# Scaphocapitate Syndrome

# 5

## 5.1 Introduction

The term "scaphocapitate syndrome" refers to the combination of a fracture through the waist of the scaphoid and a fracture of the neck of the capitate, the head of which rotates by 90°–180° [1–3].

The first references about a "scaphocapitate syndrome" were made by Lorie [4] and Perves et al. in 1937 [5], who were the first to describe a trans-scaphoid trans-capitate perilunate fracture-dislocation. In the English literature the first reference was in 1940 from Nicholson [6]. However, the term "scaphocapitate syndrome" was introduced by Fenton [7] in 1956 who described two patients with a proximal capitate fracture that was rotated 180°, but neither of them was reported to have an associated perilunate dislocation. Since then, about 43 cases have been published, involving adults. In children only 4 cases have been published [8–11], the youngest being 11-years old [12] with simultaneous fractures of the scaphoid and capitate, but these fractures were undisplaced.

Kaulesar Sukul and Johannes [13] made a literature review of 13 cases of scaphocapitate syndrome from 1955 to 1987, while Milliez et al. [14] of 25 cases from 1937 to 1992.

## 5.2 Incidence

The frequency of the scaphocapitate syndrome is not clearly known. Rand et al. [15] reported that capitate fractures accounted for 1.3 % of all carpal fractures; 0.3 % were isolated capitate fractures, 0.6 % were of scaphocapitate syndrome type and 0.4 % were fractures of the capitate in association with PLFD type of injuries. Geissler and Slade [16] stated that fractures of the capitate account for 1–2 % of all carpal fractures.

In our series, from 67 greater arc injuries (52 PLFD+S and 15 PLFD-S) we found 10 fractures of the capitate (14.9 %), which were manifested in various ways (Table 5.1 and Fig. 5.1).

Herzberg et al. [17] reported that in the trans-scaphoid-PLFD group, the most frequent variant was the trans-scaphoid, trans-capitate type and constituted 8 % of all PLFD injuries.

Adler and Shaftan [18] stated that the reported incidence of this injury may be unduly low, owing to failure of diagnosis and that a higher index of suspicion would lead to the recognition and treatment of more such injuries.

## 5.3 Mechanism of Injury

Fenton [7] assumed that during a fall, with the hand in dorsiflexion and radial deviation, the pointed radial styloid process (the chisel) impinges on the waist of the scaphoid, which is supported by the sturdy capitate (the anvil). When the force is moderately strong, the scaphoid alone will fracture, but when the blow is particularly sharp and violent, the capitate will also fracture [19].

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**Table 5.1** Data of our series

| Case | Delay | Type-nomenclature | Scaphoid # | Capitate # | F-U/result |
|---|---|---|---|---|---|
| 1 | Same day | Trans-scaphoid, Trans-capitate dorsal perilunate | Waist | Transverse proximal pole. Head dislocated dorsally, rotated 90°, facing dorsally | 15 years/scaphoid and capitate union. No arthritis |
| 2 | Same day | Trans-scaphoid, Trans-capitate, Trans-triquetral dorsal perilunate | Waist | Transverse neck. Head dislocated dorsally, rotated 180°, facing distally | 2 years/scaphoid and capitate union. No arthritis |
| 3 | Same day | Trans-scaphoid, Trans-capitate, dorsal perilunate (open injury) | Waist | Transverse neck. Head dislocated palmarly, rotated 90°, facing dorsally | 15 years/scaphoid union, capitate nonunion. Midcarpal arthritis. Symptoms free |
| 4 | Same day | Trans-scaphoid, Trans-Capitate, palmar perilunate | Proximal pole | Displaced para-sagittal of the capitate head | Lost |
| 5 | Same day | Trans-scaphoid, Trans-capitate, Trans-lunate, peri-triquetral, palmar lunate dislocation | Waist | Transverse neck. Body and head dislocated palmarly, rotated 90° facing palmarly | 1 year/scaphoid and capitate union. Excessive RC arthritis |
| 6 | 1 week | Wrist reduced. Scaphocapitate syndrome ? | Waist nonunion | Transverse proximal pole. Head rotated 180° facing distally | 1 year/scaphoid nonunion, capitate union. No arthritis |
| 7 | 1 week | Wrist reduced. Scaphocapitate syndrome | Distal pole comminuted | Transverse neck. Head dislocated dorsally. Rotated 180° facing distally | 6.3 years/scaphoid and capitate union. No arthritis |
| 8 | 4.5 months | Wrist reduced. Scaphocapitate syndrome | Waist | Transverse proximal pole, rotated 180°, facing distally | 1 year/scaphoid and capitate union. Signs of AVN |
| 9 | 1 week | Wrist reduced. Scaphocapitate syndrome | Waist | Transverse neck. Modest head displacement | 1 year/scaphoid and capitate union. No arthritis |
| 10 | 3 months | Wrist reduced. Peri-scaphoid, Trans-capitate | Avulsed STT from trapezium | Transverse proximal pole. Modest head displacement | 7 years/capitate union. Rapid development of AVN. SLC fusion |

*STT* Scapho-Trapezium-Trapezoid, *AVN* Avascular necrosis, *SLC* Scapholunocapitate

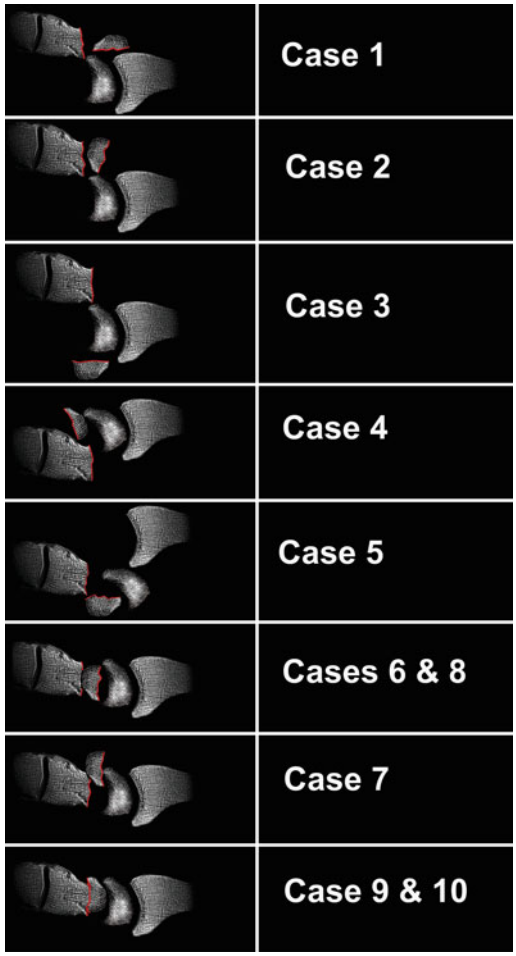



**Fig. 5.1** Our cases with the corresponding drawings of the capitate fractures and their different types of displacement

Adler and Shaftan [18] in their review of 91 capitate fractures, suggested that indirect trauma was the most common mechanism of fractures of the capitate.

Although, a direct blow to the dorsum of the volar-flexed wrist has been implicated [3, 20], most authors [9, 20], agree with the mechanism proposed by Stein and Siegel [21] based on anatomical studies on cadaver wrists, according to which the patient falls on the outstretched hand and the wrist goes into marked dorsiflexion. The capitate fracture is caused by the impaction of the capitate neck to the dorsal lip of the radius, while the scaphoid fracture is caused by the tension created at the midcarpal joint level by the forced extension. We can reasonably assume that capitate fracture precedes chronically the scaphoid fracture. Rotation of the proximal fragment appears to occur secondarily, forced by the distal fragment, as this returns to neutral position [2, 22] (Figs. 5.2 and 5.3a–h).

However, none of the above-mentioned mechanisms seems to apply in several of the reported cases [3, 23].

