—Case Reports—

Dorsal Radiocarpal Dislocation with Radial Styloid Fracture Treated with Arthroscopy-Assisted Reduction and Internal Fixation: A Report of Two Cases

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Radiocarpal dislocation is an uncommon injury that is usually caused by high-energy trauma. Herein, we present two cases of dorsal radiocarpal dislocation with radial styloid fractures that were treated by arthroscopy-assisted reduction and internal fixation. Wrist arthroscopy provides accurate information on intra-articular fractures and carpal and/or intracarpal ligamentous tears of the radiocarpal joint. Furthermore, the procedure enables simultaneous anatomical reduction of intra-articular fractures and radiocarpal and/or intercarpal ligament repair. Arthroscopy-assisted reduction and internal fixation yield satisfactory outcomes for patients presenting with dorsal radiocarpal dislocation and radial styloid fractures. (J Nippon Med Sch 2024; 91: 241–248)

Key words: wrist injury, radiocarpal dislocation, radial styloid fracture, intercarpal ligaments, arthroscopy

Introduction

Radiocarpal dislocation (RCD) is uncommon and accounts for only 0.2-4.2% of wrist injuries[1–4]. Most RCDs occur after high-energy trauma[1,5] caused by hyperflexion or hyperextension, radial or ulnar deviation, or twisting of the wrist joint[4–7]. RCD typically occurs on the palmar or dorsal surface and occasionally involves radial partial fracture, posterior or anterior marginal fracture of the distal radius, or fracture at the distal ulna[3,8]. RCD is often accompanied by carpal bone fractures and ligamentous tears, which involve radiocarpal ligaments and, sometimes, the associated intracarpal ligaments. Because of the rarity of RCD, optimal treatment remains controversial. Herein, we report two cases of RCD with radial styloid fractures treated using an arthroscopy-assisted procedure. Both patients provided informed consent for surgery and for publication of the details of their cases.

Case Report

Case 1

A 56-year-old right-handed man who worked as a gardener fell from a height of 2 meters. Radiography showed a dorsal right RCD with a radial styloid fracture, classified as Group 2 RCD by Dumontier et al.[1] (**Fig. 1A and B**). The dislocation was reduced using a closed maneuver with gentle traction on the forearm axis. However, subluxation and instability of the radiocarpal joint (RCJ) persisted (**Fig. 1C and D**). Computed tomography revealed an unreduced dorsal RCD with a styloid fracture and intercalated fragment, which caused the persistent subluxation of the RCJ (**Fig. 1E and F**).

Two days after closed reduction, arthroscopy-assisted surgery was performed with an air tourniquet under general anesthesia. The intra-articular hematoma was removed with a shaver and probe under wrist arthroscopy. Exploration of the RCJ showed an intra-articular fracture of the radial styloid and an intercalated fracture fragment with partial short radiolunate ligament attachment. The radial styloid fracture was located between the radioscaphoid and radiolunate fossa. The intra-articular radial styloid fracture showed a gap of >5 mm and step-off (**Fig. 2A**). Although no substantial scapholunate ligament tear was observed, there was a partial lunotriquetral ligament tear. The lunotriquetral ligament exhibited attenuation and hemorrhage consistent with a Geissler grade-II tear. Triangular fibrocartilage complex (TFCC) injury was

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https://doi.org/10.1272/jnms.JNMS.2024_91-201
Journal Website (https://www.nms.ac.jp/sh/jnms/)

