was discussed in Melone’s 1984 paper⁷ and was expanded on by Medoff who described a dorso-ulnar corner, a volar rim, a dorsal wall, and a free intraarticular fragment.³

Medoff also introduced the radiographic descriptions of the vitally important volar rim fragment, describing the “teardrop” as the “volar projection of the lunate fossa,” which, despite its small size, acts as “a mechanical buttress that prevents [volar] subluxation of the lunate.” He also described the “teardrop angle” which allows assessment of the displacement of this fragment.

The size of the fragments will decide the implant used for fixation and there are many choices available. Previous concerns about implant prominence have been addressed with much lower profile, anatomic plate designs, and the risk of implant prominence by crossing the “watershed line”⁸ is outweighed by the catastrophic consequences of not controlling the volar rim fragment.⁶ With modern implants, even the smallest fragments can be controlled with screws, wire forms, suture plates, or hook plates.⁶

The Implants

The Acumed Acu-Loc 2 is a well-established system for treating distal radius fractures. Although the system has distal VLPs and volar lunate facet fragment-specific plates, reaching very distal critical corner fragments can sometimes remain a challenge. The Acumed Hand Fracture System comprises a selection of 0.8 mm and 1.3 mm thickness plates, including a 0.8 mm Avulsion Hook Plate designed to provide more stability than a K-wire when a fragment is too small for a single lag screw. The Acu-Loc 2 non-locking and VA screws can integrate with both the volar distal locking plate (VDLP) and the hook plate.

Use of 0.8 mm Avulsion Hook Plate with Acu-Loc 2 VDR Plate

On rare occasion, even the distal sitting Acu-Loc 2 VDR plate may not afford adequate fixation of a critical corner fragment. In such cases, the author and others have previously used supplementary fixation with either screws or wires. However, with the validation of the 0.8 mm Avulsion Hook Plate with the Acu-Loc 2 System, the possibility of supplementing a volar plate with a low-profile adjunct arose and has been used by the author in three cases. This paper details two of those cases where postoperative follow-up was available.

Methods

Data collection for this report was by review of pre-, peri-, and postoperative data of patients undergoing treatment with a combination of an Avulsion Hook Plate and an Acu-Loc® 2 Volar Distal Radius Plate.

The Cases

Case 1

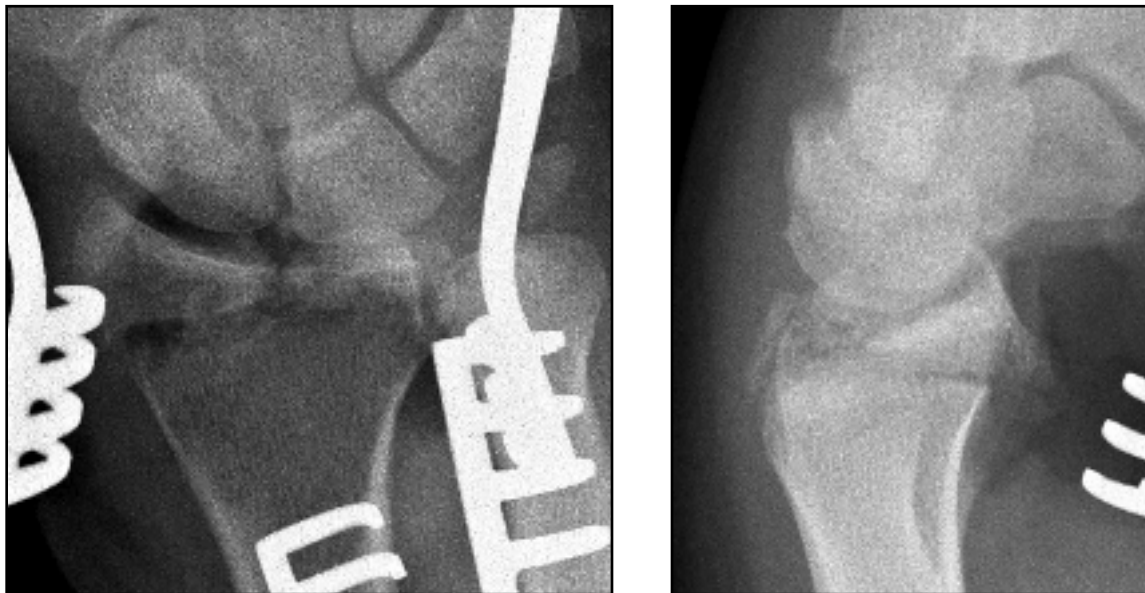
The patient was a 41-year-old male council worker who is fit and well.

