IPSILATERAL DISTAL RADIUS AND SCAPHOID FRACTURES

Chih-Hung Chang, Yi-Shiun Tsai, Jui-Sheng Sun, and Sheng-Mou Hou

Abstract: Simultaneous fractures of the distal radius and scaphoid are uncommon. Previous reports have outlined a variety of treatment methods for this condition. We describe the results in eight patients with simultaneous fractures of the distal radius and scaphoid, who were treated at National Taiwan University Hospital from 1987 to 1998. Treatments for the distal radius fractures included pin-in-cast in one patient, casting in one, external fixation in one, external fixation after pinning in three, and open reduction with internal fixation in two. All scaphoid fractures occurred at the scaphoid waist, and were treated with long-arm thumb spica in three patients, Herbert screw fixation in two, and percutaneous pinning in three. All of the fractures united, and none of the patients developed scaphoid avascular necrosis. One patient suffered from superficial radial nerve injury during external fixation. The functional results of the wrist were good in five patients and fair in three. To prevent the possible over-distraction of the scaphoid fracture, fixation of the scaphoid should be performed if a distraction force is to be applied during the treatment of the distal radius fracture. If no distraction force is to be applied, a thumb spica may provide adequate fixation for the scaphoid fracture.

Patients and Methods

From 1987 through 1998, 908 patients who sustained distal radius fractures and 127 patients who sustained scaphoid fractures were treated at National Taiwan University Hospital. The hospital records for all patients with combined distal radius fracture and scaphoid fracture were retrieved. Eight had combined distal radius and scaphoid fractures in the ipsilateral limb, including five men and three women. The average age of these patients was 55.4 years (range, 38–90 yr) at the time of injury. Preoperative studies, operative reports, and imaging studies were all reviewed (Table 1). According to the Arbeitsgemeinschaft Osteosynthesefragen (AO) classification [7], extraarticular fracture of the ulna is

Simultaneous fractures of the distal radius and scaphoid are uncommon. The reported frequency has varied from 0.7% to 6.5% in cases of isolated fractures of each bone [1–3]. Techniques currently in use for fixation of the distal radius include casting, pin-in-cast, and external fixation with or without pinning, while those used for fixation of the scaphoid include thumb spica cast, percutaneous pinning to open reduction, and screw fixation [2–6]. Some authors have suggested that cast or splint immobilization is adequate for scaphoid fractures [3, 5], while others have suggested that fixation of the scaphoid before reduction of the distal radius is needed to prevent distraction of the scaphoid, which may induce nonunion [4, 6]. The purpose of this study was to review the results in patients with ipsilateral fractures of the distal radius and scaphoid treated at National Taiwan University Hospital from 1987 through 1998.
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classified as A1, simple extraarticular radius fracture as A2, and comminuted extraarticular radius fracture as A3. Partial articular fracture of the radial styloid is classified as B1, dorsal Barton’s fracture as B2, and volar Barton’s fracture as B3. Simple complete articular fracture is classified as C1, simple complete articular fracture with metaphysis comminution as C2, and multifragmentary articular and metaphysis fracture as C3. In this series, four patients had B3 fractures, two had C1 fractures, one had a C2 fracture, and one had an A2 fracture of the distal radius. All scaphoid fractures occurred at the anatomical waist. All fractures were closed. The mechanisms of injury and associated injuries are described in Table 1.

Closed reduction under image intensifier monitoring was performed for the treatment of distal radius fracture. If closed reduction failed, open reduction was performed. The choice of fixation method depended on the intraoperative situation (Table 1). If the distal radius fracture was non-displaced, casting was performed for fixation; if the distal radius fracture was displaced, then open reduction and external fixation or plating were performed. Pinning was sometimes added to fix the major displaced fragment. In order to prevent over-distraction, which may cause nonunion of the scaphoid, fixation of the scaphoid was performed before treatment of the distal radius, especially when external fixation was to be applied (Fig. 1).

