Midcarpal instability caused by malunited fractures of the distal radius

Thirteen patients with malunited fractures of the distal radius developed symptoms of pain and instability of the midcarpal joint. In six cases, a recurrent voluntary midcarpal subluxation was also present during ulnar deviation. These symptoms were first noticed several weeks, and at times several months, after all immobilization for the treatment of the original fracture had been discontinued. We believe that the loss of the normal palmar tilt of the distal articular surface of the radius prepositions the carpus in a dorsal collapse alignment, which enables this instability to develop. Although the instability is localized to the midcarpus, it is treated best, in our opinion, by a corrective osteotomy of the distal radius. In nine patients, osteotomies resulted in relief of preoperative symptoms and correction of midcarpal instability. In one patient, osteotomy of the radius was deemed unnecessary because the loss of palmar tilt of the radius was minimal. Instead the midcarpal (triquetrohamate) joint was stabilized by ligament reconstruction. Only transient correction was obtained, with later recurrence of the voluntary midcarpal subluxation. (J HAND SURG 9A:350-57, 1984.)

Julio Taleisnik, M.D., and H. Kirk Watson, M.D., Orange, Calif., and Farmington, Conn.

Complications caused by fractures of the distal radius and their treatment are numerous. The potential for dorsal subluxation of the carpus to accompany fractures of the distal radius has been recognized for many years. Associated disruptions of intracarpal alignment, however, have rarely been mentioned. The instability is localized to the midcarpus, it is treated best, in our opinion, by a corrective osteotomy of the distal radius. In nine patients, osteotomies resulted in relief of preoperative symptoms and correction of midcarpal instability. In one patient, osteotomy of the radius was deemed unnecessary because the loss of palmar tilt of the radius was minimal. Instead the midcarpal (triquetrohamate) joint was stabilized by ligament reconstruction. Only transient correction was obtained, with later recurrence of the voluntary midcarpal subluxation. (J HAND SURG 9A:350-57, 1984.)

From the University of California, Irvine, Calif., and the University of Connecticut, Farmington, Conn.

Received for publication March 3, 1983; accepted in revised form July 7, 1983.

Reprint requests: Julio Taleisnik, M.D., 1201 W. LaVeta No. 501, Orange, CA 92668.
Midcarpal instability caused by malunited fractures

Fig. 2. Lateral view of normal wrist in ulnar deviation. The lunate is dorsiflexed (A) and shifts in the palmar direction (B). Axes of capitate and radius are colinear.

Fig. 3. The only patient in this series with radiocarpal joint involvement.

diagnostic views are useful: routine lateral, posteroanterior (PA), and lateral projection obtained with the wrist in ulnar deviation.

In the routine lateral and PA views, three radiographic measurements are significant: palmar tilt, radial inclination or deviation, and radial length. Palmar tilt (Fig. 1, A) is determined by the angle between the plane of the distal articular surface of the radius, as seen on lateral radiographs, and a line perpendicular to the long axis of the shaft of the radius. When this angle is 90°, the tilt is 0°. Palmar tilt is identified with a plus sign and dorsal tilt with a minus sign. Normally, the palmar tilt averages +11° in most series, although it may be as low as −7° or as high as +28°. Radial inclination or angulation (Fig. 1, B) is represented by the angle between a line tangential to the distal articular surface of the radius as seen in PA radiographs and a perpendicular line to the shaft of the radius. It averages 22° in most series but it may be as low as 12° or as high as 30°. Radial length (Fig. 1, C) is expressed by the distance in millimeters between two parallel lines...
that are perpendicular to the central axis of the radius, the first traced at the tip of the radial styloid and the second tangential to the head (not the styloid process) of the distal ulna as seen in PA radiographs; it averages 9 mm.\textsuperscript{29}

The lateral view with the wrist in full ulnar deviation shows the lunate dorsiflexed and a radio-luno-capitate alignment reminiscent of a dorsal carpal instability pattern, a precollapse configuration (Fig. 2). As it dorsiflexes, the lunate sinks or translates in a palmar direction, a movement made possible by the normal palmar tilt of the articular surface of the radius. This palmar shift of the lunate allows the longitudinal axes of radius and capitate to remain colinear.

