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Re-fracture of Distal Radius and Hardware Repair in the Setting of Trauma

Brandon P. Lucke-Wold, PhD^{1*}, Patrick C. Bonasso, MD², and Glen Jacob, MD³

¹ Department of Surgery, West Virginia University School of Medicine. Medical student author.

² Dept. of Surgery, West Virginia University School of Medicine. Co-author, pbonass3@hsc.wvu.edu.

³ Dept. of Surgery, West Virginia University School of Medicine. Faculty author, gjacob@hsc.wvu.edu

*Brandon Lucke-Wold, PhD.
Department of Surgery
1 Medical Center Dr.
P.O. Box 9238
Morgantown, WV 26506
Office: (719)-459-2760
Bwold@mix.wvu.edu

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ABSTRACT

Distal radius fractures are one of the most common fractures in the elderly. Falls and motor vehicle collisions lead to increased risk for this type of fracture. A seventy-three year-old female had a previous history of distal radius fracture with repair by open reduction and internal fixation. She was involved in a motor vehicle collision that re-fractured the distal radius. The plate was bent and required removal, which is a very rare but potentially serious complication. Surgery was done to fix the open reduction and internal fixation with volar locking plates while removing damaged hardware. Only a select few cases have reported hardware failure as a cause of complications. Among those cases, high-energy activities and maintained stress on the hardware were likely causes. Distal radius fractures are the most common upper extremity fracture in the elderly. We highlight a unique case of re-fracture in the setting of trauma with prior hardware failure and describe the strategy for hardware repair.

LEARNING POINTS

1. Distal radius fractures are common in the elderly following trauma
2. Volar locking plates offer a unique tool for surgical repair
3. Locking plates are useful for hardware repair in the setting of re-fracture
4. It is important to be aware of complications associated with locking plates such as median nerve compression, nonunion, tendon irritation, and regional pain syndrome

BACKGROUND

Distal radius fractures are the most common upper extremity fracture in the elderly. Falls and high impact injuries are common causes of these fractures.¹ The fractures often require reduction and internal fixation.² Twenty-five percent of fixations result in complications including compartment syndrome, regional pain syndrome, nerve and tendon injury, and nonunion injuries.³ Very rarely, however, are the complications the result of early hardware failure.⁴ A consensus on treatment approach for distal radius fracture has not been reached especially in the context of hardware failure. Closed methods, casting, percutaneous K wires, external fixation, and reduction and internal fixation are all viable options.⁵ Recent evidence suggests that open reduction and internal fixation is becoming the most commonly used for distal radius fracture and re-fractures especially in the elderly.⁶ Hospitals with specific Hand Surgery Centers have better outcomes and less complications due to expertise in appropriate equipment placement.⁷ This is especially important in rural communities because elderly patients must often travel to one of the larger medical centers to receive care.

Specific considerations must be made in order to restore the anatomy of the radius. Length, inclination, and joint surface can all play a role in appropriate hardware selection. Volar plates are an ideal choice for high impact fractures that are comminuted.⁸ During surgery, image intensification with fluoroscopy is used to assess reduction and fixation. It is also useful to ensure articular congruency and screw placement. Successful placement of the volar plates is necessary before optimization and maintenance of the reduction can be performed with screws.⁹ Post-operative immobilization maximizes recovery. Functional outcome is dependent on bony healing, which is often compromised in the elderly due to obesity and osteoporosis.¹⁰ Although rare, complications can result from failed hardware. Tendon rupture can result from misplaced

screws. Intra-articular placement of the plate warrants plate removal¹¹ Nonunion can result from poor bony healing and in some cases may require grafting.¹²

In this report, we present a unique case of a 73-yo female with a previously repaired distal radius fracture who was in a motor vehicle accident, which resulted in hardware failure. Motor vehicle collisions generate high impact injuries. In the elderly, these injuries can be severe and lead to fractures due to increased levels of osteoporosis in this population. If pre-existing hardware is present, re-fracture of a distal radius can compromise volar plate placement and alignment. Fortunately, hardware can sometimes be repaired through previous incisions and without the use of bone grafting. Depending on the extent of damage, new volar plates and screws may be necessary. We present a case of successful restoration of articular alignment following re-fracture and hardware failure due to trauma. We highlight the important considerations for treating wrist fractures in areas with an aging population.