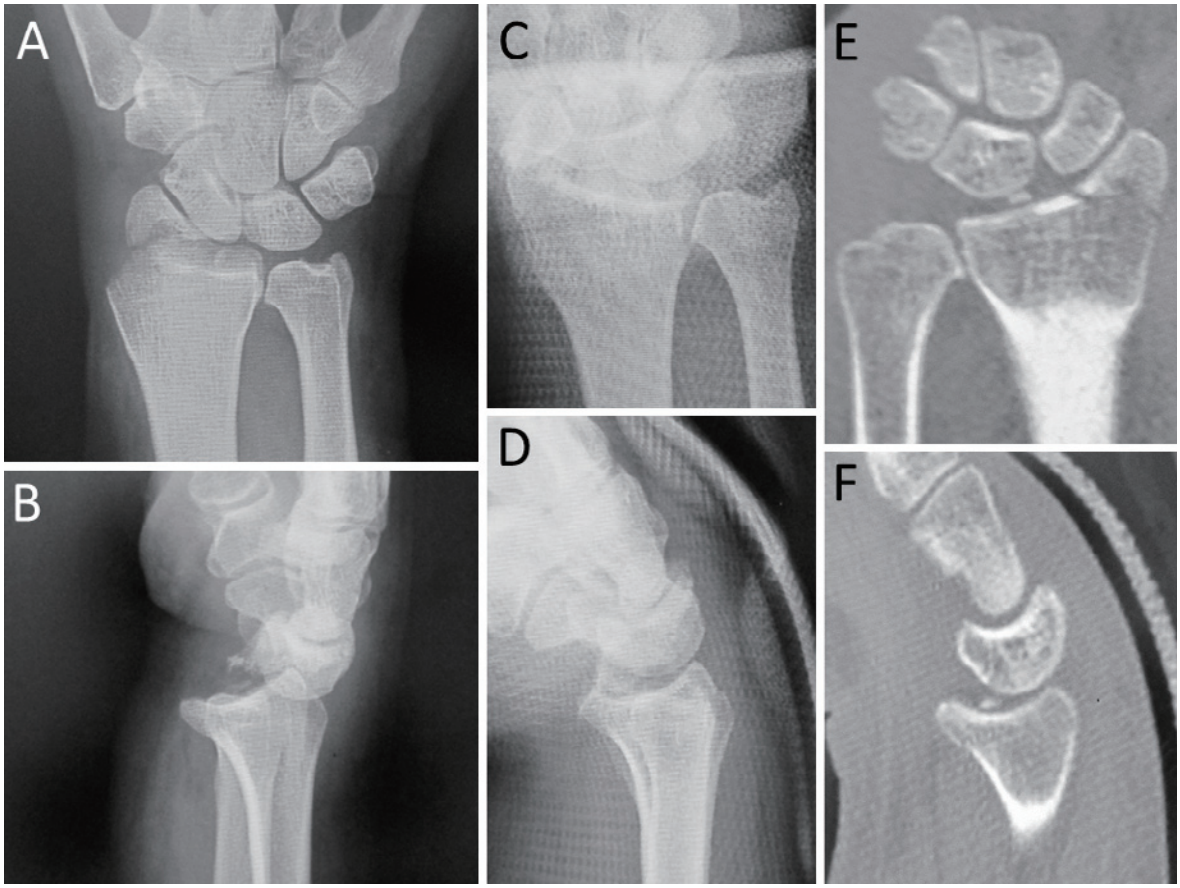

Fig. 1 Radiographs at the time of injury showed a dorsal RCD with radial styloid fracture of the right wrist of a 56-year-old man (Case 1). (C) Anteroposterior and (D) lateral views of the right wrist. Radiography and computed tomography after manual reduction showed persistent dorsal radiocarpal subluxation resulting from an intercalated fracture fragment. (C) Anteroposterior and (D) lateral views of the right wrist. (E) Coronal and (F) axial computed tomography images of the right wrist.

not noted. Midcarpal arthroscopy revealed incongruence of the lunotriquetral ligament; however, there were no injuries of any other ligamentous or cartilaginous lesions.

We observed an intercalated fracture fragment in the RCJ (**Fig. 2B**), and the fragment was removed with forceps under arthroscopy. The articular gap and step-off deformity of the articular surface of the distal radius were arthroscopically reduced and temporarily fixed with dedicated 1.2-mm guide wires. Under an image intensifier and arthroscopy, anatomical reduction of the articular surface of the radius was confirmed and fixed with a 3.5-mm canulated cancerous screw (CCS, Meira, Nagoya, Japan). After reduction with a probe, the lunotriquetral joint was fixed with two 1.5-mm Kirschner wires. Postoperative radiographs confirmed that the RCJ alignment had been restored (**Fig. 2C and D**).

The patient's right wrist was immobilized for 6 weeks with a short-arm cast. After removing the cast, the temporary fixation of the lunotriquetral joint was also removed. At 3 months postoperatively, he was allowed to fully participate in his work. At 13 months postoperatively, the range of motion of his right wrist was 70° in flexion, 70° in extension, 20° in radial deviation, and 40° in ulnar deviation. The range of motion of his right forearm was fully recovered, as compared with the contralateral (left) forearm. The patient ultimately regained a normal, painless range of motion in his right wrist. His grip strength was 32 kg, which was 103% of the strength in his contralateral wrist. At his last follow-up (13 months postoperatively), his modified Mayo wrist score[9] was 95 (20-25-25-25; excellent). Moreover, he was able to fully resume his work without pain or functional limitation. Radiographic examination showed no radiocarpal, intracarpal, or distal radioulnar joint (DRUJ) instability, and no arthritic lesions were noted (**Fig. 2E and F**).