**Clinical material.** The 13 patients in this study were grouped into two categories. Six patients had a recurrent dynamic midcarpal subluxation and seven had a painful midcarpal synovitis without dynamic subluxation. All had sustained fractures of the distal radius; with one exception (Fig. 3), the radiocarpal joint was never involved (Frykman's types I, II, V, and VI).\textsuperscript{19} All fractures had healed with the distal fragment in dorsal angulation and with varying degrees of shortening and loss of inclination of the distal articular surface of the radius. Seven of the 13 patients were male and six were female. The average age was 36.5 years, the youngest being 15 years and the oldest patient being 54 years of age. The dominant wrist involved in four cases and the nondominant nine. The mechanism of injury was a forced application to the wrist, most frequently during falls on the outstretched extremity. Four patients received their injuries as a consequence of a vehicular accident. The onset of midcarpal pain and synovitis with or without subluxation was gradual and was first noticed at least several weeks after the healing of the Colles’ fracture and cessation of immobilization. In two patients, these symptoms were not noticed until several months after...
Midcarpal instability caused by malunited fractures

...the fracture had healed. The exact time that elapsed could not be determined, but in all cases patients reported a period of satisfactory function after the fracture had healed and before the onset of progressive disability. In all cases, there was tenderness to palpation at the lunocapitate and triquetrohamate joints. In addition, the six patients in the group with subluxations consistently could reproduce a painful, audible, and palpable snap by bringing their hands into ulnar deviation with the forearm pronated (Fig. 4A). The abnormal carpal motion was clinically localized at the triquetrohamate joint level. This subluxation was similar to that described by Lichtman et al in their patients with ulnar midcarpal instability. The range of motion of the wrist was modified in proportion to the severity of the dorsal angulation of the radius. In all patients, loss of palmar flexion was greater than that of dorsiflexion although, overall, the available motion fell within a functional range. Eight patients exhibited limitation of full pronation and supination. Grip strength was seriously weakened, averaging only 17.8% of normal.

Routine lateral and PA radiographs showed a malunion of a fracture of the distal radius in all patients. Only one had an extension of the fracture into the radiocarpal joint (Fig. 3) with minimal loss of radiocarpal congruity. Palmar tilt averaged -23°, radial inclination 19.8°, and radial length 4.1 mm, compared with +14°, 25°, and 11.2 mm in the uninjured side. Clearly, the major architectural change was the severe reversal of the normal palmar tilt. In one patient, loss of palmar tilt was minimal (+8°) (Fig. 5), while two patients showed rather severe deformities (46° and 50°). In most cases (Fig. 6), the palmar tilt oscillated between -10° and -30°. Only two patients developed a negative radial length whereby the ulnar head was actually distal to the tip of the radial styloid. In both patients, the loss of length was -12 mm. If these two patients are excluded, the average radial length in the remaining patients was 7.7 mm or 68.75% of normal. Radial inclination was least involved in this group of patients. Routine lateral radiographs of the wrists of the six patients in the group with subluxations showed colinear lunate and capitate axes along a plane that was parallel but dorsal to the main axis of the shaft of the radius (Fig. 6A). Lateral radiographs were also obtained with the wrist in ulnar deviation after the patient had actively...
subluxed the carpus (Fig. 6, B). In this position, the lunate was seen to dorsiflex as it did in the uninjured wrist but with a marked reduction of normal palmar translation. Consequently, the longitudinal axis of the capitate was displaced dorsal to the main axis of the radius. It was in this position that these patients experienced the painful subluxation at the midcarpal joint level.