## 5.4 Pathologic Anatomy of the Injury

According to the prevailing view, the scapho-capitate syndrome constitutes the final stage of a greater arc injury, starting from the radial side of

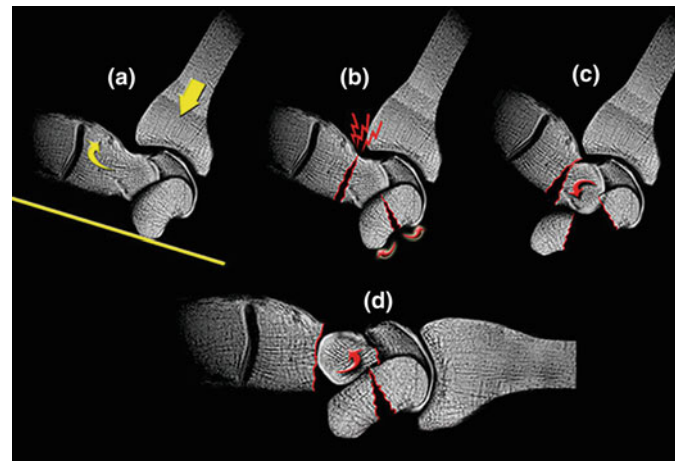
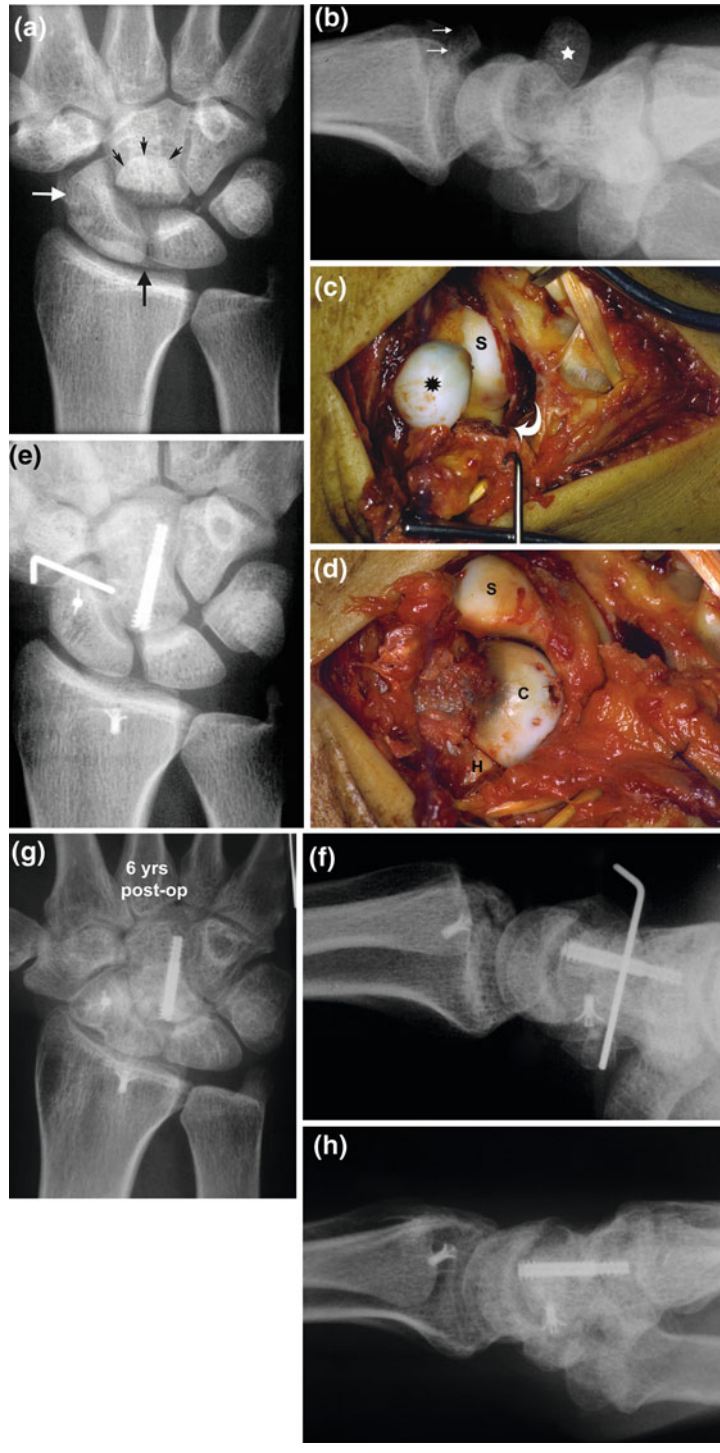



**Fig. 5.2** Schematic depiction of the mechanism of injury: With the wrist in dorsiflexion the capitate fractures impacting to the dorsal lip of the radius (**a**); the scaphoid fractures after tension at the midcarpal joint level (**b**); the capitate head is forced to rotate by the distal fragment, as this returns to neutral position (**c**, **d**). With permission from [76]


(a)
(b)
(c)
S
(e)
(d)
S
C
H
(g)
6 yrs
post-op
(f)
(h)

◀ **Fig. 5.3** Case 7. Male, 27-years old. Preoperative PA view in which the proximal capitate fragment is rotated by 180° (*small arrows*), the fracture of the distal pole of the scaphoid (*white arrow*) and the fracture of the distal radial rim (*black arrow*) (**a**); in *L view*, the head of the capitate is dorsally displaced and rotated by 180° (*asterisk*), while white arrows indicate the fractured dorsal radial rim (**b**); appearance at surgery, dorsal approach; the head of the capitate (*asterisk*) and the displaced dorsal radial fragment (*curved arrow*) (*S* Scaphoid) (**c**); after reduction and fixation of the capitate head with a headless screw, while the scaphoid with the dorsal approach, looks intact (**d**); with a separate volar approach, the fractured distal scaphoid was reduced and fixated using a bone anchor and a K-wire while the dorsal radial rim was fixed with a bone anchor; postoperative X-rays (**e**, **f**); 6 years postoperatively (**g**, **h**). With permission from [76]

the wrist and progressing through osseous structures around the lunate [24]. The injury essentially constitutes a trans-scaphoid, trans-capitate perilunate injury, which appears with the wrist being dislocated or reduced, spontaneously [25] or with closed reduction after manipulation [9, 26–29]. The wrist can be reduced but the capitate head remains displaced, with its proximal pole rotated by 90°–180° [2, 9, 14, 26–33] (Fig. 5.4a, b), while a case of scapho-capitate syndrome has been described with the head of the capitate palmarly displaced deep to the median nerve, which was tended over it [34].

It has also been stated that the scaphocapitate syndrome represents an incomplete form of the perilunate pattern of injury [20].

Kaulesar Sukul and Johannes [13] distinguished two types of trans-scaphoid, trans-capitate fracture dislocation, one in which rotation of the capitate is limited or does not occur at all, and the other where there is a 180° rotation of the capitate fragment; this implies that a perilunate dislocation was originally present.

Vance et al. [3] stated that there are two common and three uncommon patterns of injury. The first two appeared with the same incidence: In the first one, transverse fractures of the scaphoid and capitate occurred without dislocation, while the inverted capitate fragment remained in articulation with the lunate. The other presentation was a dorsal perilunate dislocation. The three other uncommon patterns that have been noted are: volar perilunate dislocation of the wrist and proximal part of the capitate, the isolated volar dislocation of the proximal part of the capitate and the isolated dorsal dislocation of the proximal part of the capitate.

Rand et al. [15] maintained that the term "scaphocapitate fracture syndrome" adds confusion to the terminology and they suggested that this term must be abandoned in favor of considering this as a special case of "trans-scaphoid, trans-capitate, perilunar fracture dislocation".

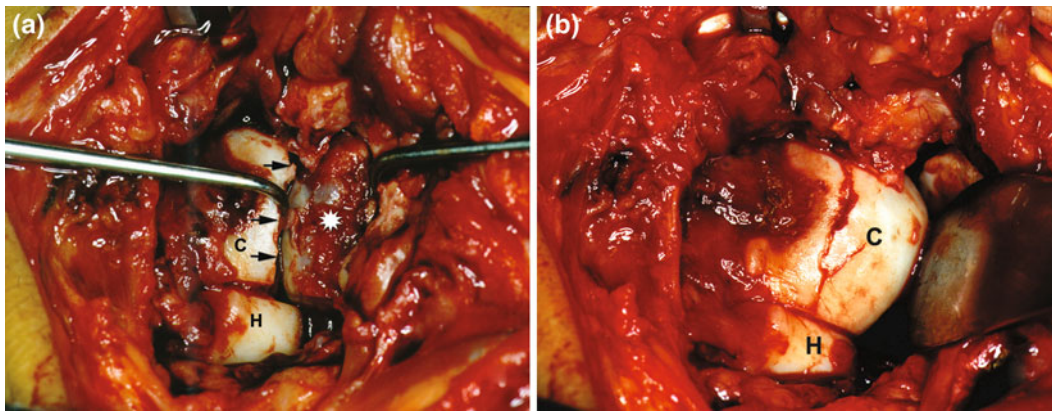



**Fig. 5.4** The fractured surface of the neck of the capitate (*black arrows*) is in contact with the articular surface of its head (*asterisk*) (**a**); the appearance after reduction of the capitate head (**b**) (*H* Hamate, *C* Capitate). With permission from [76]