Case 2

A 22-year-old right hand-dominant man presented to our hospital with left wrist pain after a fall while playing baseball. The injury was classified as Group 2 RCD[1]. On examination, he exhibited notable left wrist deformity

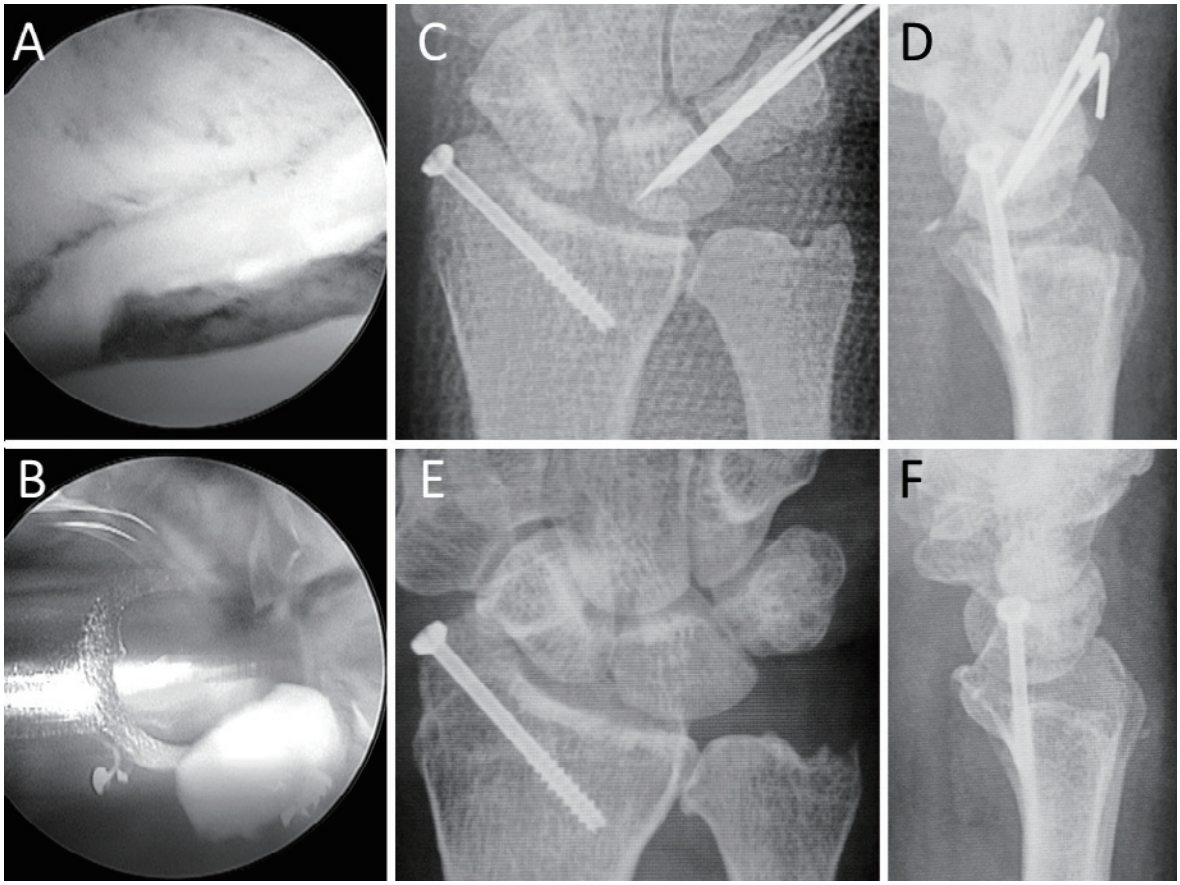

Fig. 2 Perioperative wrist arthroscopic images of the right wrist RCJ. (A, B) Postoperative radiographs showed restored articular joint of the radius and RCJ (C, D, E, F). Wrist arthroscopy showed a radial styloid fracture of the distal radius with a >5-mm step-off and gap (A) and intercalated fracture fragment in the RCJ (B). The radial styloid fracture of the distal radius was fixed with a double-threshold screw. The lunotriquetral ligament tear was temporally fixed with two Kirschner wires. (C) Anteroposterior and (D) lateral views of the right wrist. Final follow-up radiographs showed no evidence of significant degenerative arthritis of the RCJ and ulnar displacement of the carpals. (E) The anteroposterior view and (F) the lateral view of the right wrist.