Only three patients in the subluxation group agreed to surgical correction. One was treated by a ligament...
reconstruction at the triquetrohamate level, a treatment believed to restore midcarpal stability. We believed that this procedure was indicated because the loss of palmar tilt was too small to warrant an osteotomy of the radius (Fig. 5). After a period of relief of instability, the patient’s dynamic midcarpal collapse pattern remained, although the disabling preoperative pain was largely relieved. The other two patients were treated by corrective osteotomy of the distal radius with complete relief of their preoperative disabling complaints, disappearance of the subluxation “jolt,” and restoration of normal carpal mechanics in cineradiographic studies. Of the two, one patient (Fig. 4) improved his preoperative tilt from −12° to +11° (compared with +17° in the normal side); there was some residual loss of radial inclination and radial length. The second patient improved all three parameters, but particularly the palmar tilt, from −19° to +7° (compared with +12° in the uninjured side) (Fig. 7). Radiolunate and scapholunate relationships returned to normal in both patients with restoration of lunate dorsiflexion and palmar translation during ulnar deviation (Figs. 4 and 7). All seven patients in the group with synovitis underwent corrective osteotomies. Before operation, the palmar tilt for this second group averaged −31° and the radial inclination averaged 19.8°. The postoperative values were +1.42° and 19.7°, respectively. All patients experienced relief of preoperative pain on loading of the wrist, disappearance of synovitis, and correction of the recurrent midcarpal subluxation. All returned to their preoperative occupations.

Review of the literature

Malunions of fractures of the distal radius. Complications that arise from fractures of the distal radius and their treatment are numerous. Only 2.9% of 2132 cases with Colles’ fractures were judged by physicians of the Workmen’s Compensation Board of the New York State Department of Labor to have no permanent disability.1 Malunions are among the most frequent complications. Carpal instabilities caused by malunions, however, are rarely mentioned as a cause of disability. Malunion of Colles’ fractures may result in alteration of one or more of three normal radiographic parameters: palmar tilt, radial inclination, and radial length (Fig. 1). It is generally agreed that anatomic restoration results in improved functional results. A poor anatomic result, however, may be accompanied by an excellent functional recovery.4, 23, 25, 22 This was attributed by Gartland and Werley25 to the innate ability of the wrist joint to overcome and compensate for residual bony deformity . . . .” There is lack of agreement, however, as to which of the three anatomic parameters is more important in the preservation of satisfactory function.4, 11, 14, 16, 26, 27–35 Dowling and Sawyer16 concluded that no single anatomic characteristic seemed to be associated with either a good or a poor result. Even with a combination of all three anatomic variables, no connection was found except in the extremely good or poor results. We believe, however, that changes in the normal palmar tilt of the distal radius will result in disturbance of radiocarpal function, while abnormal radial inclination and length values will most likely interfere with the function of the distal radioulnar joint and result in painful or limited forearm rotation. Fernandez9 found that deformities of the radius became symptomatic if the angulation of the distal articular surface of the radius was greater than 25 to 30 degrees in either the sagittal or the frontal planes and when there was significant radioulnar length discrepancy of 6 mm or more, particularly in young, manually active patients. In some of our own patients, however, a relatively small change in palmar tilt produced midcarpal changes, a situation that, we believe, is peculiar to this syndrome (Fig. 5). In effect, it suggests that in patients with a preexisting potential for midcarpal instability, particularly if young, active, or vigorous, only a small change in radiocarpal alignment may be required to precipitate a clinical, symptomatic...
midcarpal collapse. In series of Fernandez,9 pain was referred to either the radiocarpal or the radioulnar joints. There was no specific mention of midcarpal pain, tenderness, synovitis, or instability.

**Midcarpal instability.** References to primary midcarpal instability are intermittently found in the literature.26–39 Recently, Lichtman et al.31 presented a clinical and laboratory analysis of ulnar midcarpal instability. The usual initial complaint in their patients was a painful wrist click that could be reproduced in ulnar deviation with axial compression of the wrist and with the forearm in pronation. This was a dynamic type of instability: routine radiographs were normal, but cinefluoroscopy revealed a sudden dissociation that resulted in a dorsiflexion collapse deformity.38, 39 The radiocarpal relationship was not disturbed.