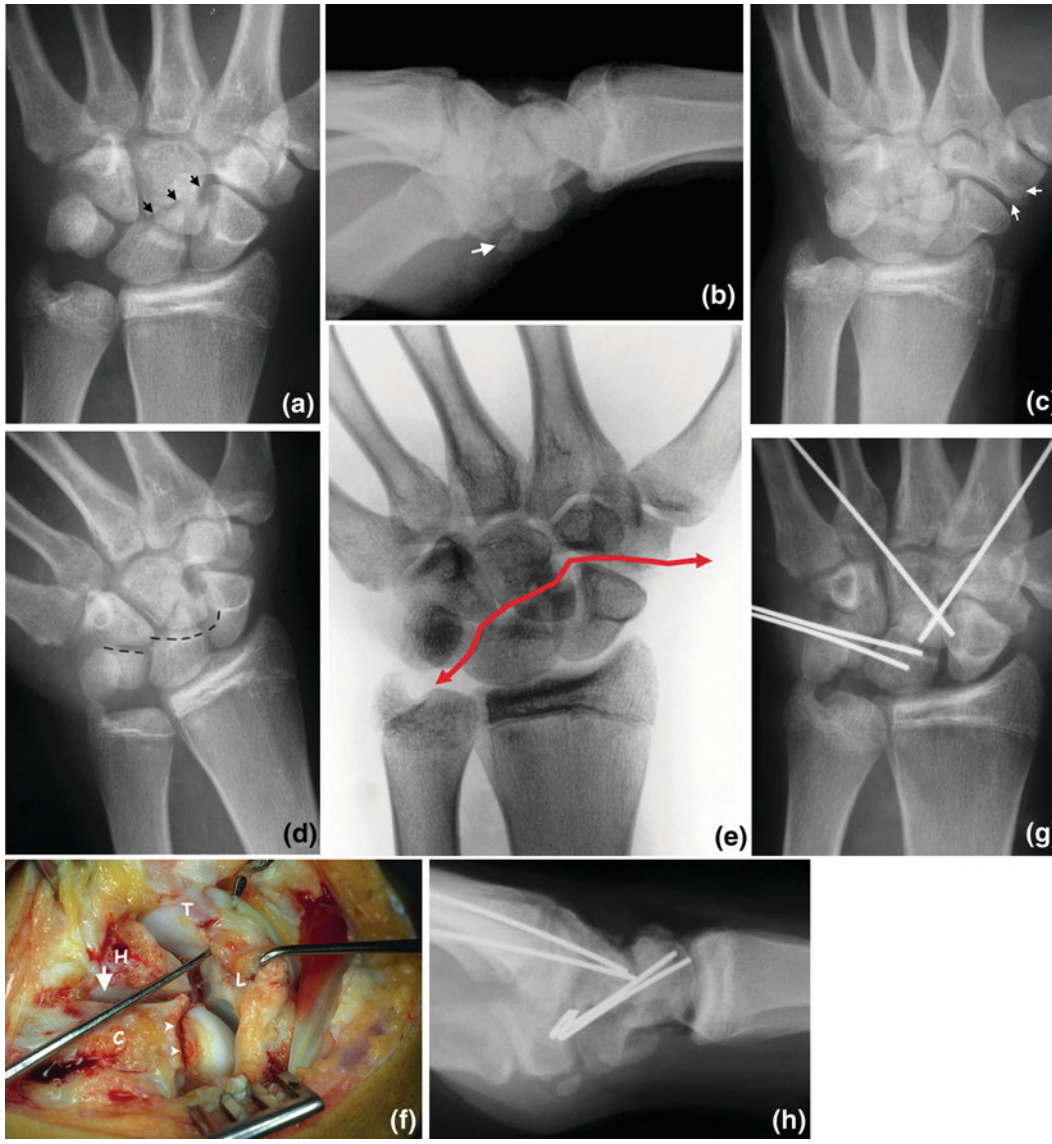



**Fig. 5.5** Case 10. Male, 19-years old, with a 3-month old reported injury, treated with a splint for 2 weeks. The P-A view indicated an oblique fracture of the capitate (*arrows*) (**a**); the lateral and oblique views, showed an avulsed osseous fragment from the trapezium (probably the attachment of the STT ligament) (*white arrows*) (**b**, **c**); in ulnar deviation, disruption of Gilula's arc is apparent (**d**); the presumptive path of injury (**e**); appearance at surgery, dorsal approach. The fractured capitate (*white arrows*), a mild dissociation between capitate and hamate (*arrow*), while the probe shows the disruption of the LT ligament (*H* Hamate, *C* Capitate, *L* Lunate, *T* Triquetrum) (**f**); postoperative appearance (**g**, **h**); 6 months later the midcarpal joint had been obliterated, while the capitate showed signs of AVN (**i**); a midcarpal fusion was performed (**j**); the radiographic appearance and the ROM 7 years postoperatively (**k**-**n**). With permission from [76]

There is some confusion in the literature regarding the terminology and diversity in the appearance of these injuries [13, 15]. Any misunderstanding would be addressed, if we accepted that the term "scaphocapitate syndrome" should only be used in cases of a reduced wrist, with concomitant fractures of the scaphoid and the neck of the capitate, with its proximal pole rotated by 90°–180°.

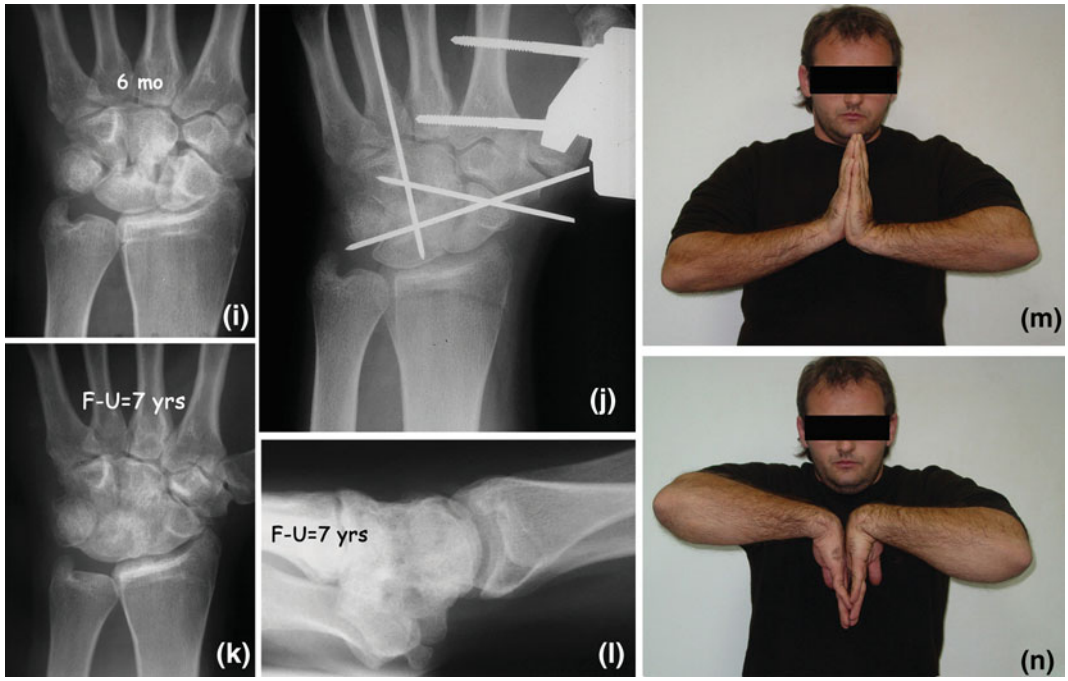



**Fig. 5.5** (continued)

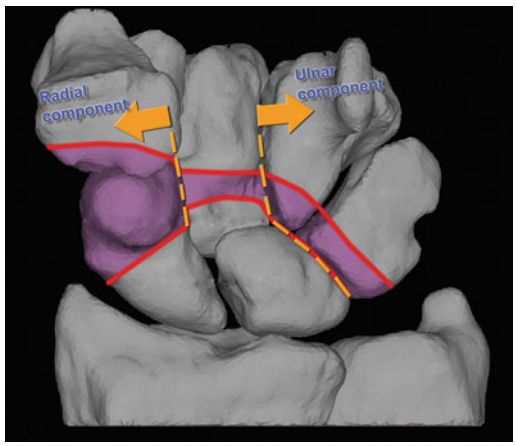



**Fig. 5.6** Every displaced, angulated, or rotated fracture of the capitate constitutes a greater arc injury (confined to *shadowed area*), which is associated with a radial and an ulnar component. Both components could be related with injuries that are not detectable in X-rays, e.g., STT or LT ligament injury

**Fig. 5.7** The combined undisplaced or minimally displaced fractures of the radius, scaphoid, and capitate probably indicate the first stage of a progressively developing greater arc injury

