

## Case Report

# A case of volar lunate subluxation after volar locking plate fixation for volarly displaced distal radius fracture

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We report a rare case of volar lunate subluxation that occurred after volar locking plate fixation for a volarly displaced distal radius fracture. The patient was a 63-year-old male who was injured when his motorcycle collided with a car. He had a right volarly displaced distal radius fracture (AO/OTA classification 2R3B3), an ipsilateral femoral neck, segmental shaft, and distal femur fracture that extended to the knee joint, as well as a traumatic subarachnoid hemorrhage as complicating injuries. The distal radius fracture was internally fixed with a volar locking plate (VALCP Plate). At re-examination five months postoperatively, plain radiographs and computed tomography images showed that the distal radius fragments were fused while being volarly displaced and the lunate was volarly subluxated. Although the patient only reported mild pain, radiocarpal arthrodesis, and ulnar head resection were performed nine months after the original procedure due to concerns about future rupture of the finger flexor tendon. As of 12 months after the additional operation, the patient was engaged in design work, as he was before the injury, and had 'good' wrist function, achieving 70 points in the evaluation criteria by the Japanese Society for Surgery of the Hand. The causes of postoperative volar subluxation of the lunate were thought to be insufficient fixation force on volar lunate fossa fragments, femoral fractures as complicating injuries, and axial pressure applied to the radial joint surface when the patient used his hands to walk with a walker or stand up.

ACTA MEDICA NAGASAKIENSIA 67: 85–90, 2024

**Key words:** volarly displaced distal radius fracture, postoperative complication, lunate subluxation, volar locking plate fixation

## Introduction

Buttress plate fixation using a volar locking plate is commonly performed for volarly displaced distal radius fractures, also known as Smith fractures (including volar Barton fractures). We report a rare case of volar lunate subluxation that occurred after volar locking plate fixation, which we experienced in our hospital.

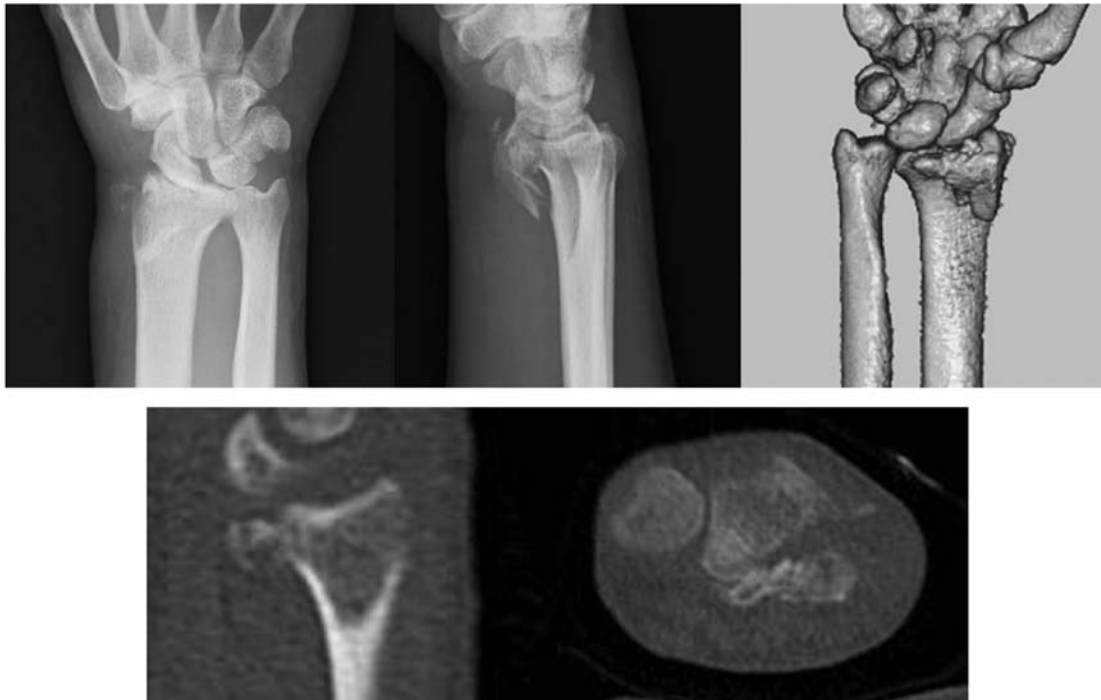
## Case Presentation

The patient was a 63-year-old male, who was injured in a collision with a car while riding a motorcycle. He had a volarly displaced distal radius fracture of AO/OTA classification 2R3B3. Volar bone fragments, forming a cluster, were thought to be AO/OTA classification 2R3B3.2, with clustered volar bone fragments and split joint surface (Figure 1). In addition, the injury was complicated by an ipsilateral femoral neck, segmental shaft, distal femur fracture that extended to the knee joint, multiple facial bone fractures, and traumatic subarachnoid hemorrhage (Figure 2).