The patient slipped on wet floor in a bar while on holiday in Italy where he was placed in splint and repatriated.

Upon presentation to ED, radiographs and CT confirmed a very unusual intraarticular DRF with a shear fracture of the whole of the lunate facet which had dislocated volarly.



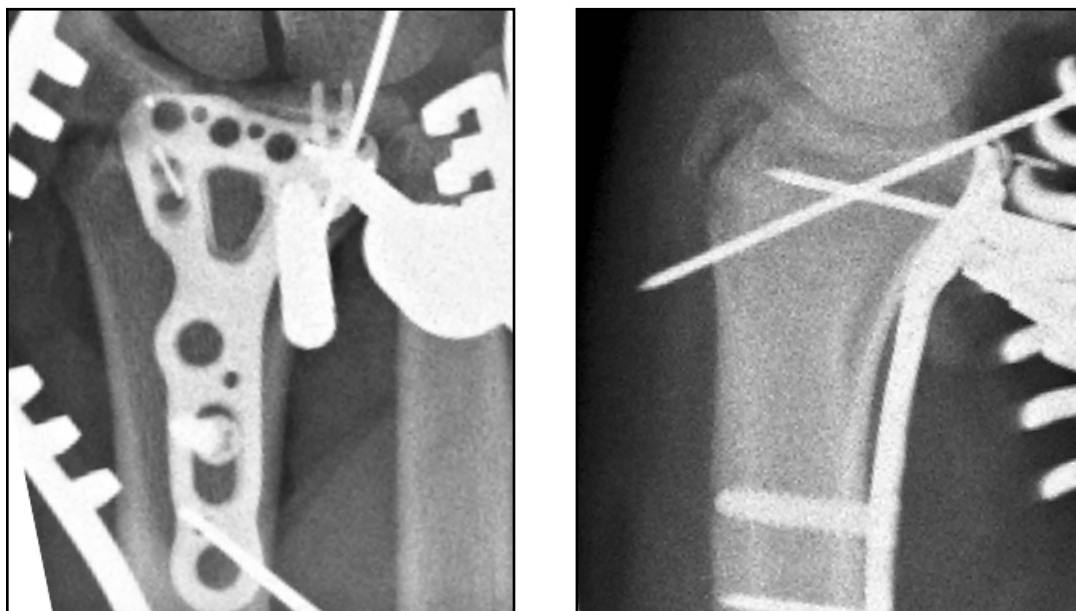
At time of surgery, through an flexor carpi radialis (FCR) approach, the fragment was identified within pronator quadratus and confirmed as the whole lunate facet with volar capsule attached. The associated capsular tear extended to allow reduction of the fragment after hyperextension of the wrist.