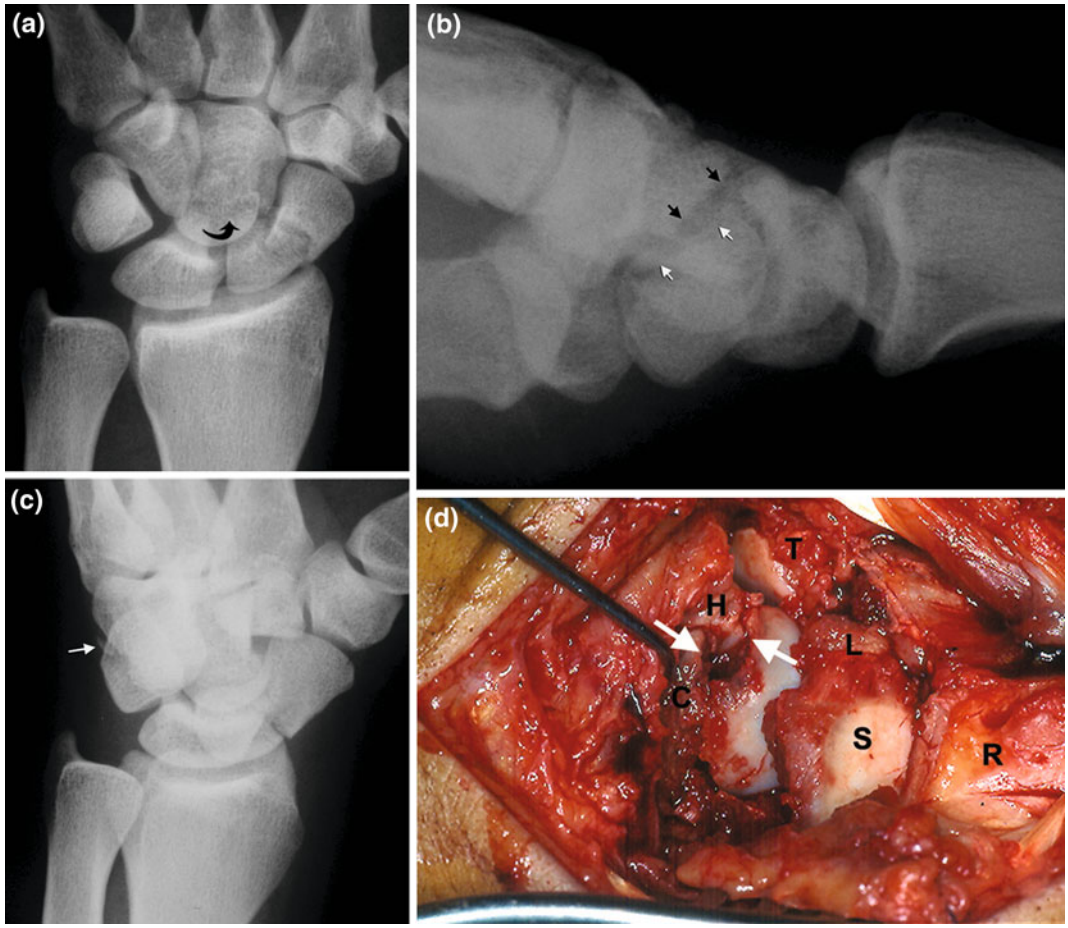



**Fig. 5.8** Case 9. Male, 39-years old. He was referred as having a displaced fracture of the scaphoid. A fracture of the capitate neck with rotation and volar displacement of the capitate head were apparent (**a**, **b**); oblique view indicated an avulsion fragment from the dorsal surface of the hamate (**c**); appearance at surgery with dorsal approach; the displacement of the capitate fracture (*arrows*) (**d**); reduction and fixation of the capitate using a headless screw and temporary fixation with 2 K-wires (**e**); the reduced and fixated with a headless screw scaphoid using bone grafts; the tail of the hamate showed a compression fracture (*arrow*) (**f**); final X-rays 1 year postoperatively (**g**, **h**). With permission from [76]

Compared to the simple, isolated, and undisplaced fractures of the capitate, there are reports of isolated fractures of the capitate neck with palmar dislocation of the proximal pole [35, 36] or with the proximal pole rotated by 180°, without an apparent associated scaphoid fracture [22, 37, 38]. There are doubts however, as to whether these are really isolated fractures of the capitate. When one considers the central position of the capitate, surrounded by the other carpal bones and the base of the third metacarpal, it is difficult to accept that such displacement and rotation of the proximal capitate can occur in isolation.

Two of our cases had displaced fractures of the capitate neck, combined with injuries distal to the waist of the scaphoid. One of these was a comminuted fracture of the distal pole of the scaphoid, which was hardly shown on the X-rays (Fig. 5.3a–h) and the other was an avulsion fracture from the radiovolar surface of the trapezium (Fig. 5.5a–n), corresponding to the attachment of the STT ligament. Both injuries had an associated rupture of the LT ligament and both could easily be overlooked. A similar case with fracture of the capitate associated with STT and LT ligaments rupture, has already been reported [39].

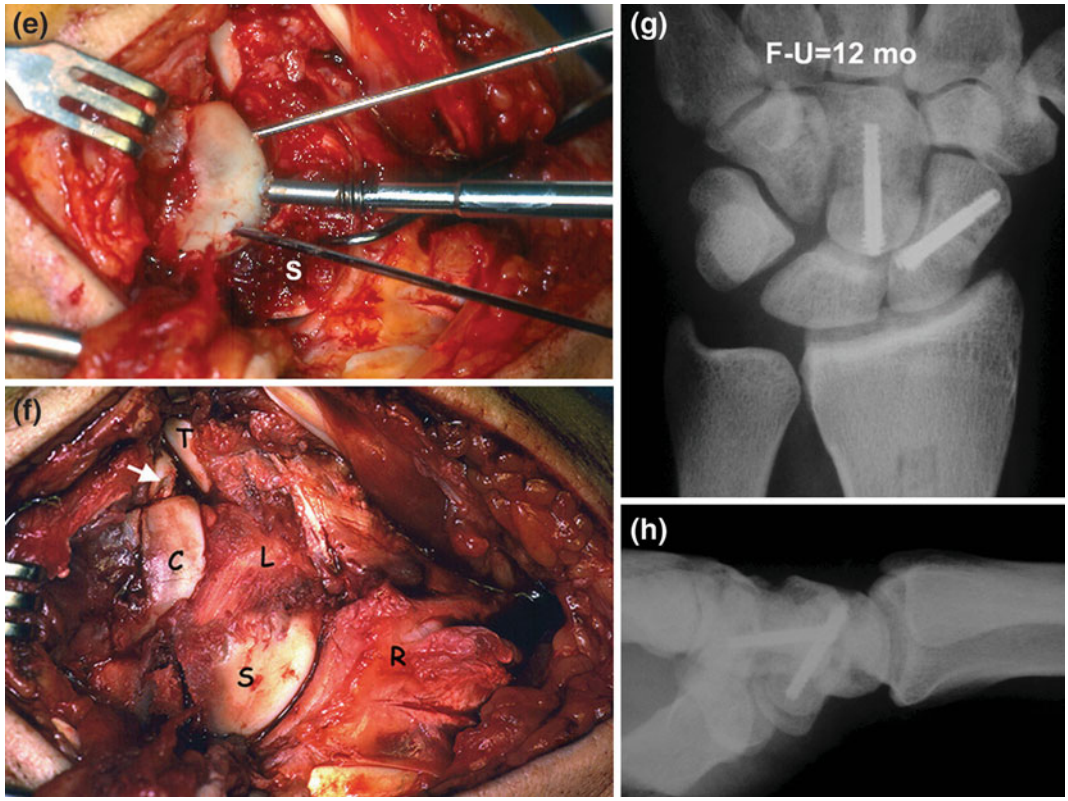



**Fig. 5.8** (continued)

We consider that every displaced, angulated, and/or rotated fracture of the neck of the capitate indicates indeed a greater arc injury and that they are always associated with a radial and an ulnar component. The radial component could be located between the waist of the scaphoid and the trapezium-trapezoid bones (including rupture of the STT ligament, which is not detectable by X-rays). The ulnar component is usually a lunotriquetral ligament injury, but may be a fracture of either the triquetrum or the hamate bones (Fig. 5.6). Reported cases of combined fractures of the scaphoid and capitate neck with no or little displacement [12], probably represent the first stage of this progressively developing injury (Fig. 5.7).

Possibly, in cases of displaced fractures of the capitate neck with otherwise normal X-rays, a midcarpal arthrogram or arthroscopy is indicated to identify possible coexisting ligamentous injuries, indicating a path of injury, other than the path through the scaphoid.

The final delineation of the injury depends on two factors: (a) the direction of the force of the injury (usually radial to ulnar, although pure dorsopalmar application of force is possible) and (b) the magnitude of the applied force, which determines how many of the three columns of the wrist are injured.

Therefore, the term ‘‘scaphocapitate syndrome ’’ constitutes only one subtype of a group of injuries and it may be better to use the term ‘‘capitate syndrome’’ instead of ‘‘scaphocapitate syndrome’’. The former can be defined as a displaced fracture through the neck of the capitate, with associated bony and/or ligamentous injuries on the radial and/or ulnar sides of the wrist [40].

## 5.5 Diagnosis

Diagnosis is based on careful radiographic evaluation but the true extent of injury can easily be missed. The injury may be labeled as an isolated fracture of the scaphoid or a typical trans-scaphoid perilunate fracture-dislocation, while the lesion to the capitate may be overlooked [20]. A posteroanterior traction radiograph (with the hand suspended in finger-traps) is useful, since the squared-off end of the proximal capitate is easily seen in this view [2]. This radiographic appearance has also been characterized as «cut-off-top-of-an-egg» [41] (Fig. 5.3a). Sometimes in questionable cases the diagnosis is made with the aid of computed tomography [42] or MRI [43, 44].

Delayed, deficient, or even complete lack of diagnosis of these injuries, are unfortunately quite common occurrences [14, 19, 45, 46]. In 1/3 out of 26 cases mentioned in the literature from 1937 until 1994, there was a delay in diagnosis of more than 15 days [14], some even 2 years later [46]. Boisgard et al. [47] reported that 8 out of 26 cases, evaded diagnosis during the initial assessment, in spite of the adequate radiological control performed.

The injury could be manifested with three basic radiographic patterns: (a) As incomplete injury with fractures of both the scaphoid and capitate, which are undisplaced or with minimal displacement (Figs. 5.7, 5.8a–h), (b) As a classic scaphocapitate syndrome, with fractures through the waist of the scaphoid and the capitate neck, with the wrist reduced and the head of the capitate displaced or rotated in varying degrees (Fig. 5.9a–k) and (c) As a trans-scaphoid, trans-capitate perilunar fracture dislocation (Fig. 5.10a–h).