CASE REPORT

A seventy-three year-old female with a previous history of an open reduction and internal fixation of a right distal radius fracture via a four-hole T plate three years prior was brought to the hospital following a motor vehicle collision. Her injuries included a grade four splenic laceration with active extravasation, closed head injury, and right radius and ulna fracture. X-rays showed the volar plate was angulated and still affixed to the distal radius. The angulation resulted in abnormal volar displacement of the radiocarpal joint relative to the distal ulna with a dorsal articular tilt of forty-six degrees (Figure 1). She was taken emergently for splenic artery embolization.

Post Trauma day-three, the patient was taken to the operating room for removal of deformed hardware and to perform a new open reduction and internal fixation. A longitudinal incision was made in the previous superficial scar with the standard volar Henry approach. Previous areas of screw placement had some ossification, so a rongeur was used to smooth out the areas and help facilitate placement of a new plate. Open reduction was performed with traction along the fingers in the radial direction and slight flexion and extension evaluated by fluoroscopy (Figure 2). Internal fixation was performed with a volar locking plate. Reduction maintenance and violation of the articular surfaces was verified, and placement of two additional screws in the radius shaft was performed with conformational fluoroscopy (Figure 3). Articular alignment was restored to a neutral volar tilt. The wound was irrigated, approximated, and closed. The patient was discharged and scheduled for follow-up with an orthopedic surgeon closer to home.

DISCUSSION

The dynamics of the damaged plate due to trauma in an elderly female in this case makes it unique in the literature in that the hardware required repair for adequate restoration of alignment. Because of the bending of the plate, it is difficult to know whether the plate itself complicated the injury or provided protection during the trauma. There is no lucency surrounding her hardware evident on plain films, and her hardware was well affixed to the bone at the time of hardware removal. This would suggest that nonunion was not involved in this situation, but nonunion should be considered in elderly patients due to increased risk of osteoporosis. The plate could have distributed the force load to stop further injury or created an unseen complication by holding the distal radial epiphysis in a dislocated state. The particular hardware chosen by her

previous surgeon may have contributed to the failure as the plate was thin, and not a volar locking plate design, which contributes to a less stable repair in the elderly (Figure 4). Fortunately, the patient had an uncomplicated recovery. She was discharged and referred to a hand surgeon close to home for continued follow-up.

Open reduction and internal fixation with volar plating for treatment of distal radius fracture is becoming the emerging gold standard¹³ The most common complications of this treatment are extensor tendon or flexor tendon injury, flexor pollicis rupture, complex regional pain syndrome, and loss of reduction³ Hardware failure is a relatively rare occurrence.⁴ Hardware failure due to trauma is extremely rare, but more common in the elderly due to motor vehicle collisions. In a retrospective review of twenty-one papers, almost 3% of volar plates required resultant surgery due to hardware failure, loosening, or at patient's request¹⁴ Case reports in the literature dealing with hardware failure put the blame on prolonged stresses from improper alignment making the hardware more likely to break upon impact^{12,15,16} The prolonged stress such as repetitive impact loading can lead to early breakage of volar plates and/or screws¹⁷ Often the failure is a result of poor selection of hardware during the initial surgery. Other factors that must be considered for the elderly include osteoporosis, obesity, and muscle weakness. Hardware failure in this reported case involved motor vehicle collision trauma, but the same principles must be considered for falls as well. Trauma provided high impact acute stress that resulted in bending of the plate. Prolonged stress, more often seen in the elderly, can weaken the hardware to the point of breaking.