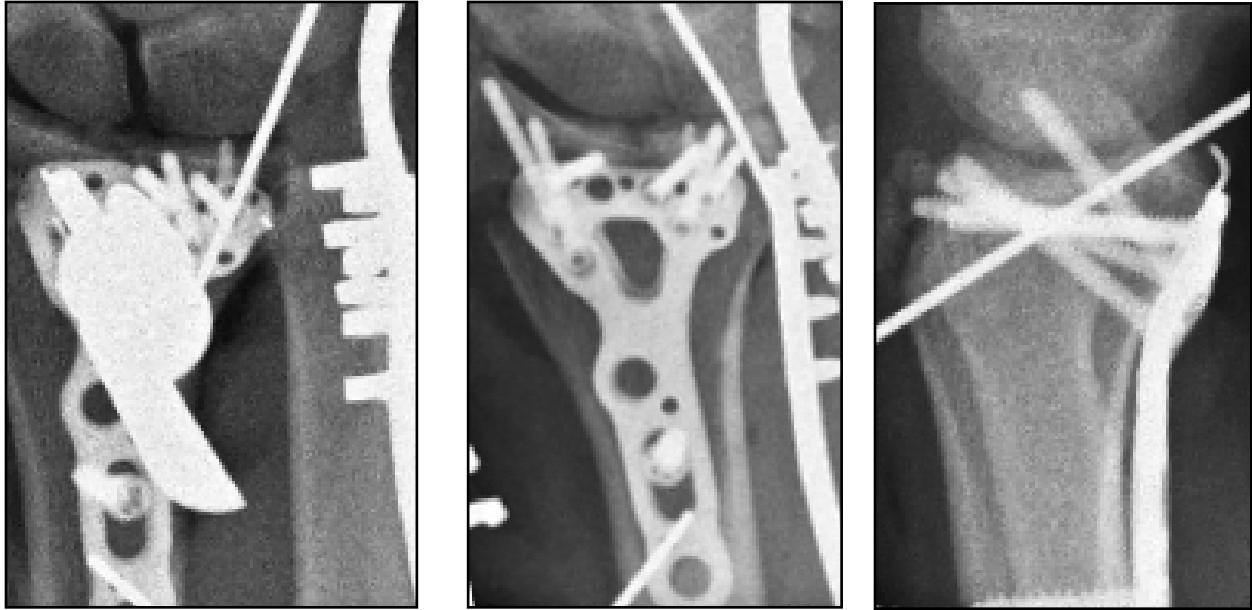
The volar aspect of the lunate facet fragment was temporarily fixed with an oblique K-wire distal to the plate. An Acumed Acu-Loc® 2 VDR plate was secured to the shaft of the radius in the ideal position using a 3.5 mm nonlocking cortical screw through the oval hole to allow repositioning of the plate.

Since the VDR plate did not support the fragment, the decision was made to use the Avulsion Hook Plate under the volar plate.

The hook plate was applied to the fragment and temporarily fixed with a 0.035" K-wire through the wire hole. The volar plate was placed over the AHP, aligning the most ulnar distal screw hole in the VDR plate and the screw hole of the AHP. The construct was temporarily secured with a K-wire through the 0.054" K-wire guide, placed within the VDR plate's targeting guide in order to provide rotational stability during screw insertion.