Generally, the Herbert screw is the implant of choice for scaphoid fixation. Because it is a demanding procedure, some operators preferred pinning fixation. The only three exceptions were patients 3, 5, and 6. Patient 3 was a 90-year-old woman who was treated with insertion of K-wires in the distal radius and application of a long arm thumb spica cast for fixation of both bones. The scaphoid was kept non-displaced after reduction of the distal radius. Patients 5 and 6 sustained volar Barton’s fractures. Reduction of the distal radius was achieved by pressuring the volar side of the wrist to maintain the non-displaced distal radius fracture (patient 6) or open reduction with plate fixation (patient 5); no major distraction force was applied across the wrist joint, so the scaphoid was kept well reduced. A long-arm thumb spica was applied for fixation.

Functional results of the wrist were judged according to the methods of Oskam et al [5]. When no pain occurred with use, the result was judged as good; if pain and moderate discomfort were present with use, the result was judged as fair, provided that the patient had completely returned to normal activities. The functional end result was considered to be poor in worse circumstances. The anatomical results after distal radius fracture were evaluated according to Sarmiento et al’s modification of Lindström’s classification (Table 2) [8].

Results

The mean duration of follow-up was 4.4 years (range, 1.0–11.6 yr). Healing of the distal radius and scaphoid fractures was achieved in all patients. There was no scaphoid avascular necrosis or nonunion. One patient (patient 2) sustained a superficial radial nerve injury after application of the external fixator, which made him uncomfortable; the functional result was graded as fair. The distal radius fractures in two patients (patients 1 and 6) healed in the grade 2 deformity position according to Sarmiento et al’s criteria (Fig. 2). They resumed normal daily activities, although mild wrist pain and diminished dorsal flexion were noted. The functional results in both of these patients were graded as fair.

Discussion

Simultaneous fracture of the distal radius and scaphoid is rare. In our hospital, only eight cases occurred in a 12-year period, and this condition accounted for 0.8% of all distal radius fractures and 5.5% of scaphoid fractures. The reported age distribution for this combined injury is mainly from the third to the fifth decade [3]. Our series had a similar age distribution, which was mainly from 38 to 63 years old.
### Table 1. Demographic and clinical characteristics of patients treated for ipsilateral distal radius and scaphoid fractures

<table>
<thead>
<tr>
<th>Pt No.</th>
<th>Side</th>
<th>Age (yr)/Sex</th>
<th>Type of fracture</th>
<th>Associated injury</th>
<th>Radius treatment</th>
<th>Scaphoid</th>
<th>Mechanism</th>
<th>F/U (yr)</th>
<th>Function</th>
<th>Anatomic result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L</td>
<td>38/F</td>
<td>Displaced</td>
<td>Metatarsus Fx, L</td>
<td>ESF + pinning</td>
<td>Herbert screw</td>
<td>Traffic accident</td>
<td>1.3</td>
<td>Fair</td>
<td>Grade 2</td>
</tr>
<tr>
<td>2</td>
<td>L</td>
<td>56/M</td>
<td>Non-displaced</td>
<td>Nil</td>
<td>ESF + pinning</td>
<td>Pinning</td>
<td>Fall</td>
<td>1.2</td>
<td>Fair</td>
<td>Grade 1</td>
</tr>
<tr>
<td>3</td>
<td>L</td>
<td>90/F</td>
<td>Non-displaced</td>
<td>Femoral neck Fx, L</td>
<td>Pin in cast</td>
<td>Thumb spica</td>
<td>Fall</td>
<td>3.7</td>
<td>Good</td>
<td>Grade 1</td>
</tr>
<tr>
<td>4</td>
<td>R</td>
<td>47/M</td>
<td>Non-displaced</td>
<td>Nil</td>
<td>ESF</td>
<td>Herbert screw</td>
<td>Direct blow</td>
<td>8.6</td>
<td>Good</td>
<td>Grade 1</td>
</tr>
<tr>
<td>5</td>
<td>R</td>
<td>59/M</td>
<td>Non-displaced</td>
<td>Nil</td>
<td>Buttress plate</td>
<td>Thumb spica</td>
<td>Fall</td>
<td>11.6</td>
<td>Good</td>
<td>Grade 1</td>
</tr>
<tr>
<td>6</td>
<td>L</td>
<td>51/F</td>
<td>Non-displaced</td>
<td>AC dislocation, ankle Fx</td>
<td>Long arm cast</td>
<td>Thumb spica</td>
<td>Traffic accident</td>
<td>1.1</td>
<td>Fair</td>
<td>Grade 2</td>
</tr>
<tr>
<td>7</td>
<td>L</td>
<td>63/M</td>
<td>Non-displaced</td>
<td>Nil</td>
<td>ESF + pinning</td>
<td>Pinning</td>
<td>Fall</td>
<td>1.0</td>
<td>Good</td>
<td>Grade 1</td>
</tr>
<tr>
<td>8</td>
<td>R</td>
<td>39/M</td>
<td>Non-displaced</td>
<td>Nil</td>
<td>Buttress plate</td>
<td>Pinning</td>
<td>Traffic accident</td>
<td>8.2</td>
<td>Good</td>
<td>Grade 1</td>
</tr>
</tbody>
</table>