with pain, swelling, and paresthesia in the median nerve distribution. Radiographs showed a dorsal RCD with radial styloid fracture, dorsal marginal rim fracture of the distal radius, proximal scaphoid fracture, and abnormal-appearing distal radius and proximal carpal row (**Fig. 3A and B**).

The fracture was reduced with manual longitudinal traction, and pressure was applied volarly on the carpal bones. The carpus was reduced, but the RCJ appeared unstable; ulnar translocation of the carpus was noted on radiography. Dorsal RCD with radial styloid fracture, dorsal rim fracture of the distal radius, and proximal scaphoid fracture were noted on computed tomography (**Fig. 4A～D**).

Arthroscopy-assisted surgery was performed with an air tourniquet under general anesthesia. Arthroscopy was used to explore the articular surface of the radius between the radioscaphoid and radiolunate fossa. The joint was separated with a gap >5 mm and step-off (**Fig. 5A**). A scaphoid fracture was visible at the proximal pole. Moreover, a dorsal marginal rim fracture of the distal radius with an attachment of the dorsal capsule was observed. Although the intercarpal ligaments, including the scapholunate and lunotriquetral ligaments, were intact, the TFCC was detached from the fovea of the ulna. Arthroscopic probing revealed a TFCC injury and redundant and decreased tension of the TFCC disc proper (**Fig. 5B**). Midcarpal arthroscopy showed no ligamentous or cartilaginous lesions.

The articular gap and step-off deformity of the partial radius fracture were arthroscopically reduced and temporally fixed with a dedicated 1.2-mm guide wire. Anatomical reduction of the articular surface of the radius was confirmed using an image intensifier and ar-

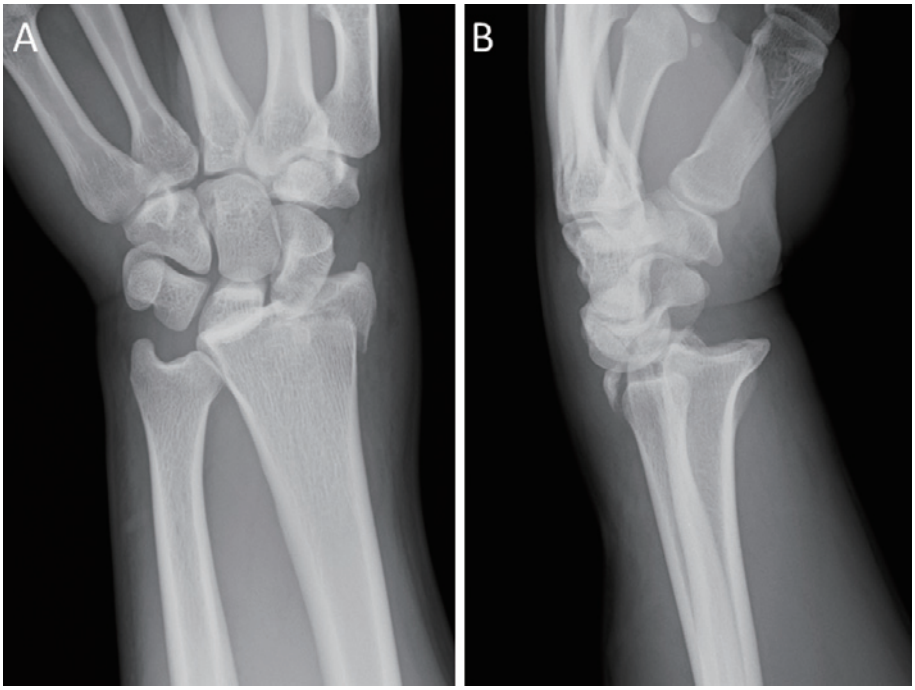

Fig. 3 Radiographs at the time of injury showed a dorsal RCD with a radial styloid fracture, dorsal marginal rim fracture of the radius, and scaphoid fracture of the left wrist in a 22-year-old man (Case 2). (A) Anteroposterior and (B) lateral views of the left wrist.