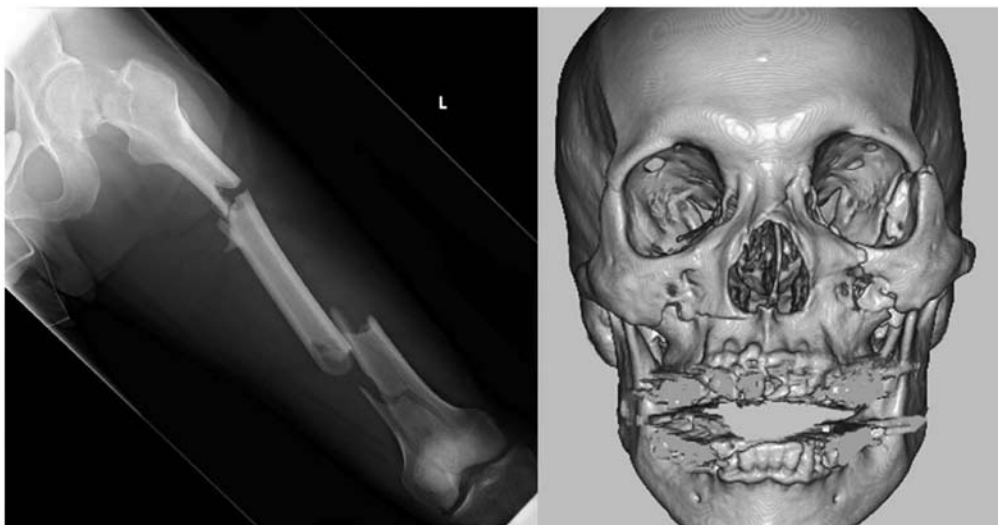
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Received June 20, 2023; Accepted July 30, 2023



**Figure 1.** A volarly displaced distal radius fracture of AO/OTA classification 2R3B3 in the 63-year-old male patient. Volar bone fragments forming a cluster, which were thought to be AO/OTA classification 2R3B3.2, with clustered volar bone fragments and split joint surface are shown.



**Figure 2.** Associated injuries in the patient. (Left) An ipsilateral femoral neck, segmental shaft, and distal femur fracture that extended to the knee joint, are shown. (Right) Multiple facial bone fractures are shown.

The distal radius fracture was externally fixed on the day of the injury and internally fixed with a volar locking plate (VALCP® Two-Colum Distal Radius Plate [DePuy Synthes, Inc.]; henceforth referred to as VALCP Plate) seven days after the injury (Figure 3). The femoral fractures were treated with intramedullary nail fixation, and the patient was transferred to another hospital for rehabilitation 17 days postoperatively.

Because the patient had a repeated chronic subdural hematoma after the transfer, the first examination following the transfer was performed five months after the operation. The hospital to which he was transferred reported that the patient's consciousness was not impaired during rehabilitation. Plain radiographs and computed tomography (CT) images taken at that time showed that distal fragments of the distal



**Figure 3.** Initial operation of the wrist joint

The wrist joint internally fixed with a volar locking plate (VA LCP® Two-Column Distal Radius Plate [DePuy Synthes, Inc.]) is shown. The screws are inserted in the optimal position immediately below the subchondral bone.

radius were fused while being displaced beyond the volar plate to the proximal volar side, and the lunate was volarly subluxated. A supernumerary bone was formed on the volar side of the plate (Figure 4). Although the range of motion of the wrist joint was limited, the patient reported only mild pain, with good finger movement and no carpal tunnel syndrome. Therefore, surgery was not implemented at that point.

The presence of bone formation on the volar plate raised

concern about the possibility of future rupture of the finger flexor tendon. Thus, additional surgery was performed nine months after the initial operation. Because the midcarpal joint conformation was preserved despite the collapsed radiocarpal and distal radioulnar joints, radiocarpal arthrodesis and ulnar head resection were performed. The implant used was the contralateral side of the dorsal H plate (APTUS®2.5 [Medical Engineering System, Inc.]), which was fixed from the volar

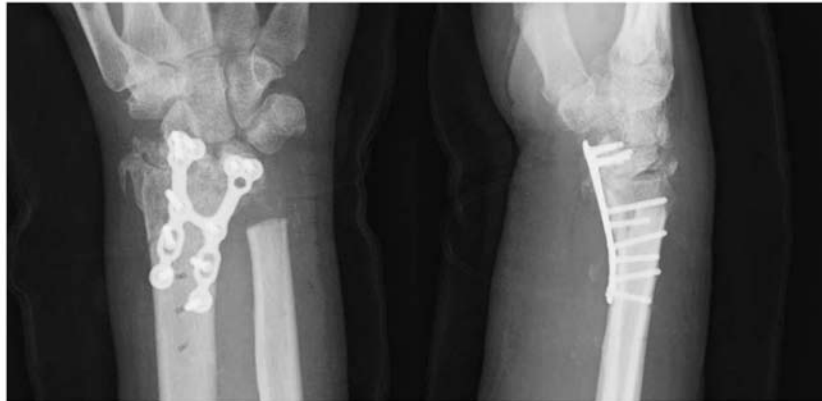


**Figure 4.** Findings of the wrist joint five months after the operation

Distal fragments of the distal radius are fused while displaced beyond the volar plate to the proximal volar side. The lunate is volarly subluxated. A supernumerary bone is formed on the volar side of the plate.