Volar plating was initially used to give support to distal radius fixations in order to prevent hyperextension. They were designed to allow normal wrist mobilization early after surgery. Conventional volar plates were flat and contoured. These conventional plates required

bone grafts for extra metaphyseal support but the grafts do not always prevent non-union in the elderly. The introduction of the fixed angle locking-plate allowed for rigid stabilizer without additional intervention or bone graft¹⁸ This treatment type has shown positive outcomes in both the twenty to forty year old age groups and especially in the greater than sixty year old age group¹⁹

The use of volar locking plates result in excellent outcomes for most patients at extended time points and lead to high patient satisfaction. A small number of patients do experience complications however that can be debilitating such as median nerve compression, nonunion, tendon irritation, and regional pain syndrome²⁰ Two percent of patients experience some type of hardware failure. Dorsal low-profile plates have been used when volar locking plates fail.²¹ Dorsal low-profile plates can reduce tendon irritation. Because the hardware failure in this case was the result of trauma, volar plates were used to repair the distal radius fracture. Falls and trauma are the most common causes of distal radius fractures in the elderly thereby making volar plates the ideal choice in this age group. Factors that may lead to higher risk for hardware failure include high-energy activities, such as motor vehicle collisions, and the complexity of injury. High impact trauma accounted for the hardware overload in the aforementioned case. Distal radius fractures must be considered whenever caring for elderly patients following falls or motor vehicle collisions.

REFERENCES

1. Sebastin SJ, Chung KC. An Asian perspective on the management of distal radius fractures. *Hand Clin.* 2012;28(2):151-156.
2. Kose A, Aydin A, Ezirmik N, Topal M, Can CE, Yilar S. Intramedullary nailing of adult isolated diaphyseal radius fractures. *Ulusal travma ve acil cerrahi dergisi = Turkish journal of trauma & emergency surgery : TJTES.* 2016;22(2):184-191.
3. Berglund LM, Messer TM. Complications of volar plate fixation for managing distal radius fractures. *The Journal of the American Academy of Orthopaedic Surgeons.* 2009;17(6):369-377.
4. Lattmann T, Meier C, Dietrich M, Forberger J, Platz A. Results of volar locking plate osteosynthesis for distal radial fractures. *Journal of trauma.* 2011;70(6):1510-1518.
5. Harness NG. Fixation Options for the Volar Lunate Facet Fracture: Thinking Outside the Box. *J Wrist Surg.* 2016;5(1):9-16.
6. Ezzat A, Baliga S, Carnegie C, Johnstone A. Volar locking plate fixation for distal radius fractures: Does age affect outcome? *J Orthop.* 2016;13(2):76-80.
7. Dasari CR, Sandhu M, Wisner DH, Wong MS. Approaches to Distal Upper-Extremity Trauma: A Comparison of Plastic, Orthopedic, and Hand Surgeons in Academic Practice. *Ann Plast Surg.* 2016;76 Suppl 3:S162-164.
8. Geissler WB, Clark SM. Fragment-Specific Fixation for Fractures of the Distal Radius. *J Wrist Surg.* 2016;5(1):22-30.
9. Pillukat T, Fuhrmann R, Windolf J, van Schoonhoven J. [The volar locking plate for extension fractures of the distal radius]. *Oper Orthop Traumatol.* 2016;28(1):47-64.
10. Korpelainen R, Korpelainen J, Heikkinen J, Vaananen K, Keinanen-Kiukaanniemi S. Lifelong risk factors for osteoporosis and fractures in elderly women with low body mass index--a population-based study. *Bone.* 2006;39(2):385-391.
11. Gyuricza C, Carlson MG, Weiland AJ, Wolfe SW, Hotchkiss RN, Daluiski A. Removal of locked volar plates after distal radius fractures. *The Journal of hand surgery.* 2011;36(6):982-985.
12. De Baere T, Lecouvet F, Barbier O. Breakage of a volar locking plate after delayed union of a distal radius fracture. *Acta orthopaedica Belgica.* 2007;73(6):785-790.
13. Naito K, Zemirline A, Sugiyama Y, Obata H, Liverneaux P, Kaneko K. Possibility of Fixation of a Distal Radius Fracture With a Volar Locking Plate Through a 10 mm Approach. *Tech Hand Up Extrem Surg.* 2016;20(2):71-76.