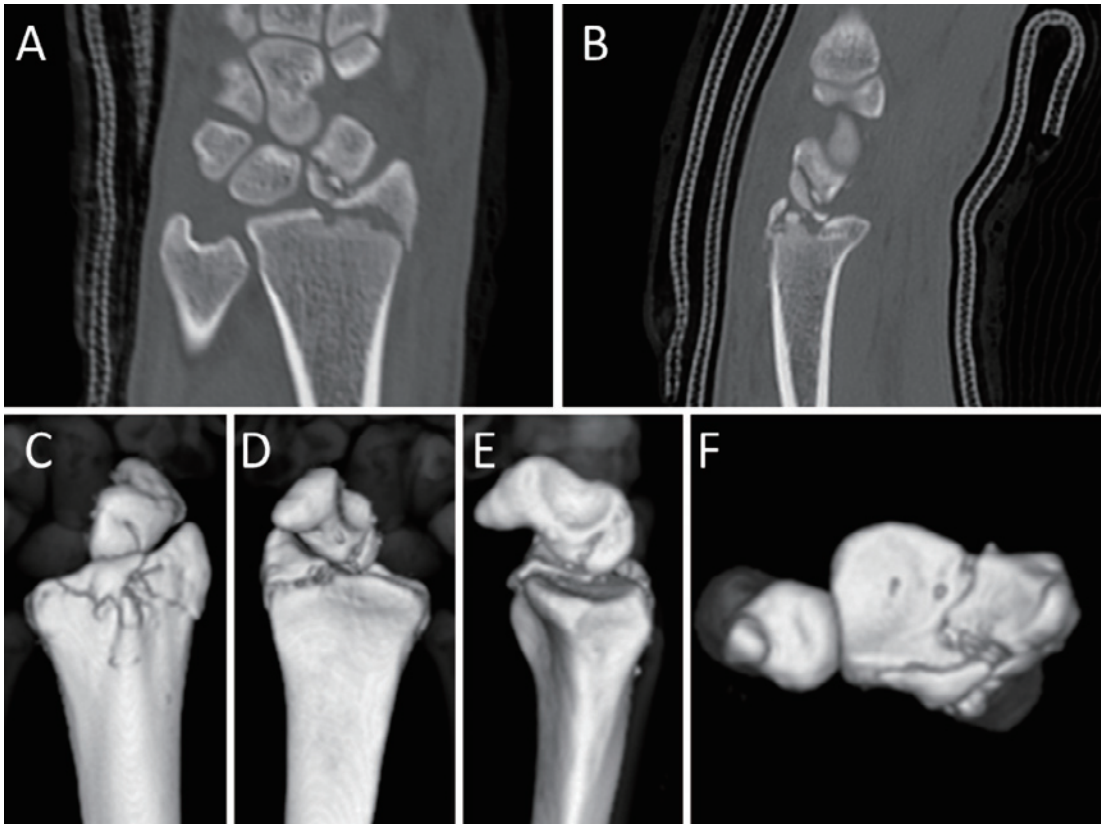

Fig. 4 Computed tomography after manual reduction showed a radial styloid fracture, dorsal marginal rim fracture of the radius, and scaphoid fracture at the proximal pole of the left wrist (A). Coronal and (B) axial views of the left wrist obtained using computed tomography. Three-dimensional computed tomography images of the distal radius view from the (C) dorsal, (D) volar, (E) ulnar, and (F) distal sides.