The capitate fracture is usually located to its proximal or middle third and rarely to its distal third [15]. Geissler and Slade [16] recognized four major patterns of fractures in the capitate. These include: transverse fracture of the proximal pole of the capitate, transverse fracture of the body of the capitate, verticofrontal fracture and a parasagittal fracture pattern.

Associated fractures with this type of injury have also been described: fractured triquetrum [48–50], lunate [14] and radial styloid [21, 51], while more frequently reported, is an associated fracture of the distal radius [3, 9, 15, 18, 21, 52, 53].

Patients with preexisting nonunion of the scaphoid are vulnerable to dorsiflexion injuries, since the protective role of the scaphoid is omitted and the force is applied directly to the neck of the capitate from the dorsal radial rim [54] (Fig. 19 in chapter of acute PLI).

## 5.6 Management

Early reports recommended the excision of the head of the capitate and its replacement with an anchovy-type fascial graft, since avascular necrosis and nonunion were considered inevitable [6, 7, 21, 55].

Conservative treatment may lead to good results in undisplaced concomitant fractures of the scaphoid and capitate [12]. Jones [25] reported an excellent result in a patient treated only with immobilization, while the capitate was allowed to heal with its proximal portion rotated by 180°. Adler and Shaftan [18] reported that one of their patients, who sustained a trans-scaphoid, trans-capitate, dorsal perilunate fracture-dislocation with the head of the capitate rotated by 180°, was treated with closed reduction. After 5 months of immobilization he had a painless wrist with full flexion–extension arc and good strength, although he developed osteonecrosis of both proximal scaphoid and capitate.

It is understood that if closed reduction is attempted, any displacement of the capitate or scaphoid fractures is an indication for open reduction, but generally the result after conservative treatment is far from satisfactory [56].

Most authors [9, 12, 22, 23, 47, 57–60] agree that regardless of the radiographic appearance of the injury, open reduction and internal fixation is the treatment of choice. In cases of trans-

scaphoid, trans-capitate PLFD, the combined approach is recommended, while in pure scaphocapitate syndrome the dorsal approach is usually sufficient. The capitate fragment is usually devoid of any soft tissues and is reduced relatively easy to the neck with manual pressure, by applying traction to the hand. K-wires or headless screws may be placed from the proximal to the distal side and have been equally successful for the fixation of the scaphoid and capitate. Reduction and fixation of the capitate must precede that of the scaphoid, otherwise the reduction of the latter is extremely difficult [3, 59] (Fig. 5.11a–h).

Transient avascular changes of the proximal capitate are usually seen, but the union of the fracture generally remains unaffected [20], while the possible objection that operative intervention might lead to necrosis seems unjustified [13]. Kohut et al. [61] reported that in three out of six patients with trans-scaphoid, trans-capitate PLFD, the first dorsal intermetacarpal artery and vein were implanted into the fractured proximal pole of the capitate to assist revascularization; other than that, all of them were treated during the first 12 days from injury. The fractured capitate united in all six cases and in one case the density of the proximal pole of the capitate increased temporarily.

When the capitate fracture is comminuted or if the treatment is applied belatedly, primary bone grafting is indicated [49, 59].

In cases of symptomatic osteonecrosis of the capitate head or severe damage of the articular cartilage, the excision of the fragment and a partial fusion (LC or SLC) with autologous bone grafting are indicated.

For injuries diagnosed late, i.e., after 2 months, the management depends on the patients' symptoms. As long as the scaphoid fracture has already or is about to unite, probably the best solution is patient monitoring, since some of them remain asymptomatic or with well tolerated symptoms for many years, despite the malposition of the capitate head. On the contrary, symptomatic patients with bone malalignment probably require some type of midcarpal fusion [20, 46].

We treated ten patients with capitate fracture (two cases with isolated fracture of the capitate were excluded). Five cases were considered as scaphocapitate syndrome and were treated with an average delay of 6 weeks (range, 1–18 weeks), while five cases belonged to the PLFD type of injuries and were treated the same day of the injury. They were all treated with open reduction and internal fixation. One patient was uncontactable for follow-up. The average follow-up of the remaining patients was 4.8 years (range, 1–15 years). Eight out of nine scaphoid fractures and nine out of ten capitate fractures were united successfully. Three out of ten cases developed signs of arthritis (two at the midcarpal and one at the radiocarpal level) and two patients developed signs of avascular necrosis, while one of them was subjected to scapholunocapitate fusion (Table 5.1).

## 5.7 Complications

Nonunion, osteonecrosis and the development of arthritis in the long-term, are potential complications regardless of the applied method of treatment [12, 15, 20]. Early open, anatomical reduction, and stable fixation are prerequisites to minimize the above complications.

The capitate is at particular risk for avascular necrosis, because its proximal pole is entirely intra-articular and also has peculiar vascularity. According to experimental studies [43, 47, 62–64], the capitate receives its vascularity from dorsal and palmar sources. In the majority of specimens (67 %) the dorsal vessels supply the major part of the capitate. In 33 % of specimens, the vascularity to the capitate head originates entirely from the palmar surface. Regardless of pattern, the proximal pole is supplied in a retrograde fashion in all specimens and is dependent on distal–to-proximal flow across the capitate waist analogous to the blood supply of the proximal scaphoid. The more proximal the fracture of the capitate is, the greater is the risk of aseptic necrosis [63]. Milliez et al. [65] classified

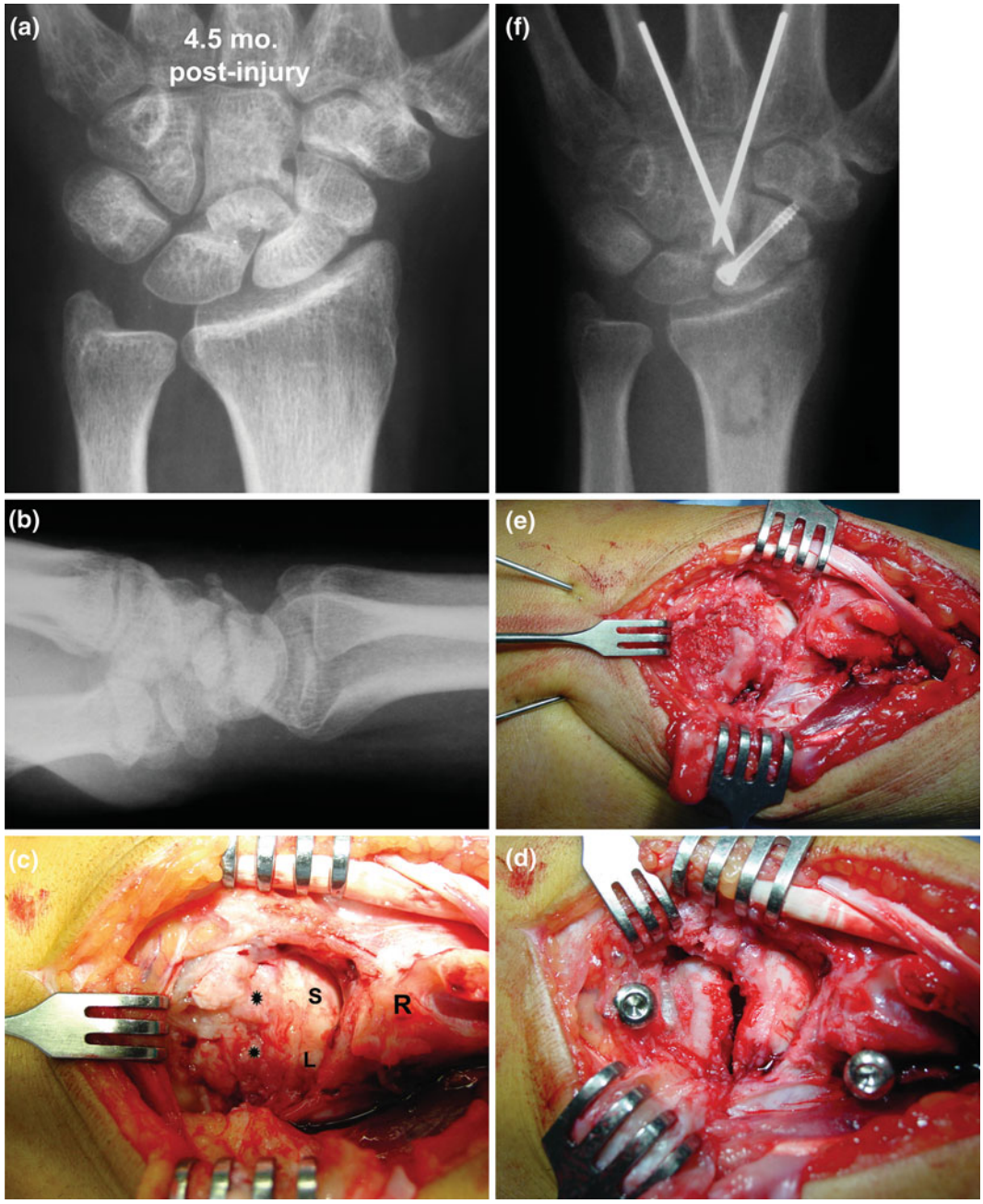



**Fig. 5.9** Case 8. Male, 24-years old, with a 4.5 month-old reported injury. He was treated for a fractured scaphoid with a below-elbow cast for 3 months. The fracture and rotation of the capitate head were apparent in the X-rays (**a**, **b**); with the dorsal approach abundant scar tissue was located to the dorsal surface of the capitate (*asterisks*) (**c**); removal of the scar tissue and relocation of the capitate head which was proved to be particularly friable, using 2 screws and a lamina spreader for reduction (**d**); the capitate was reduced, the bone was grafted and fixated with 2 K-wires, while the scaphoid was fixated with a cannulated screw (**e**); postoperative X-rays (**f**, **g**); radiographic appearance and ROM after 12 months (**h**–**k**)