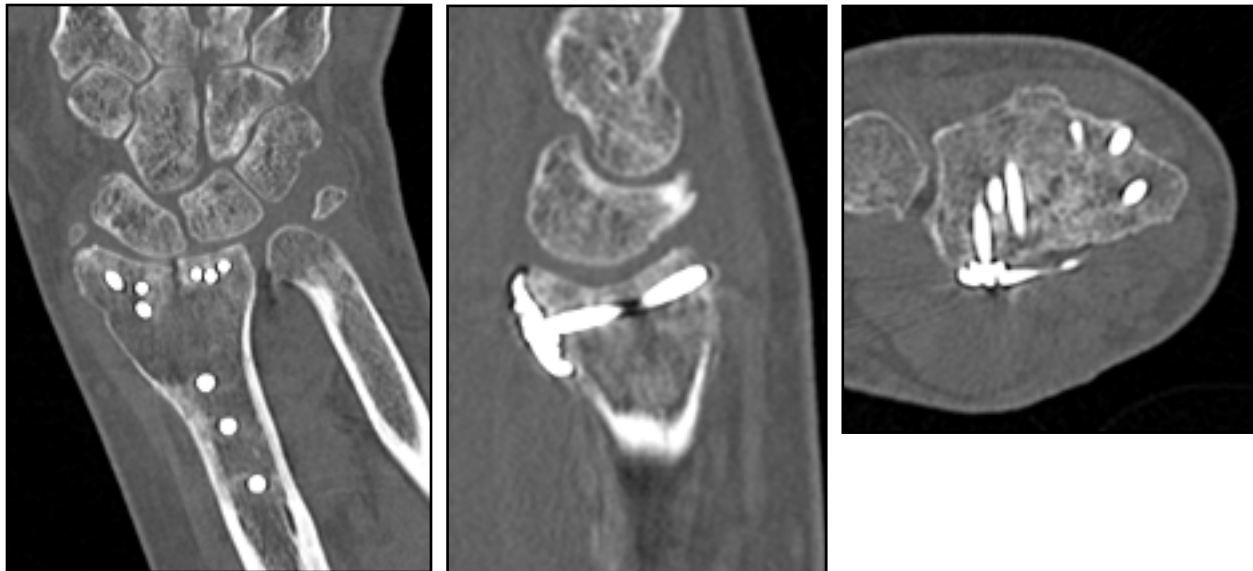
The lunate facet fragment was then secured using the ulnar cluster of 2.3 mm variable angle locking screws from the Acu-Loc 2 system.



Stabilization of the radial column with 2.3 mm screws completed the articular fixation. Two further 3.5 mm locking screws in the shaft completed the surgery.

There were no intraoperative or postoperative complications. The patient was discharged and referred to therapy.

After six months post injury, the patient made a positive recovery. He had good pain relief, full range of movement, and good function in the wrist and hand. There was clicking on supination, which a CT scan suggested may be coming from the distal radioulnar joint (DRUJ). He considered having the plates removed.



Case 2

The patient was a 17-year-old male who is fit and works as plumber. He fell from height (20' from a ladder), landing on his outstretched hands onto concrete. He sustained a bilateral DRF.

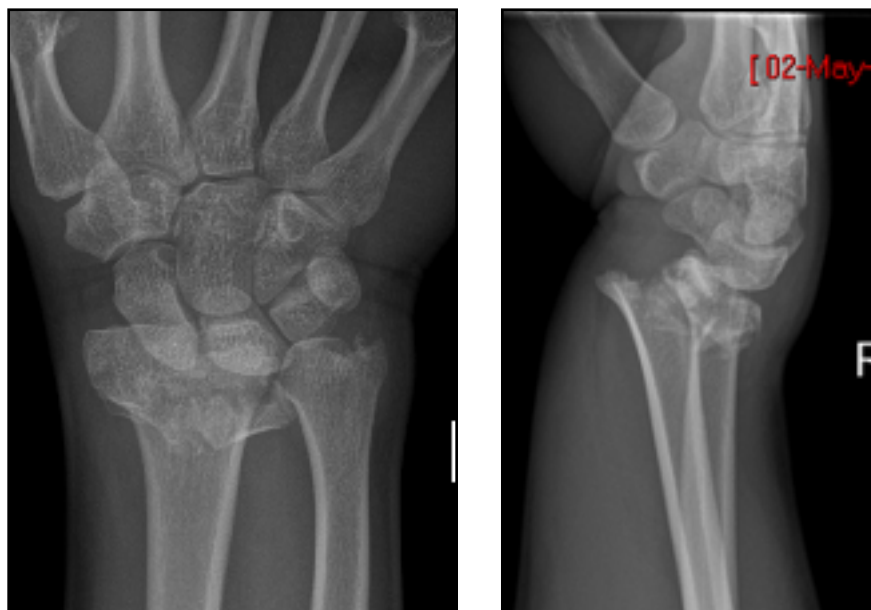
He had obvious deformities, was in severe pain, and had median nerve symptoms on the right hand side. He underwent manipulation under anesthesia in the emergency department and his median nerve symptoms improved.