14. Diaz-Garcia RJ, Oda T, Shauver MJ, Chung KC. A systematic review of outcomes and complications of treating unstable distal radius fractures in the elderly. *The Journal of hand surgery*. 2011;36(5):824-835 e822.
15. Cao J, Ozer K. Failure of volar locking plate fixation of an extraarticular distal radius fracture: A case report. *Patient safety in surgery*. 2010;4(1):19.
16. Yukata K, Doi K, Hattori Y, Sakamoto S. Early breakage of a titanium volar locking plate for fixation of a distal radius fracture: case report. *The Journal of hand surgery*. 2009;34(5):907-909.
17. Wall LB, Brodt MD, Silva MJ, Boyer MI, Calfee RP. The effects of screw length on stability of simulated osteoporotic distal radius fractures fixed with volar locking plates. *The Journal of hand surgery*. 2012;37(3):446-453.
18. Arora R, Gabl M, Erhart S, Schmidle G, Dallapozza C, Lutz M. Aspects of current management of distal radius fractures in the elderly individuals. *Geriatric orthopaedic surgery & rehabilitation*. 2011;2(5-6):187-194.
19. Chung KC, Squitieri L, Kim HM. Comparative outcomes study using the volar locking plating system for distal radius fractures in both young adults and adults older than 60 years. *The Journal of hand surgery*. 2008;33(6):809-819.
20. Sugun TS, Gurbuz Y, Ozaksar K, Toros T, Bal E, Kayalar M. A new complication in volar locking plating of the distal radius: longitudinal fractures of the near cortex. *Acta Orthop Traumatol Turc*. 2016;50(2):147-152.
21. Yu YR, Makhni MC, Tabrizi S, Rozental TD, Mundanthanam G, Day CS. Complications of low-profile dorsal versus volar locking plates in the distal radius: a comparative study. *The Journal of hand surgery*. 2011;36(7):1135-1141.

FIGURES



Figure 1: Right hand X-rays prior to operative management showing deformed hardware and displaced distal radius fracture.



Figure 2: Intraoperative fluoroscopy imaging of right radius showing removal of previous hardware and visualization of screw holes with open reduction of the distal radius.

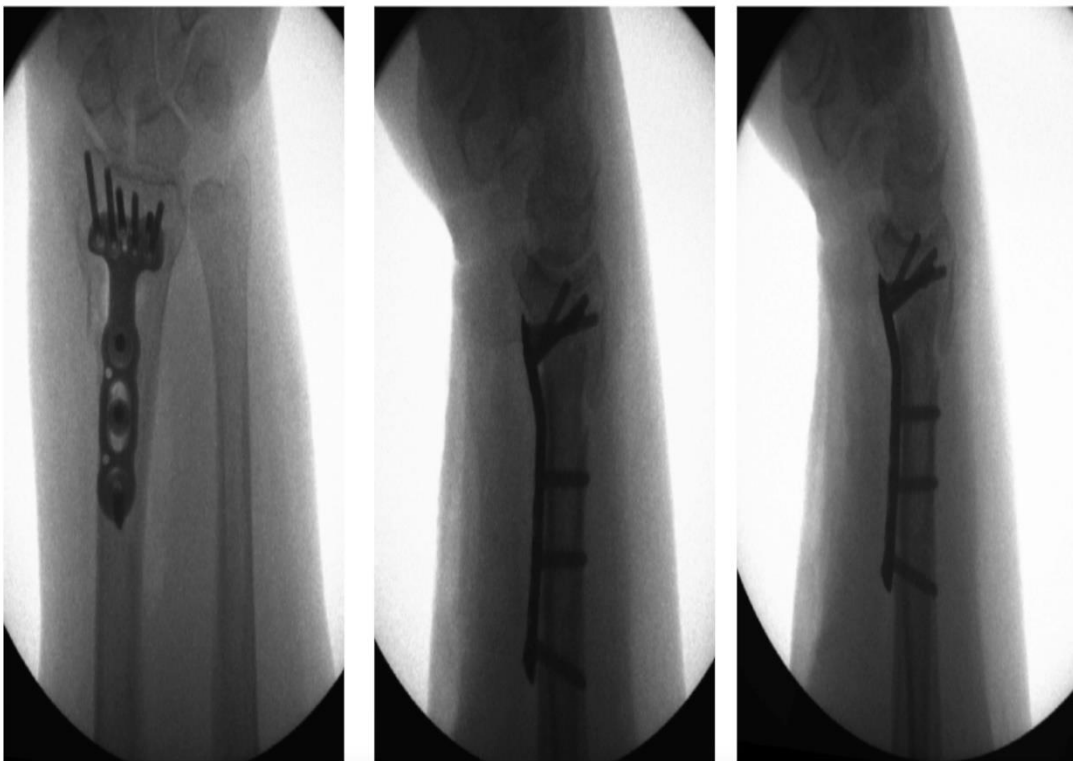


Figure 3: Intraoperative fluoroscopy showing placement of volar locking-plate.