F/U = follow up; L = left; R = right; M = male; F = female; Fx = fracture; ESF = extra-skeletal fixation; Pinning = percutaneous pinning; Herbert screw = open reduction and internal fixation with Herbert screw; Buttress plate = open reduction and internal fixation with buttress plate; AC = acromion-clavicula.

### Table 2. Sarmiento et al.'s modification of Lindström's classification [8]

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Dorsal angulation not exceeding neutral and/or shortening</th>
<th>Dorsal angulation of 1-10 degrees and/or shortening by 3-6 mm</th>
<th>Dorsal angulation of 11-14 degrees and/or shortening by 7-11 mm</th>
<th>Dorsal angulation &gt;15 degrees and/or shortening &gt;12 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>No or negligible deformation</td>
<td>Dorsal angulation not exceeding neutral and/or shortening &lt;3 mm</td>
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<tr>
<td>Grade 2</td>
<td>Slight deformation</td>
<td>Dorsal angulation of 1-10 degrees and/or shortening by 3-6 mm</td>
<td>Dorsal angulation of 11-14 degrees and/or shortening by 7-11 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3</td>
<td>Moderate deformation</td>
<td>Dorsal angulation of 11-14 degrees and/or shortening by 7-11 mm</td>
<td></td>
<td>Dorsal angulation &gt;15 degrees and/or shortening &gt;12 mm</td>
<td></td>
</tr>
<tr>
<td>Grade 4</td>
<td>Serious deformation</td>
<td>Dorsal angulation &gt;15 degrees and/or shortening &gt;12 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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During lower-energy trauma, after the initial scaphoid fracture occurs first and then continued axial loading and extension of the wrist produce the fracture of the radius. Fracture of one bone may dissipate sufficient force to protect the adjacent bone from fracture. In our series, all scaphoid fractures except one were non-displaced waist fractures, while the fractures of the distal radius varied from type A to C, including different severities of comminution. It seemed that the radius had absorbed the majority of the energy, which led to different fracture patterns, then the residual energy produced a non-displaced scaphoid fracture.

Generally, the decision of whether to operate on simultaneous fractures should be based on the same criteria as used for isolated fractures. That is, operation is indicated if an unstable, displaced scaphoid fracture and an unstable, displaced distal radius fracture or carpal instability has developed [5]. However, there are different opinions about the necessity for fixing the non-displaced scaphoid fracture in treating this situation. Many authors believe that, in most instances, the scaphoid fracture is non-displaced and, thus, is stable, union is almost always certain, and reduction of the scaphoid will not be lost even with traction forces across the wrist [1, 3, 5, 9]. They conclude that fixation prior to reduction of the radius to prevent over-distraction of the scaphoid is not necessary, and the use of a splint or cast are enough for immobilization.