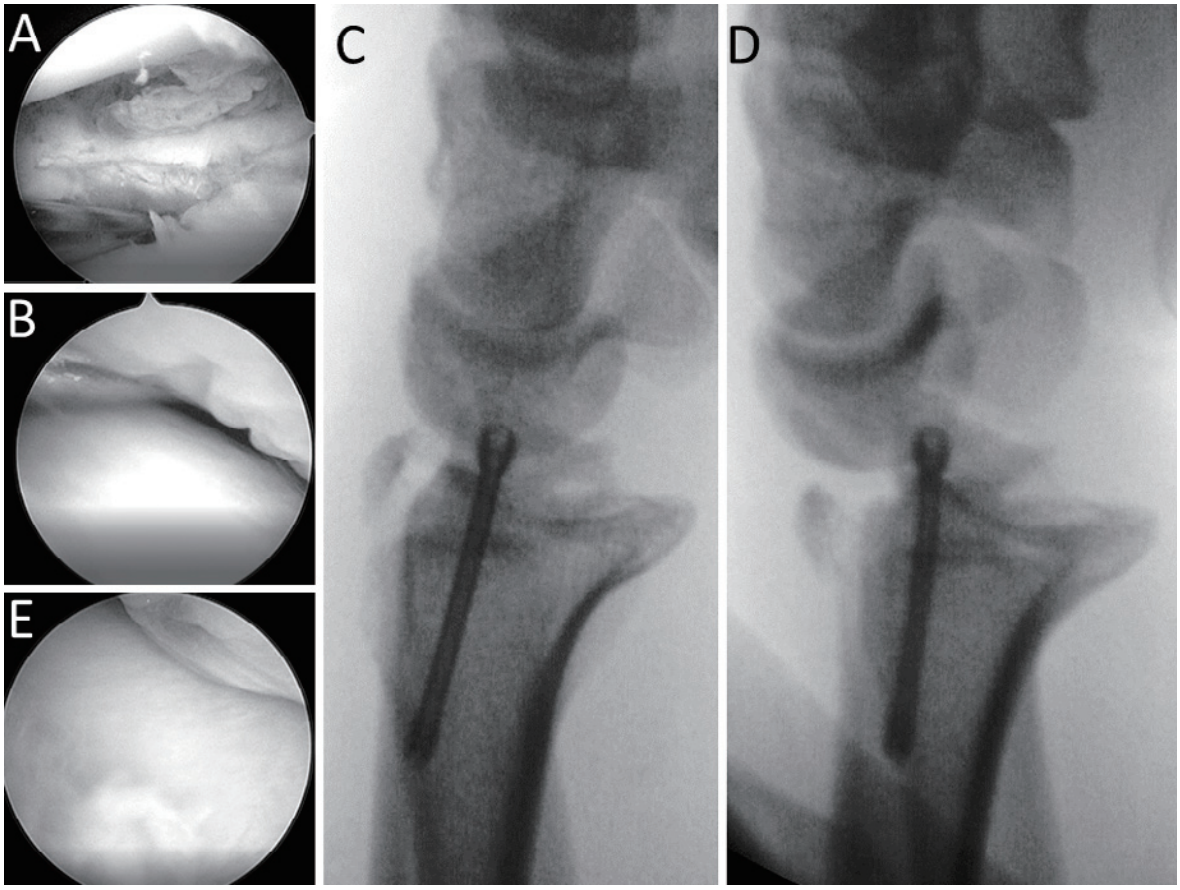

Fig. 5 Perioperative static and stress lateral view images of the left wrist using an image intensifier (A, B), and arthroscopic images of the left wrist RCJ (C, D, E). Static lateral view image after the fixation of the radial styloid fracture, restoring RCJ alignment (A). The stress lateral view image showed residual dorsal instability of the carpals. Wrist arthroscopy showed a radial styloid fracture of the distal radius with a >5-mm step-off and gap (C). Arthroscopic probing revealed a TFCC injury with redundant and decreased tension of the TFCC disc proper (D). Wrist arthroscopy showed restored tension of the TFCC disc proper after arthroscopy-assisted repair.

throscopy, and the area was fixed with double-threshold headless screws (DTJ, Meira, Nagoya, Japan). After radial styloid fixation, the image intensifier revealed obvious instability of the RCJ, indicating a need for dorsal marginal rim fracture fixation (**Fig. 5C and D**). Arthroscopically, the scaphoid fracture and dorsal rim fracture of the radius were reduced and temporally fixed with dedicated 1.2-mm guide wires. After confirming the anatomical reduction with arthroscopy and an image intensifier, the scaphoid fracture and dorsal rim fracture of the radius were fixed with double-threshold headless screws (DTJ, Meira, Nagoya, Japan). Although the RCJ was stabilized after both fractures, persistent DRUJ instability was confirmed using an image intensifier and arthroscopy.