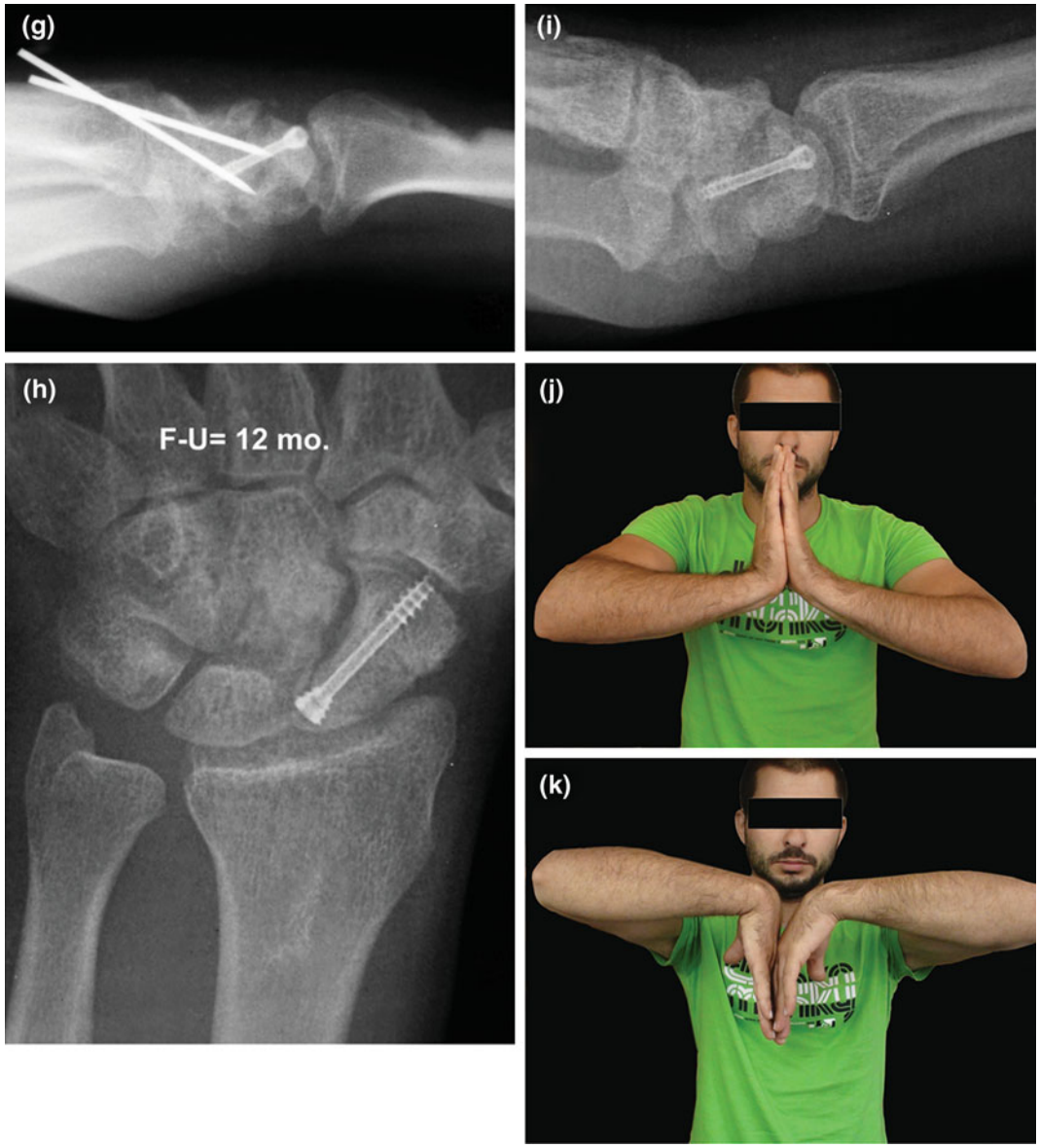



**Fig. 5.9** (continued)

the avascular necrosis of the capitate into three types. In type I (which is the most common) the necrosis involves only the proximal pole, in Type II it involves the distal portion of the capitate, while in type III it involves the entire capitate. Avascular necrosis has been reported infrequently in isolated capitate fractures but is more common in higher-energy fractures, particularly when the capitate is rotated [16, 66].

The true incidence of capitate nonunion in cases with scaphocapitate syndrome is not known, but it is known that the most substantial and under-recognized complication of isolated capitate fractures is that of nonunion, the

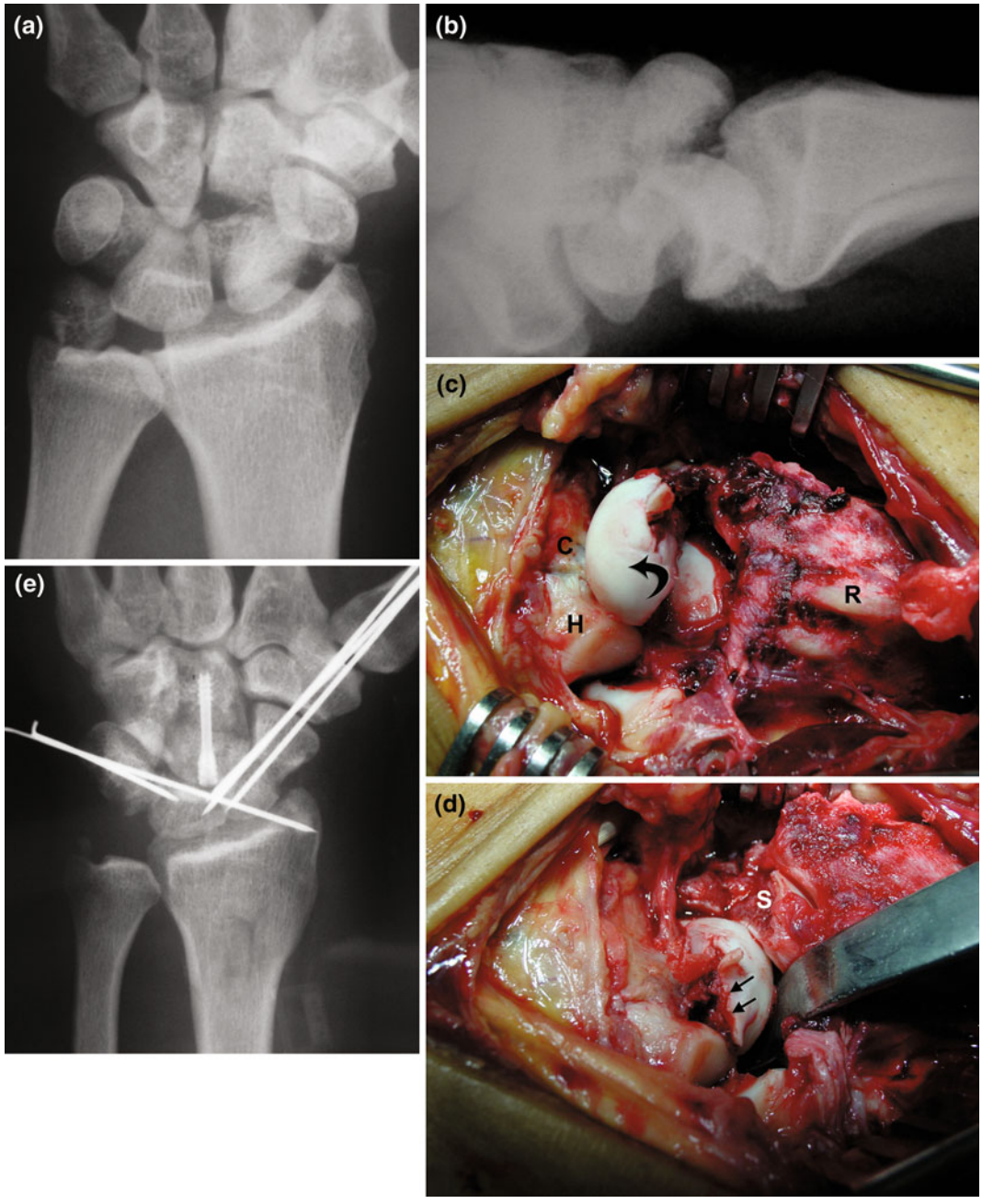



**Fig. 5.10** Case 2. Male, 31-years old. Trans-scaphoid, trans-capitate, trans-triquetral dorsal perilunate fracture dislocation with the head of the capitate dorsally displaced, rotated by 180° and facing distally (**a**, **b**); with the dorsal approach, rotation of the capitate head was apparent (*curved arrow*) (*C* Capitate, *H* Hamate, *R* Radius) (**c**); double arrows indicate the comminution of the fractured capitate (*S* Scaphoid) (**d**); postoperative X-rays (**e**, **f**); final follow-up X-rays after 2 years (**g**, **h**)