The patient was admitted for evaluation, preoperative planning, and Compartment Syndrome monitoring to determine potential injury to his median nerve.

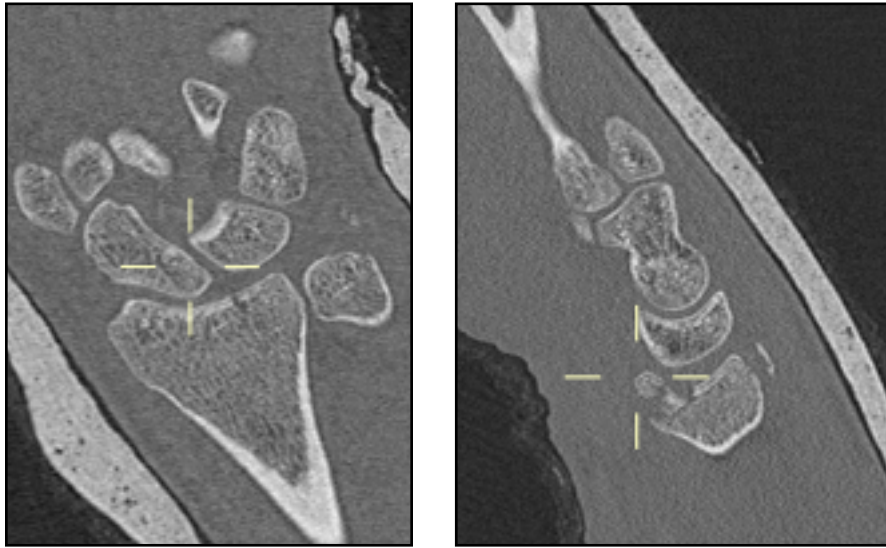
The fracture of the left distal radius was a comminuted AO C3 fracture treated with a standard VLP with favorable effect.

The fracture of the right distal radius is discussed here:

Plain radiographs confirmed a distal AO C3 fracture with significant dorsal comminution.



CT scans confirmed the distal nature of the fracture and a small, rotated volar lunate facet fragment.



Due to a combination of a displaced critical corner fragment and significant dorsal comminution, the decision was made to treat this with volar distal locking plate (VDLP) templated dorsal buttress plating.¹

Through a volar FCR approach, an Acu-Loc® 2 VDR plate was applied to the shaft of the radius and secured in the ideal position using a 3.5 mm nonlocking cortical screw through the oval hole in the shaft to allow repositioning of the plate.

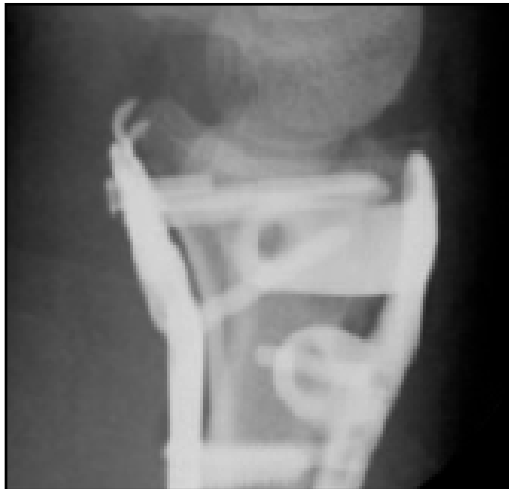
The critical corner fragment was reduced and temporarily fixed using a 0.054" K-wire through the fragment, distal to the plate. Following reduction, the volar plate did not appear to support the volar lunate facet fragment and it was decided to use the AHP.

The hook plate was applied to the fragment and temporarily fixed with a 0.035" K-wire through the K-wire hole. The volar plate was reapplied over the AHP, aligning the most ulnar distal screw hole in the VDR plate with the screw hole of the hook plate. The fragment was temporarily secured with a 0.054" K-wire through the K-wire guide, placed within the volar plate's targeting guide in order to maintain rotational stability during screw insertion.

