Repair of the triangular ligament in Colles' fracture

No effect in a prospective randomized study

Fredrik af Ekenstam[1], Olafur P. Jakobsson[1] and Karin Wadin[2]

We present a prospective and randomized study of two different treatments of extraarticular Colles' fracture with a fractured ulnar styloid. The study comprised 41 patients with 2 years' follow-up; 22 patients were treated with closed manipulation and an above-the-elbow plaster cast, whereas in 19 patients the avulsed ulnar styloid was transfixed and/or the triangular ligament was repaired after closed reduction of the fractured radius. In all the operated on patients, a complete rupture of the triangular ligament was found. Good reduction of all the fractures was achieved primarily according to the radiographic examination. At follow-up the alignment had deteriorated, with no difference between the two treatment groups. Neither did the findings in the wrist arthrograms differ between the two groups, nor did the subjective complaints of the patients. We conclude that repair of the ruptured triangular ligament in extraarticular fractures of the distal radius is not better than conventional treatment.

The triangular ligament or its attachments must be injured to allow displacement of an extraarticular fracture of the distal radius (af Ekenstam and Hagert 1985b), We have studied the repair of this structure. Our hypothesis was that anchoring the distal radial fragment by repairing the ligament or the styloid would prevent its dislocation. A prospective randomized study was designed where half of the patients were treated surgically and half by closed reduction only.

Patients and methods

The study comprised 41 patients who were treated for a closed, extraarticular, dislocated fracture of the distal radius during 1981. The only cases accepted for the study were those classified as Lidström (1959) Group IIa + c or Frykman (1967) Groups II + VI. The patients were divided into two groups: Group A were born on even dates and Group B were born on uneven dates. Reduction and splinting of the fractured radius were identical in both groups.

Group A included 19 patients—14 women and 5 men—aged 49 (16–68) years at the time of injury. The treatment was closed manipulation followed by suturing of the triangular ligament and stabilization of the ulnar styloid. The distal part of the ulna was explored through a dorsal incision. The sheath of the digiti minimi tendon and the proximal part of the sheath of the extensor carpi ulnaris tendon were opened. An incision through the dorsal capsule of the distal radioulnar joint brought the proximal part of the triangular ligament into view. The distal part of the ligament could be studied through a transverse incision of the dorsal capsule of the radiocarpal joint. The ulnar styloid was fixed in 17 cases. This was done by osteosuture in 11 cases, by K-wire in 4 cases, and by tension band in 2 cases. In 10 cases the triangular ligament was avulsed from the fovea at the base of the styloid and, accordingly, the ligament was reattached (Figure 1). After wound closure, an above-the-elbow plaster cast was applied.

Group B included 22 patients—17 women and 5 men—aged 53 (18–69) years at the time of injury. These patients were treated by closed reduction and fixation by only a plaster cast.

The injured arm was anesthetized using 40 mL of 0.5 percent Citanest(TM) intravenously in a bloodless field. Closed reduction of the fracture was done by traction and manipulation. An above-the-elbow plaster cast (with the elbow joint flexed 90°, the forearm slightly pronated, and the wrist slightly flexed and ulnarly tilted) immobilized the arm for 5 weeks.

Departments of Plastic and Hand Surgery[1] and Radiology[2], Uppsala University, Akademiska sjukhuset, S-751 85 Uppsala, Sweden

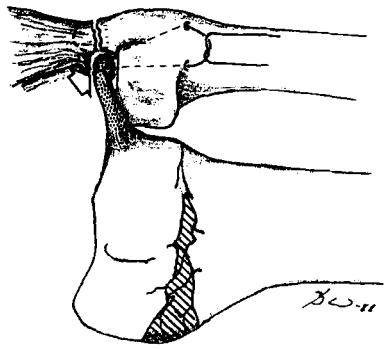

Figure 1. The technique used to reattach the triangular ligament to the base of the ulnar styloid (fovea) using 3/0 Supramid® suture through drill holes. Avulsed styloid was reduced and stabilized by a K-wire, osteosuture, or tension-band technique.