**Malunion of fractures of the distal radius and midcarpal instability.** In their encyclopedic discussion of wrist injuries presented to the Twenty-eighth French Congress of Surgery of 1919, Jeanne and Mouchet23 listed “dorsal luxation of the capitate” as a possible complication of malunited fractures of the distal radius. Subsequent references to intracarpal problems associated with Colles’ type fractures have been rare. In 1972 Linscheid et al.34 described loss of carpal alignment of proximal or distal carpal rows (specifically a dorsiflexion instability pattern) after fractures that caused a reversal of the normal tilt of the distal articular surface of the radius in a dorsal and radial direction. “Intercarpal collapse deformity” was included by Dobyns and Linscheid7 among intermediate and late complications of Colles’ fractures. In a review of 565 fractures of the distal radius that were seen at the Mayo Clinic, Cooney et al.4 found five patients with associated intracarpal injuries, four of whom required operative reconstruction of the scapholunate ligament. They did not report any patients with midcarpal instabilities.

**Conclusions**

We believe that our patients represent a link between malunions of fractures of the distal radius and dynamic medial (ulnar) midcarpal instabilities. We believe that it is the abnormal dorsal tilt caused by the malunion that leads to the midcarpal instability. In all cases of malunion with dorsal tilt, carpal alignment is most stable, but least functional, when the hand is dorsiflexed enough to line up with the displaced distal fragment of the radius (Fig. 8, A). Most frequently, realignment of the hand from this more stable dorsiflexion attitude to a neutral alignment with the forearm is accomplished through partial palmar flexion at the radiolunate level (Fig. 8, B). Lunate and capitate remain colinear and shift together along the now abnormal, dorsal slope of the distal radius to a position that is dorsal to the forearm. These patients may develop a symptomatic instability that is referred to the radiocarpal joint and apparent to them from the time the immobilization for the treatment of the Colles’ fracture is discontinued. In contrast, our patients realigned their hands with the forearms by palmar flexion at the lunocapitate level (Figs. 4, B, 5, A, 6 B, and 7, D) and developed instability gradually after the fracture healed as the midcarpal joint was stressed during loading of the wrist. Lunate dorsiflexion and capitate alignment dorsal to the shaft of the radius create an unstable, true zig-zag deformity. In some patients, the progression of instability was enough to allow them to sublux actively the midcarpal joint in ulnar deviation. We believe that these patients represent a small, select group among those with Colles’ fractures. They are younger, more active, and vigorous, and they present a predisposing potential midcarpal instability. The loss of the normal palmar tilt and the repetitive loading of their wrists may lead to a mechanical synovitis at the capitolunate articulation or to a gradual relaxation of midcarpal support, allowing the wrist to develop a dynamic form of dorsal instability during active ulnar deviation. It may be argued that, in reality, the midcarpal instability resulted from the same injury that caused the fracture initially and not from the repetitive loading of the malaligned corpus. That this instability was not caused by the original injury is shown by the fact that these patients did not develop symptoms until several weeks or months after the fractures had healed, that these symptoms became worse with time and were eventually disabling, and that all those who received corrective osteotomies were relieved of the disability, although the midcarpal joint itself was never treated. Conversely, further confirmation is provided by the only patient whose midcarpal joint was stabilized without correction of the distal radial deformity but who promptly experienced the recurrence of midcarpal instability.

**Summary**

The 13 patients in this study had complaints of pain and swelling at the midcarpal level. In six of these patients, a painful snap of the wrist was also noticed and could be reproduced in ulnar deviation. In these patients, disability was due to the reversal of the normal palmar tilt of the distal radius.

Corrective osteotomy of the distal radius was performed in nine patients and was successful in relieving preoperative pain and instability. In one patient who had a minimal loss of palmar radial tilt, an attempt at midcarpal (triquetrohamate) stabilization helped to decrease her preoperative pain but did not correct the
dorsal to the symptomatic palmar joint and fixation for continued immobilization in dorsiflexion with their capitate level elevated is the midcarpal wrist. L. dorsal to the zig-zag deformity was noted the midcarpal instability rely the midcarpal deformity adult, with osseous, bone grafting, and internal fixation. J Bone Joint Surg [Am] 64:1164, 1982


17. Lynch AC, Lipscomb PR: The carpal tunnel syndrome and Colles' fractures. JAMA 185:363, 1963