In our series, the satisfactory result obtained in a 90-year-old patient (patient 3) with pin-in-cast for distal radius fracture without prior fixation of the scaphoid may support this hypothesis. However, Albert demonstrated that the longitudinal traction across the wrist will cause a non-displaced scaphoid to become distracted and displaced [14]. Reduction of the scaphoid occurs after the traction is relaxed. Some other authors also suggested that initial fixation of the scaphoid, either by percutaneous pinning or open reduction with Herbert screw fixation, is necessary to prevent over-distraction during radius reduction or external fixator application, which could result in scaphoid nonunion [4, 6]. Therefore, we fix the scaphoid first in cases where closed reduction of the distal radius is indicated, thereby eliminating the potential for development of the over-distraction phenomenon. In this series, the scaphoid was immobilized with cast without internal fixation in three patients (patients 3, 5, and 6). In patients 5 and 6, no major distraction was applied across the wrist joint. This might explain why the scaphoid was not displaced in these cases and could be adequately treated with a thumb spica cast. The only exception was patient 3. Although the surgeon performed reduction of the distal radius in this patient, the scaphoid was kept in place without displacement. If open reduction and internal fixation are performed for radius fracture (such as Barton’s fracture) or no traction force is applied across the wrist joint, it may not be necessary to fix the scaphoid fracture. Further studies to demonstrate the intraoperative status of the scaphoid fracture are necessary to confirm this hypothesis. Because of the problems related to prolonged casting, such as stiffness of the adjacent joint, atrophy of articular cartilage, and intraarticular adhesion [15], our preference now is to use an external fixator and percutaneous pinning. This provides earlier rehabilitation and also better care for the polytraumatized patient. However, great care must be taken to avoid complications such as pin-tract infection or superficial radial nerve injury.

Most authors agree that very high impact energy is necessary for the development of this condition [2, 4, 9, 10]. In our series, four younger patients had suffered higher-energy trauma such as traffic accidents or direct blows, while the older patients had suffered lower-energy injuries such as falls. This observation is also compatible with previous reports that, in younger adults, the injury mechanism seems to involve a great force acting over the wrist, while in the elderly, these fractures are probably due to osteoporosis causing vulnerability to minor trauma [3, 11]. However, there is still some controversy about the mechanism of this type of combined injury.

Frykman used experimental methods to show that the distal radius fracture occurs first, followed by the scaphoid fracture [12]. However, Stother [9], Mayfield [13], and Moller [11] suggested that under high-energy insult, the scaphoid fracture occurs first and then continued axial loading and extension of the wrist produce the fracture of the radius. Frykman used experimental methods to show that the distal radius fracture occurs first, followed by the scaphoid fracture [12]. However, Stother [9], Mayfield [13], and Moller [11] suggested that under high-energy insult, the scaphoid fracture occurs first and then continued axial loading and extension of the wrist produce the fracture of the radius. During lower-energy trauma, after the initial scaphoid fracture occurs, a rotation of the distal radius with the hand locked in pronation will stretch the radiocarpal ligament to a maximum, leading to a fracture of the osteoporotic radius.

![Fig. 2. Patient (case 1) who also sustained comminuted distal radius fracture. The patient had a displaced scaphoid fracture. A) Post-operative antero-posterior (AP) view. The height was reduced but the die-punch fragment still remained displaced. B) Post-operative lateral view. Although the scaphoid is not well reduced, the scaphoid height is still preserved. C), D) 6 months after operation. AP view showed mild collapse of the radial height, and lateral view revealed 10 degrees dorsal angulation. The functional result was fair.](image-url)
Oskam et al indicated that distal radius fracture is the principal injury that determines the outcome of treatment [5]. In our series, except for one patient who sustained iatrogenic superficial radial nerve injury, the remaining two patients who had fair results had grade 2 radius deformity. Patients with grade 1 anatomical results also had good functional results. These findings seem compatible with Oskam et al's observation [5].

Most scaphoid fractures are non-displaced. Fixation of the scaphoid before reducing the radius may be necessary to prevent possible over-distraction, which could result in non-union. The prognosis is mainly related to the results of treatment of the distal radius fracture.

References