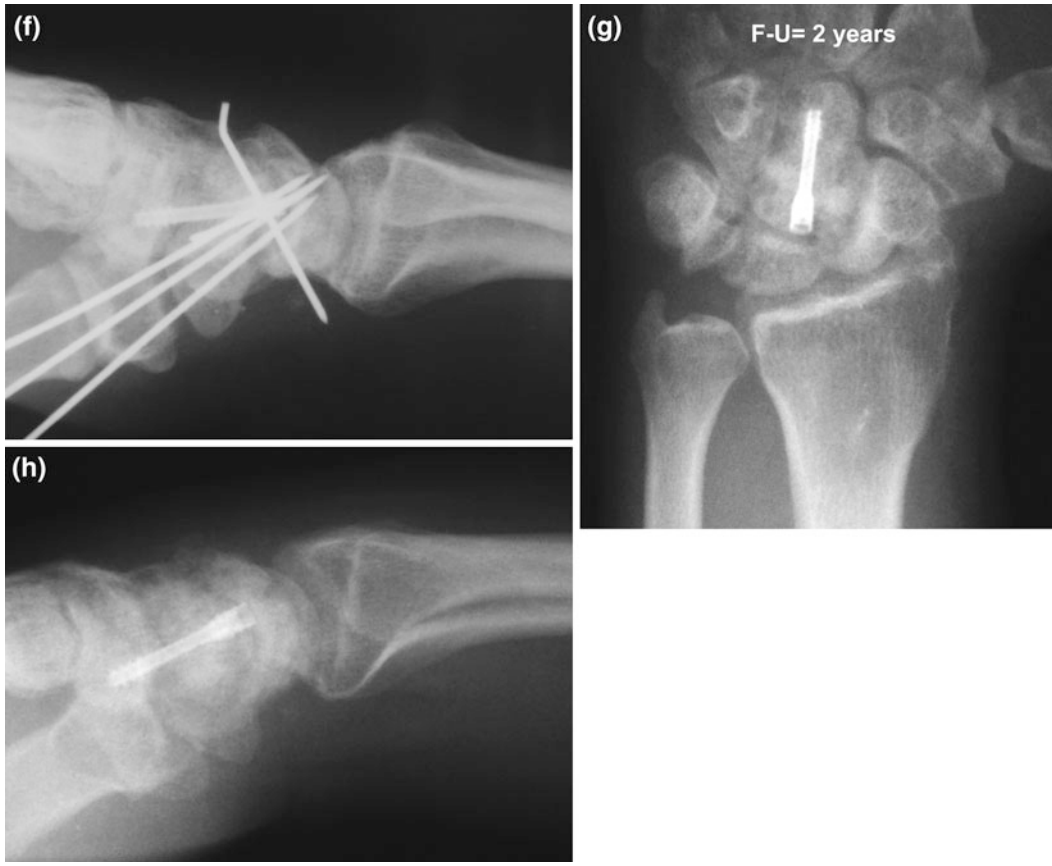



**Fig. 5.10** (continued)

incidence of which ranges between 19.6 and 56 % [67, 68] (Fig. 5.12a–l).

Nonunion of the capitate may be related to both vascular and mechanical factors and is usually associated with absorption of the fracture surfaces and shortening of the capitate [15, 69–71]. This shortening induces carpal collapse and overloading to the scaphotrapezial-trapezoidal and triquetral hamate joints, on either side. In cases of capitate shortening, the fragments should be distracted to accept an intercalary graft, regain the lost length and restore carpal stability [15, 16, 70, 72].

Rand et al. [15], reported 13 cases of fractures, three of which were isolated and two of which progressed to nonunion after non-operative treatment. Freeman and Hay [69] introduced a case with nonunion of the capitate presented with a painful snapping wrist, while Rayan [73] reported a case with occult wrist pain due to capitate nonunion. Both were cases with isolated injury to the capitate.

Kammermeier et al. [74] considered the uninjured palmar V ligament responsible for the development of capitate nonunion.

Rico et al. [75] presented a case with nonunion of an isolated fracture of the capitate, which was successfully treated with iliac bone graft and K-wires fixation. They stated that although isolated capitate fractures were less frequent, the incidence of pseudarthrosis was greater than in fractures of the capitate associated with other injuries. Reviewing the literature they found 10 cases of capitate nonunion.

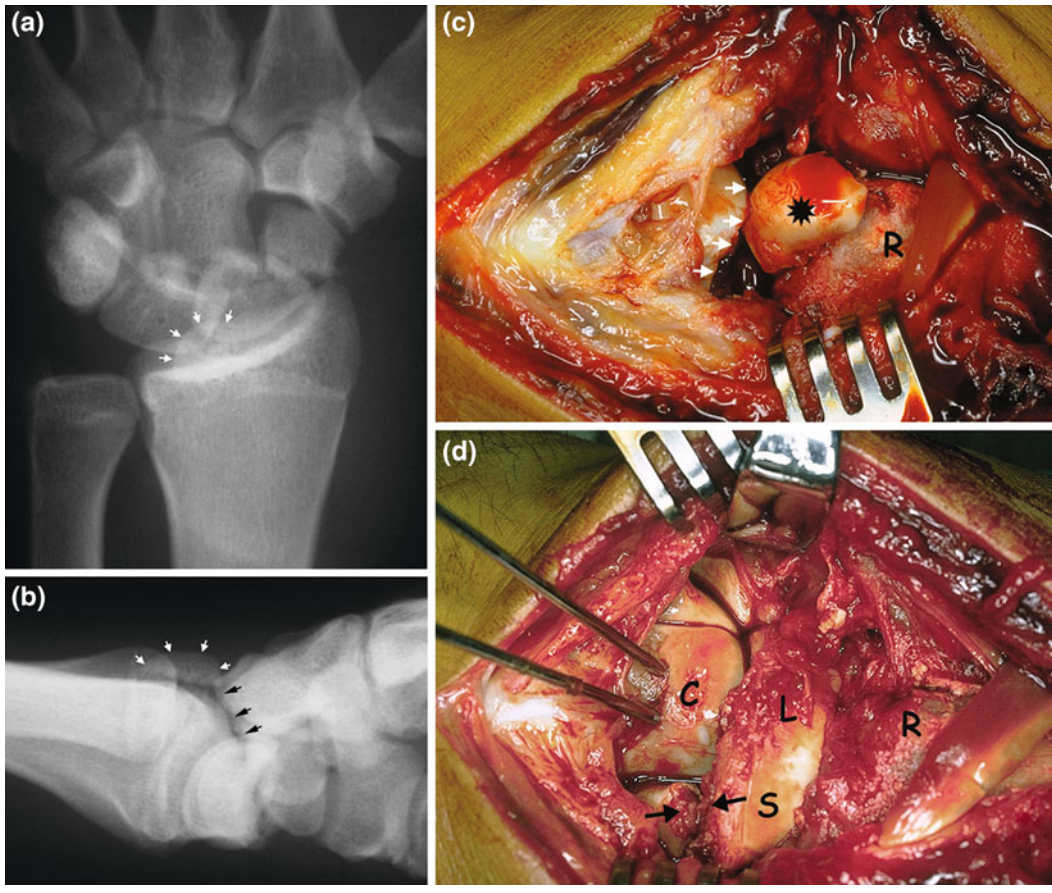



**Fig. 5.11** Case 1. Male, 16-years old. Trans-scaphoid, trans-capitate dorsal perilunate fracture dislocation with the proximal head of the capitate located at the dorsal surface of the distal radius and rotated by 90° (**a**, **b**); fracture of the neck of the capitate (*white arrows*) and the head of the capitate (*asterisk*) located on the dorsal surface of the radius (**c**); reduction and fixation with 2 K-wires of the capitate while comminution of the dorsal scaphoid was obvious (*arrows*) (*C* Capitate, *S* Scaphoid, *L* Lunate, *R* Radius) (**d**); postoperative X-rays (**e**, **f**); 15 years postoperatively (**g**, **h**). With permission from [76]