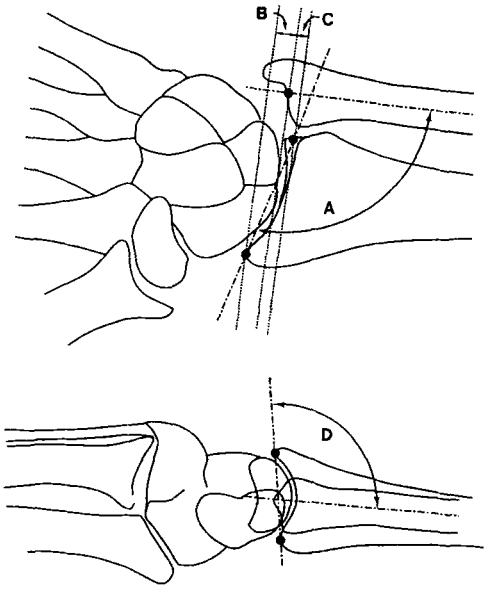

Figure 2. The four variables as shown by the arrows. The points show the landmarks that define the reference lines.

Table 1. Results of the clinical examination. Strength is expressed in arbitrary units, whereas all the other measurements are in degrees. Mean *SD*

		Treatment	
	Controls n 41	Closed n 22	Open n 19
Strength	60 *22*	58 *18*	59 *25*
Flexion	68 *11*	58 *11*	57 *15*
Extension	63 *8.9*	59 *12*	65 *8.6*
Ulnar deviation	43 *8.3*	37 *8.4*	40 *9.3*
Radial deviation	26 *7.4*	25 *5.5*	23 *6.9*
Supination	88 *5.1*	84 *9.1*	82 *8.7*
Pronation	84 *6.2*	81 *7.4*	82 *6.5*

When the cast was removed, the patients received instructions from a physiotherapist on how to regain strength and motion.

Standard radiographic AP and lateral projections with the forearm in the neutral position (Epner et al. 1982) were obtained immediately before and after fracture treatment, at 1 week, and at the 2-year follow-up. At the follow-up, each patient was interviewed, the range of motion in both wrist joints and forearms was measured, and the grip strength was evaluated by a Jamar dynamometer. The normal (uninjured) wrists of 39 of the 41 patients were used as controls, for both the clinical and radiographic examinations. Arthrograms of the radiocarpal joint were made of 54 wrists—33 fractures and 21 controls.

Dorsal angulation, radial compression, shortening of the radius, and the distance between the styloid of the radius and the ulnar head were measured on tracings of all the films (Figure 2). This was done with the PROFILE computer software for geometric measurements (Jakobsson 1988) using a HIPAD digitizer (Houston Instruments Inc.).

Statistical analyses were made using the SAS-PC package (SAS Institute Inc.). We used the Student's *t*-test to compare the measurements, with $P < 0.05$ as a significant difference.

Results

In the operated on group, 4 of 19 patients complained of painful restricted forearm rotation. Among the conservatively treated patients, 7 of 21 complained of painful forearm rotation or restricted forearm rotation or reduced grip strength. On clinical examination (Table 1), only supination and flexion differed when the controls were compared with either of the two treatment methods ($P < 0.05$).

There was no difference between the two treatment methods for any part of the clinical examination.

Radiography immediately after treatment revealed that the fractures were correctly reduced in both groups, with alignment well retained 1 week later. At the 2-year follow-up, the alignment of the distal fragment of the radius had deteriorated (Figure 3), equally in both treatment groups. When compared with the controls, however, a difference emerged for the radius-ulna length and the radius-ulna angle in frontal view ($P < 0.05$). Only the radius-ulna angle measured in side view did not differ from the control values.