The TFCC was repaired using an outside-in procedure[10]. Wrist arthroscopy showed restored tension of the TFCC disc proper after repair (**Fig. 5E**). Postoperative radiographs indicated that alignment of the RCJ was restored (**Fig. 6A and B**). Postoperatively, the patient's wrist was immobilized for 6 weeks with a short-arm cast. At 6 weeks postoperatively, he was allowed to grip with full strength and returned to work. He was further permitted to fully participate in baseball at 3 months postoperatively. At 12 months postoperatively, he experienced mild wrist pain when stretching his wrist. The range of wrist motion was 45° of flexion, 45° of extension, 20° of radial deviation, and 20° of ulnar deviation. Hence, at 12 months postoperatively a second surgery for capsular release of the RCJ was performed using arthroscopy. Synovitis of the RCJ was observed, and the capsule healed with scar tissue because of restriction of the range of motion of the wrist joint. The dorsal radiocarpal capsule was resected and sheaved with an arthroscopic shaver. All articular surfaces were healed without a gap or step-off. The disc proper of TFCC was stabilized without any instability of DRUJ.

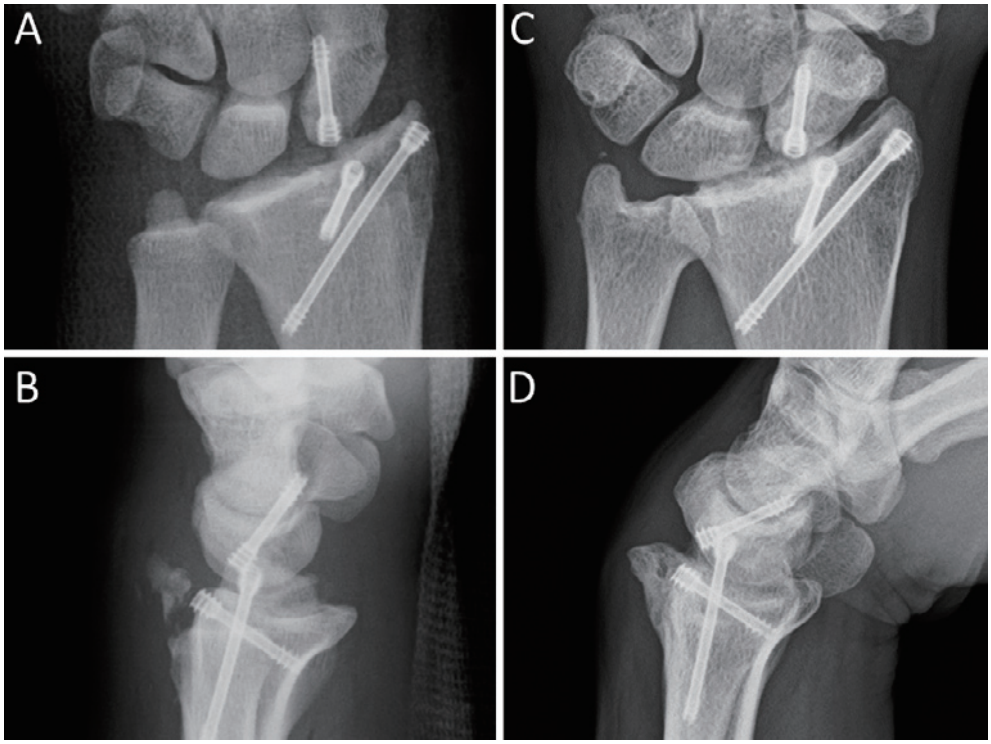

Fig. 6 Postoperative radiographs showed a restored articular joint of the radius and RCJ. Radial styloid fracture, dorsal rim fracture of the distal radius, and proximal pole fracture of the scaphoid were fixed with double-threshold screws. (A) Anteroposterior and (B) lateral views of the left wrist. Final follow-up radiographs showed no evidence of degenerative arthritis of the RCJ or ulnar displacement of the carpals. (C) Anteroposterior and (D) lateral views of the left wrist.

At his last follow-up (18 months postoperatively), the patient complained of slight wrist pain when doing push-ups but not ulnar-sided wrist pain. The range of motion of his wrist was 60° in flexion, 75° in extension, 20° in radial deviation, and 40° in ulnar deviation. The range of motion of his forearm was the same as that of his contralateral forearm, without DRUJ instability. His grip strength was 50 kg, 84.3% of his measured contralateral wrist strength. His modified Mayo wrist score[9] was 80 (20-25-20-15; good). Radiography revealed no arthritic lesions, and he experienced near-full performance recovery without ulnar wrist pain (**Fig. 6C and D**).