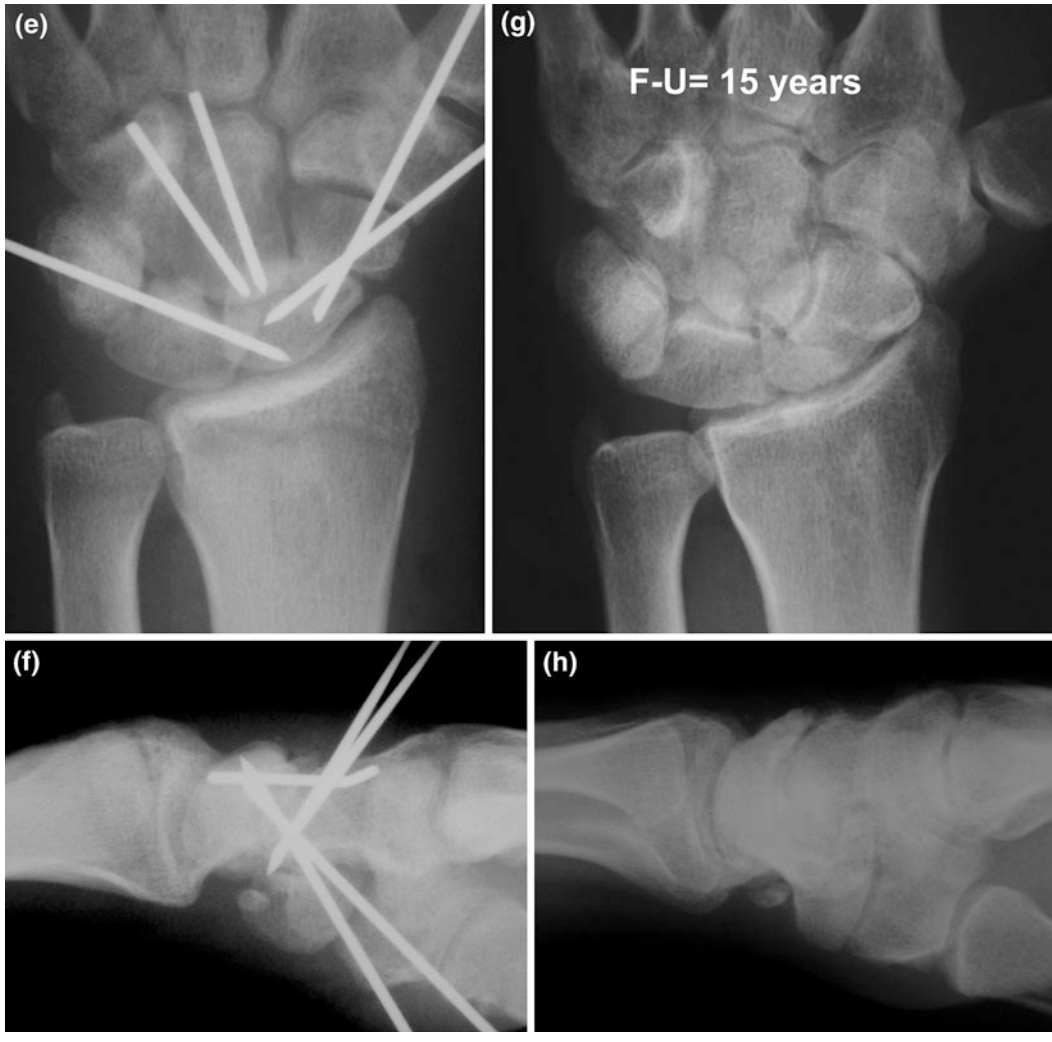



**Fig. 5.11** (continued)

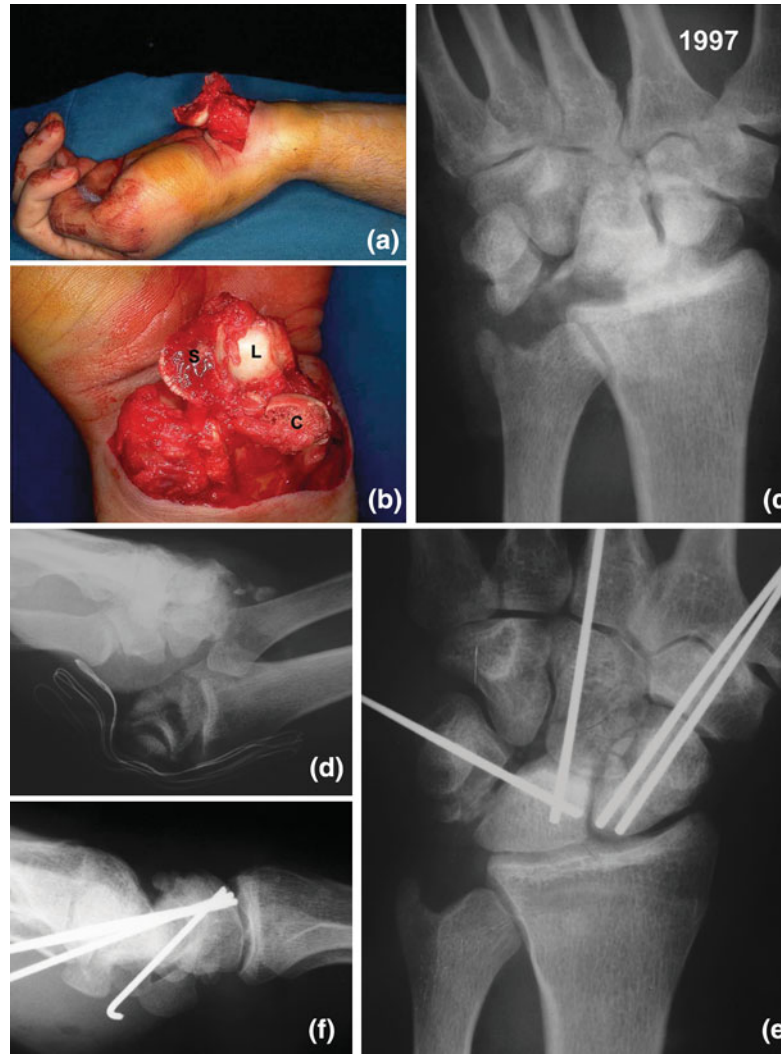



**Fig. 5.12** Case 3. Male, 33-years old, polytrauma patient. Wrist bones were ejected through the volar wound without neurovascular injury (*S* Scaphoid, *L* Lunate, *C* capitate) (**a**, **b**); initial radiographs (**c**, **d**); reduction and fixation with combined approach (**e**, **f**); 2 years later a nonunion of the capitate was apparent (**g**); the patient refused the suggested operation since he had only mild discomfort. The radiological and clinical course vindicated the patient, as 15 years later he remains symptoms free with only minor restriction of ROM (**h–l**). With permission from [76]

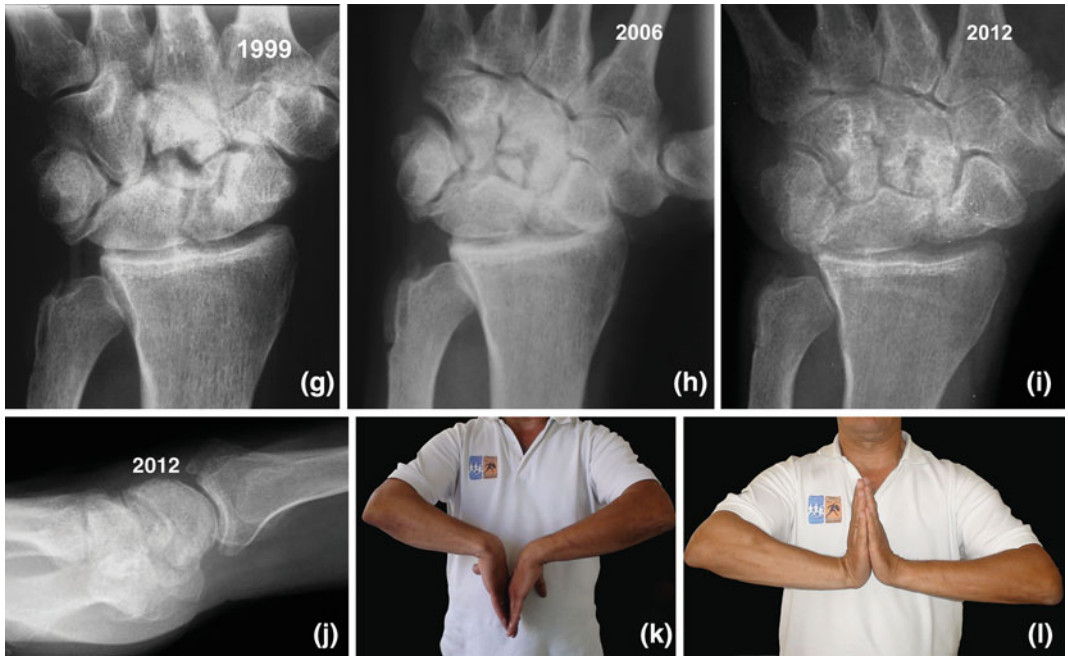



**Fig. 5.12** (continued)

Rand et al. [15] reported that the incidence of post-traumatic arthritis in patients with scapho-capitate syndrome reached 66 %.

Marsh and Lampros [48] demonstrated that the proximal capitate fragment may undergo necrosis if left unreduced, a view also supported by others [59].

Kohut et al. [61] treated six patients with greater arc injuries and capitate fractures, with open reduction and K-wires fixation. After a follow-up of 6.4 years all wrists showed mild or moderate (one patient) arthritic changes. Only one patient was entirely free of pain, whereas the others experienced some discomfort or pain at various activity levels.

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