The ulnar styloid healed at the same frequency in both groups. Leakage of contrast fluid into the distal radioulnar joint from the radiocarpal joint was equally

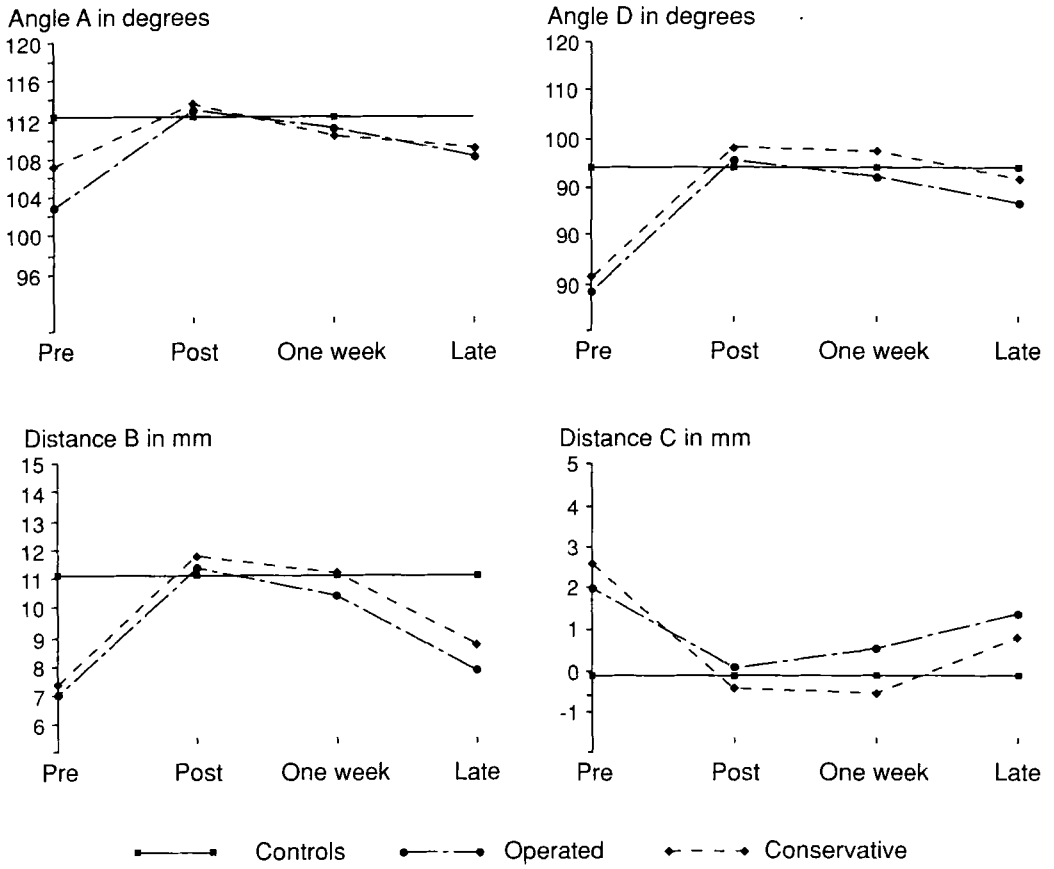

Figure 3. Radiographic measurements in dislocated Colles' fracture. The letters A to D correspond to the markings on Figure 2.
A, D: The angulation of the distal radial joint surface as measured to the ulnar length axis.
B, C: The relative shortening of the radius in respect to the ulna.
Note that the horizontal axes in these graphs are not linear and that the vertical axes do not coincide.

frequent in the treated patients as in the controls, and the contrast medium concentration in the foveolar area, at the base of the ulnar styloid, was equal in the two treatment groups.