The AHP was secured to the volar plate using a short 2.3 mm locking screw from the Acu-Loc 2 system, ensuring that it remained only in the volar lunate facet fragment so as not to interfere with reduction of the dorsal lunate facet fragments.

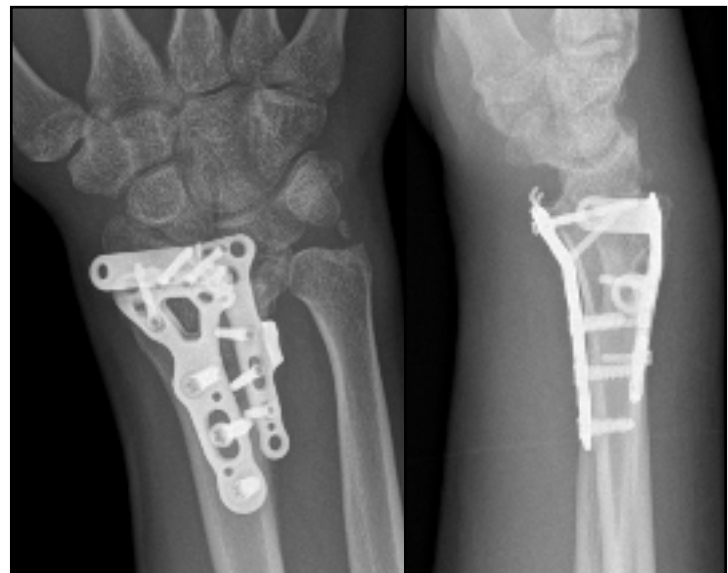
A dorsal extensor approach between the third and fourth compartment was made to the distal radius and an Acu-Loc 2 dorsal rim plate was applied using a nontoggling screw through the shaft of the dorsal plate to buttress the articular fragments against the VDR plate, which acted as an anatomic template.

Following reduction, fixation was completed by inserting locking screws into the distal aspect of the VDR plate and into the proximal section of both plates.



Postoperatively, the patient was kept in the hospital with the limb elevated overnight. Radiographs revealed a mild prominent screw position with the 2.3 mm locking screw. Selecting a 2.3 mm VAL screw would have provided a more lower profile fit. The patient experienced anticipated mild median nerve symptoms alongside swelling and pain complications from the original trauma. Therapy began to improve his hand function and his median nerve symptoms settled. He was discharged after 48 hours.

He continued with outpatient physiotherapy and at six months postinjury, his pain had settled, with only a mild residual ache. He had good pronation and supination (90° and 75°, respectively). Flexion-extension (40°–30°) and radial-ulnar deviation (15°–20°) were improved and he had good hand function. Overall, he was happy and back to work. He considered having his plates removed to try to improve his flexion-extension.



Summary

The Acumed 0.8 mm Avulsion Hook Plate from the Hand Fracture System can be usefully combined with the standard VDR Plate from the Acu-Loc®2 Wrist Plating System to capture and stabilize critical corner fragments.

The AHP can be temporarily secured to the VDR plate by aligning and guiding it over a 0.035" K-wire inserted into any of the distal K-wire holes of the VDR plate.

The two plates are then secured together using 2.3 mm VAL screws from the Acu-Loc 2 system while care is taken to ensure the AHP does not rotate as the locking mechanism engages.

Disclosures

I am a paid consultant for Acumed. I receive no royalties but do receive industry standard payment for the provision of educational, research, and consulting services, including the collection of data, and writing of this report.

Confirmation

I can confirm that all data in this report and opinions presented, are factual and genuine. The original patient data will be kept by me for a period of not less than three years in case any clarification is required.



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HNW60-01-A | Effective: 2024/05 | © 2024 Acumed® LLC