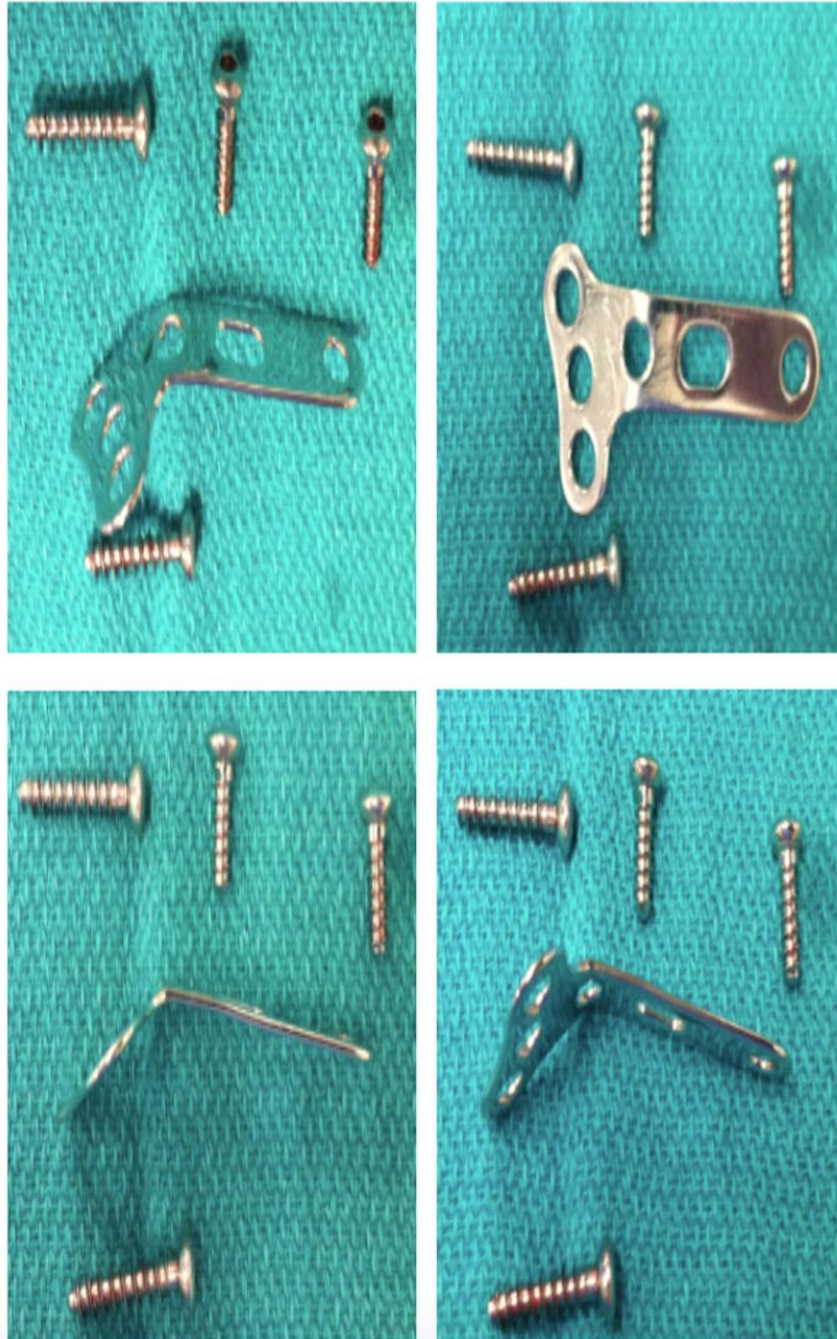


Figure 4: Ex vivo: removal of previous deformed volar plate and screws.