Discussion

Reducing a Colles' fracture can be difficult, but the main challenge is how to retain the alignment. Hyperextension violence to the wrist is the main traumatic mechanism eliciting wrist pain (Mayfield 1980, Sennwald 1987). Several structures may be traumatized depending on the position of the forearm, wrist, and fingers, and also on the direction of the force at the time of injury. If the radius breaks, the fracture may be combined with disruption of the radiocarpal, ulnar carpal, radioulnar, and intercarpal ligaments (Mayfield 1980). The types of different ligament injuries are not known, and are usually neglected when treating a Colles' fracture. In theory, reduction of the fracture approximates the ligament ruptures. The ligamento-taxis is the supposed explanation behind different procedures used to reduce the distal fragment (Kongsholm 1987). However, keeping the wrist joint volarly and ulnarly tilted does not always keep the fragment from sliding backwards. Consequently, ligaments that are supposed to support the radial fragment are not sufficient to retain the achieved alignment; either the ligaments are torn or the method of immobilization is inadequate.

The triangular ligament plays an important role in holding the radius both to the ulna and indirectly to the carpus. Frykman (1967) appreciated this by including ulnar styloid fractures in his classification, because

these fractures may imply an injury to the triangular ligament. Other authors have suggested that the styloid fracture is the result of compression against the carpus (Sennwald 1987).

The triangular ligament has its main insertion to the foveolar area of the ulnar head just radial to the base of the ulnar styloid (af Ekenstam and Hagert 1985a), distally joining the ulnocarpal ligament and the tendon sheath of the extensor carpi ulnaris. From an anatomic point of view, the fractured ulnar styloid does not signify a complete lesion of the ligament. Our study included only patients with a fractured ulnar styloid; and in the surgically treated group, we confirmed a complete rupture of the triangular ligament in all the cases. This supports the view that dislocation of the distal radial fragment is not possible with an intact triangular ligament. Cadaver studies have confirmed the importance of the triangular ligament and forearm position in extraarticular Colles' fractures (af Ekenstam and Hagert 1985b): Intact ligament and forearm in the neutral or pronated position prevented dorsal sliding of the distal radial fragment.

Our investigation showed that triangular ligament repair did not improve the treatment of Colles' fracture, which might be explained by elongation or inadequate healing. Ligament healing was assessed by arthrography, but problems in evaluating the films make it difficult to reach conclusions in this respect.

References

af Ekenstam F, Hagert C G. Anatomical studies on the geometry and stability of the distal radio ulnar joint. Scand J Plast Reconstr Surg 1985a;19(1):17–25.

af Ekenstam F, Hagert C G. The distal radio ulnar joint. The influence of geometry and ligament on simulated Colles' fracture. An experimental study. Scand J Plast Reconstr Surg 1985b;19(1):27–31.

Epner R A, Bowers W H, Guilford W B. Ulnar variance the effect of wrist positioning and roentgen filming technique. J Hand Surg (Am) 1982;7(3):298–305.

Frykman G. Fracture of the distal radius including sequelae shoulder-hand-finger syndrome, disturbance in the distal radio-ulnar joint and impairment of nerve function. A clinical and experimental study. Acta Orthop Scand 1967; (Suppl 108).

Jakobsson O P. PROFILE: a user configurable system for the measurements of angles and distances on pictures. Comput Methods Programs Biomed 1988;26(2):123–8.

Kongsholm J, Olerud C. Reduction of Colles' fractures without anaesthesia using a new dynamic bone alignment system. Injury 1987:18(2):133–6.

Lidström A. Fractures of the distal end of the radius. A clinical and statistical study of the end results. Acta Orthop Scand 1959;(Suppl 41).

Mayfield J K, Johnson R P, Kilcoyne R K. Carpal dislocations: pathomechanics and progressive perilunar instability. J Hand Surg (Am) 1980;5(3):226–41.

Sennwald G. The Wrist. Springer Verlag, Berlin, Heidelberg 1987.

Acknowledgement

Financial support was given by the Disabilities Committee of the Swedish insurance companies.