Discussion

RCD classification is used for decision making in treatment. Dumontier et al.[1] stated that a radial styloid fracture involving more than one-third of the scaphoid fossa width is attached to the radiocarpal ligament. They advocated classifying RCDs into two groups: Group 1 includes patients with pure RCDs and those with only radial styloid process tip fractures. Group 2 includes patients with RCDs and associated radial styloid process fractures that involve more than one-third of the width of the scaphoid fossa. To restore stability of the RCJ, radial styloid fractures that involve more than one-third of the width of the scaphoid fossa require fixation because the radiocarpal ligament is attached to the fracture fragment[1,4,8]. Moreover, the intercarpal and carpal ligaments are occasionally injured in patients with RCD,[1,4,11] and these injuries should be treated when the ligaments are responsible for the stability of the wrist joint[1,3,4,8]. Additionally, since the posterior or anterior rim of the articular surface and the ligaments are attached to prevent subluxation in the sagittal plane, fixation of rim fractures and intracarpal ligament repair are critical[1,3–5,8]. Thus, precise information on the pattern of intra-articular fractures and carpal ligament and intracarpal ligamentous injuries is essential.

Diagnostic modalities-including dynamic radiography, wrist arthrography, and wrist arthroscopy-provide information on the pattern of intra-articular fractures and carpal ligament and intracarpal ligamentous injuries. Wrist arthroscopy yields precise information on the pattern of intra-articular fractures and ligamentous injuries and enables simultaneous anatomical reduction and fixation of fracture fragments and ligament repair. As conventional

treatment for RCDs, some authors have reported treatment of RCDs involving radial styloid and marginal rim fractures with percutaneous pinning or by using open reduction with screw synthesis. However, fixation with percutaneous pinning under an image intensifier occasionally fails to provide anatomical reduction, and a secondary radial displacement of a radial styloid fracture occurs after pinning[2]. Pattee and Thompson[2] maintained that a residual articular step-off >1 mm would likely fail to prevent future degenerative arthritis and recommended surgical reduction of the articular surface. Open surgery to expose the articular cartilage of the RCJ is associated with a risk of further injuries of the radiocarpal and/or intercarpal ligaments. Moreover, open reduction of the articular surface results in postoperative joint contracture of the radiocarpal joint. Thus, wrist arthroscopy is essential to achieve anatomical reduction of intra-articular fracture. Moreover, since wrist arthroscopy provides precise information on the intercarpal and carpal ligamentous injuries and allows repair of ligamentous injuries, it is essential for diagnosing and treating ligamentous injuries accompanied by RCDs.

We have reported two cases of Group 2 RCD with radial styloid fractures treated using an arthroscopy-assisted procedure. Case 1 underwent fixation of the radial styloid fracture under arthroscopy and removal of the intercalated fracture fragment. Arthroscopy showed no evidence of tearing of ligaments essential for RCJ stability, including TFCC and the scapholunate ligament; however, the lunotriquetral ligament was partially torn. After internal fixation of the radial styloid fracture, we restored stability to the radial side of the RCJ, even after removing the intercalated fracture fragment.

In contrast, Case 2 required fixation of the radial styloid fracture, proximal scaphoid fracture, and dorsal marginal rim fracture, followed by TFCC repair. Because the carpal and intracarpal ligaments stabilize the RCJ, residual RCJ instability yields unsatisfactory outcomes that persist after fracture fragment fixation.

Satisfactory outcomes were obtained in both cases. Precise information on the pattern of intra-articular fractures and injuries of the carpal ligament and intracarpal ligaments of RCJ is essential when treating RCDs. Patients with Group 2 RCDs require anatomical reduction of the intra-articular fracture and radiocarpal and/or intercarpal ligament repair[1,3,4,8]. Arthroscopy-assisted surgery provides precise information on RCJ injuries and enables simultaneous anatomical reduction of the articular surface and RCJ stabilization. Both procedures optimize outcomes for patients with RCDs.

Conclusion

We reported two cases of RCD with radial styloid fractures treated using an arthroscopy-assisted procedure. Arthroscopy-assisted reduction and internal fixation provide satisfactory outcomes for patients with dorsal RCDs with radial styloid fractures.

Conflict of Interest: The authors declare no conflicts of interest and are responsible for the content and language of this article.

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(Received, August 25, 2022)
(Accepted, December 28, 2022)