side (Figure 5). Bone fusion at the arthrodesis site was achieved eight months after the additional surgery (Figure 6), and the device was removed. As of 12 months after the additional surgical procedure (Figure 7), the range of motion of the wrist joint was 20° in volar flexion, 20° in dorsal flexion, 80°

in pronation, and 90° in supination, and the grip-strength of the injured compared to the uninjured side was 76.7%. Moreover, the patient returned to design work and had “good” wrist function, achieving 70 points in the evaluation criteria by the Japanese Society for Surgery of the Hand.



**Figure 5.** Additional operation nine months after the initial operation

Radiocarpal arthrodesis and ulnar head resection were performed. The implant used was the contralateral side of the dorsal H plate (APTUS®2.5 [Medical Engineering System, Inc.]).



**Figure 6.** Findings of the wrist joint eight months after the additional operation



**Figure 7.** Findings of the wrist joint twelve months after the additional surgery  
The device was removed as bone fusion was achieved at the arthrodesis site.

## Discussion

In 2004, Harness et al. reported seven cases of volar subluxation that occurred after volar plate fixation for volarly displaced distal radius fracture<sup>1)</sup>. Subsequently, similar reports were made for four out of 24 hands by Ueno et al.<sup>2)</sup>, seven out of 52 hands by Beck et al.<sup>3)</sup>, and two out of 33 hands by Kawasaki et al.<sup>4)</sup> Despite extensive literature search, we found no report of bone fusion occurring while the lunate is greatly subluxated, as in the present case. The causes of volar lunate subluxation after volar locking plate fixation for distal radius fracture are believed to include insufficient support of volar lunate fossa (VLF) fragments due to small fragment size or improper plate installation position and refracture of VLF fragments.

In addition, Osada et al.<sup>5)</sup> and Moritani et al.<sup>6)</sup> reported that supporting the subchondral bone with a screw is important for preventing postoperative correction loss of volarly displaced distal radius fracture.

In the present case, we initially thought that the cluster of volar bone fragments could be sufficiently supported by installing the VALCP Plate, which is a type of proximally installed plate, slightly distally. The screw was inserted in the optimal position immediately below the subchondral bone (Figure 3). A retrospective examination of 3D-CT images taken at the time of the injury revealed a fracture without displacement on the ulnar side of the volar bone fragments, and the AO/OTA classification of fracture type was found to be 2R3B3.3 with comminuted volar bone fragments, rather than 2R3B3.2 with clustered volar bone fragments and split joint surface as we had initially thought. Also, VLF fragments with small longitudinal and transverse diameters were observed (Figure 8). Therefore, the VALCP Plate was unable to support the small VLF fragments. Figure 8 shows enlarged images from Figure 1. The CT images of the wrist joint in Figure 1 have low resolution as they were reconstructed from the CT images of the whole body taken at the time of the injury. One of the reasons for the misjudgment of the fracture type was that a detailed CT examination capturing only the images of the wrist joint was not additionally performed. In addition, the injury was complicated by an ipsilateral femoral neck, segmental shaft, and distal femur fracture that extended to the knee joint. Furthermore, because of the action of putting pressure on the hands when walking with a walker or when standing up, axial pressure was likely applied to the radial joint surface, resulting in volar subluxation of the lunate together with the VLF fragments. If small VLF fragments had been noted at the time of the injury, the use of a rim plate, which has been recently developed for the fixation

of marginal fractures having VLF fragments, might have prevented volar subluxation. Also, in cases of a distal radius fracture complicated by a lower extremity fracture, we recommend at least four weeks of cast immobilization to stabilize the fracture site as a preventive measure against displacement, as in the present case.



**Figure 8.** Enlarged 3D-CT image from Figure 1

A fracture without displacement is present on the ulnar side of the volar bone fragments, and the AO/OTA classification of fracture type is found to be 2R3B3.3 with comminuted volar bone fragments. Also, VLF fragments with small longitudinal and transverse diameters are observed.

## Summary

1. We report a rare case of volar lunate subluxation that occurred after volar locking plate fixation for volarly displaced distal radius fracture.
2. The causes of postoperative volar subluxation of the lunate were regarded to be insufficient fixation force on VLF fragments, femoral fractures as complicating injuries, and axial pressure applied to the radial joint surface when the patient used his hands to walk with a walker or stand up.
3. Due to the collapsed radiocarpal and distal radioulnar joints, additional surgery was performed with radiocarpal arthrodesis and ulnar head resection.

## Acknowledgments

We would like to thank Editage ([www.editage.com](http://www.editage.com)) for English language editing.

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