Evaluating the Distal Extent of Visualization in Volar Approaches for Distal Radius Fracture Fixation

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INTRODUCTION:

Distal radius fractures may include the difficult-to-treat fracture of the volar ulnar corner, colloquially termed the “critical corner.” These fragments are problematic because they are often missed on initial radiographic evaluation. Further, the small size, thick periosteal coverage, and remote location of these fragments complicate their intraoperative detection. Fixation is challenging due to fragment size, the potential for avascularity, and tendon proximity to the volar rim. The vascular anatomy of the volar distal radius is variable, and it is likely that intraosseous vessels are the sole supply of these small fragments. This reinforces the importance of successful fixation at the index procedure, as revision fixation portends unsatisfactory outcomes. Improved visualization and access to the volar ulnar corner of the distal radius can facilitate detection and fixation of these fragments.

Surgical approaches should minimize soft tissue disruption and potential for complication while providing ample exposure to identify and fix all components of the fracture. Jupiter et al. and Harness et al. alluded to the importance of approach in management of distal radius fractures with volar marginal fragments. Commonly utilized radial-sided approaches to the volar distal radius include the Henry approach, modifications of the Henry approach, the flexor carpi radialis (FCR) approach and the extended flexor carpi radialis approach (EFCR). Evidence-based guidance is needed to determine if there are demonstrable differences between these options. We aimed to compare the exposure of the volar surface of the distal radius between the classic Henry approach and the extended flexor carpi radialis approach.

METHODS: Thirteen matched pair shoulder disarticulation cadaveric specimens were randomized to receive either a Henry approach or an EFCR approach to the volar distal radius. A clamp was placed across the forearm, just distal to the elbow and across the palm, distal to the trapezium. A small Weitlaner was placed proximally and opened to its maximum width to standardize the initial retraction. A 6 millimeter (mm) mini Hohmann retractor was used to provide distal retraction at the level of the critical corner. The Hohmann was placed as distally as possible against the ulnar aspect of the radius, abutting the volar distal radioulnar joint capsule, to ulnarly retract the soft tissue. The Hohmann angle of retraction was standardized at 60 degrees and was confirmed with a digital angle gauge. The force needed to attain 60 degrees of retraction was measured in a standardized manner with a force gauge. Then a 0.062-inch Kirschner wire was placed at the most distal and most ulnar point that was visible from a position directly above the incision. Each distal radius was sectioned 15 cm proximal to the wrist joint and removed from the specimen. All soft tissues were stripped from the bone. The pin was removed from each radius and a felt-tipped marker was used to mark the pin hole. A digital caliper was used to measure the distance from the pin hole to the articular margin of the lunate fossa, along a line parallel to the long axis of the radius.

RESULTS:

The EFCR approach resulted in a mean distance of the pin to the articular margin of 2.94 mm ± 1.69 mm. The Henry approach resulted in a mean distance of the pin to the articular margin of 9.70 mm ± 2.70 mm. The pin was significantly closer to the articular margin in the EFCR approach compared to the Henry approach ($p<0.05$). Interrater reliability (ICC) was 0.989 (95% CI 0.976-0.995).

The mean moment of retraction was not significantly different ($p=0.22$) when comparing the EFCR approach (1.47 +/- 0.77 Newton-meters) to the Henry approach (1.88 +/- 1.12 Newton-meters).

DISCUSSION AND CONCLUSION:

Fixation of distal radius fracture remains challenging. Recently there has been increased awareness of fracture of the volar ulnar corner, which is often referred to as the volar marginal fragment. When these fragments are not properly managed, an incongruous articular surface and subsequent wrist instability may occur. Adequate exposure of the volar surface of the distal radius is crucial for assessment and fixation of the volar marginal fragment.

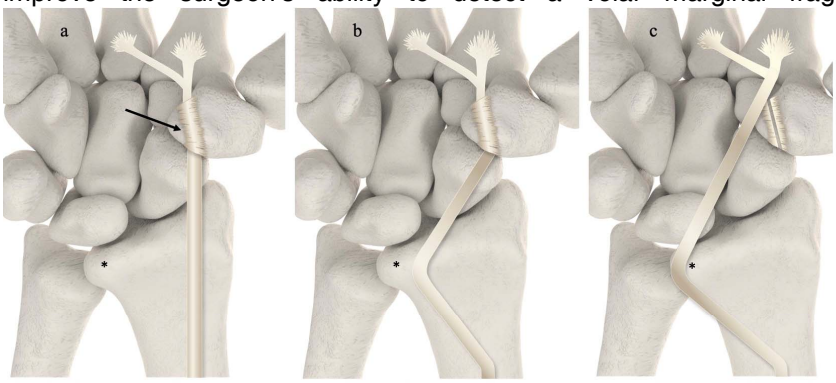
Rigorous study has brought attention to two important aspects involving the volar marginal fragment. First, the potential for an unrecognized volar marginal fragment. Harness et al. noted that these fragments may not always be readily apparent on radiograph. Second, the difficulty in achieving adequate fixation. Harness et al. and Jupiter et al. described the importance of adequate exposure in the management of these fragments.

Volar marginal fragments can often be overlooked on radiographic evaluation. Intraoperative visualization of volar marginal fragments can be problematic due to their diminutive size and cryptic location. Therefore, inadequate exposure will hinder complete assessment of volar marginal fragments.

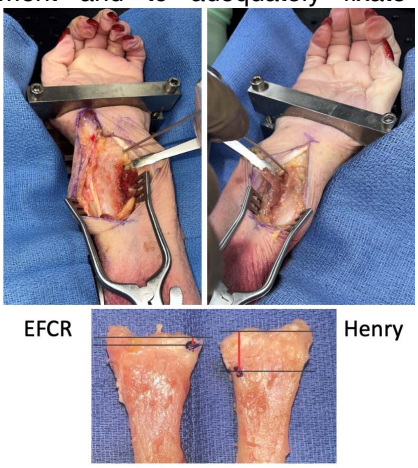
The morphology of the volar ulnar corner is problematic for fixation. There is a marked volar projection of the distal radius volar rim moving from radial to ulnar, which is difficult to fix with a flat plate. Volar marginal fragments are at risk for redisplacement if not properly addressed. Modern options for fixation of these fragments include specifically designed

plates and extensions that can be added to VLPs. Maximizing the distal extent of visualization may facilitate the application of these fixation options.

In conclusion, our results demonstrate a significantly more distal visualization of the volar distal radius with the extended flexor carpi radialis approach compared to the Henry approach. Complete visualization of the volar ulnar corner may improve the surgeon's ability to detect a volar marginal fragment and to adequately fixate this fragment.



Graphic demonstrating flexor carpi radialis insertion onto the trapezium (arrow) and the volar ulnar corner of the distal radius (*) (a). The Henry approach performed as described without release of the flexor carpi radialis insertion onto the trapezium (b) and the extended flexor carpi radialis approach performed as described with release of the flexor carpi radialis insertion onto the trapezium (c).



EFCR Henry