Trans-styloid fixation of fractures of the distal radius

A prospective randomized comparison between 6- and 1-week postoperative immobilization in 60 fractures

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We performed a prospective randomized study on 60 patients with dorsally displaced extra-articular or noncomminuted intraarticular fractures of the distal radius. All 60 fractures were treated by closed reduction and Kirchner wire trans-styloid fixation. 30 patients had 1 week's postoperative immobilization and 30 patients had 6 weeks' immobilization.

All patients had a clinical and radiographic review at 6 weeks and at 1 year after the operation. Pain, range of movement and grip strength were tested clinically, and changes in dorsal tilt, frontal radial deviation, ulnar variance, and radial shortening were assessed radiographically.

Rates of complications were the same in both groups. At follow-up, pain was similar in both groups and range of motion and grip strength were somewhat better after early mobilization—in comparison with the opposite wrist—but this was statistically significant only for ulnar deviation. The postoperative radiographic reductions were similar in both groups, with no differences in loss of reduction after bone healing.

Therefore, in Colles' fractures, trans-styloid fixation with two K-wires seems to give a stable osteosynthesis, which does not need additional immobilization with a plaster cast.

Patients and methods

We recruited 60 patients, excluding those with anteriorly displaced fractures, fracture-dislocations, open fractures, multiple trauma, or previous fractures of either wrist or elbow. We also excluded articular fractures with more than two articular fragments, and those with too small a styloid fragment, which did not permit fixation with trans-styloid K-wires. The patients were all skeletally mature with no other age limit. The 60 fractures in 60 patients were treated with trans-styloid K-wire fixation and prospectively randomized, on the basis of an even chart number, to a group with a postoperative immobilization of 1 week (group 1) or to a group with a postoperative immobilization of 6 weeks (group 2). No patient was lost to follow-up.

The fractures were classified under the AO system (Table 1) on the basis of prereduction posteroanterior and lateral films and axial traction radiographs, taken under anesthesia to determine the extent of the frac-
ture more exactly. The dorsal cortical comminution of the radius was estimated on the basis of prereduction posteroanterior and lateral views and axial traction radiographs. The comminution was defined as the existence of a metaphyseal impaction, multiple fracture lines and/or dorsal fragments with metaphyseal cancellous defects (Figure 1). 24 fractures had a dorsal cortical comminution of the fracture line of the radius: 13 in group 1 (10 A3 and 3 C2 fractures) and 11 in group 2 (7 A3 and 4 C2 fractures).

Of the 30 patients in group 1, 9 were men, and in 15 patients the fracture was in the dominant limb. The average age at injury was 53 (18–87) years. 21 patients had active professional activities and 12 were sportsmen.

Of the 30 patients in group 2, 6 were men and 12 had their injury in the dominant limb. The average age was 57 (21–83) years. 18 patients had active professional activities and 12 were sportsmen.

Operating technique
All procedures were performed in the operating theater, under regional or general anesthesia, with intraoperative fluoroscopic and radiographic control of reduction and postoperative radiographic control of K-wire positioning. Reduction was obtained by traction in the axis of the forearm. After a 2 cm skin incision on the relief of the radial styloid to free the styloid, two 1.8 mm K-wires were inserted by a powered driver through the radial styloid, and fixed into the opposite cortex of the proximal radius. After operation, the wrist was immobilized in a short-arm circular plaster for 1 or 6 weeks, according to the randomization. In both groups, the hand was raised to prevent pain and edema for the first few days. The elbow and fingers were always mobilized immediately after the surgical procedure, including pronation and supination of the forearm. In both groups, the patient was encouraged to mobilize his wrist just after cast removal, but no physiotherapist was involved. In group 1, no heavy work was allowed before 6 weeks, but daily activities were recommended. The operating surgeon at the time of the surgical procedure did not know in which group the patient was.

Review
All the patients were independently reviewed, after a 1-year follow-up, by a single physician, who did not take part in the treatment of the fractures and did not know the duration of the period of postoperative immobilization. At 4 weeks and 1 year after the surgical procedure, pain was recorded by the patient on a 15-cm visual analog scale line. The pain score ranged from 0 point (worst possible pain) to 15 points (no pain). A goniometer was used to measure flexion and extension of the wrist, radial and cubital deviation and rotation of the forearm (pronation and supination) of the injured and contralateral wrists. Strength of grip was measured with a Jamar dynamometer. The injured forearm was compared with the opposite side, with allowance for dominance: a 10% weakness of the non-dominant hand was allowed (Pool 1973). Each patient was questioned at follow-up about discomfort in the injured wrist during domestic activities. The use of analgesics, because of wrist pain, was assessed during the postoperative period and at 1 year, and classified as major analgesic (with codeine or morphine-like drug), minor analgesic or no medicine. The subjective outcome was classified as entirely satisfied, satisfied, disappointed, or dissatisfied.

Radiographs were taken immediately after the surgical procedure, at 45 days just before and just after K-wire removal and after 1 year. Posteroanterior and lateral views were used to determine (Figure 2):

1) The frontal radial deviation: angle between the articular surface and the long axis of the radius (Lidström 1959),

2) The radioulnar index: distance between the most proximal point of the articular surface of the radius and the ulnar head (Altissimi et al. 1986). Negative values indicate that the radius is more proximal than the ulna and positive values that it is more distal,

3) The volar tilt: counted positively, by convention (a posterior displacement may eliminate this angle or make it negative).
4) The radial length: vertical distance between the radial styloid and the ulna head (Gartland and Werley 1951).

We used the Student’s t-test, analysis of variance and Mann-Whitney’s U-test for the statistical analysis.

Results

Complications

No deep infection occurred, but there was one superficial infection around a pin in group 1, which subsided after the planned removal of K-wires, with local treatment, but no other antibiotic therapy. There was 1 reflex sympathetic dystrophy in group 1, and none in group 2. Paresthesia and/or hypoesthesia in the radial nerve territory occurred in 3 patients in group 2 and in 1 patient in group 1, with persistent symptoms after 1 year. This complication usually seemed to be caused by K-wire removal, rather than the previous surgical procedure: 3 patients did not have this complication before K-wire removal. One patient, with 6 weeks’ immobilization, had a tendon rupture of the extensor pollicis brevis and of the abductor pollicis longus, which required a surgical procedure. One patient in group 2 had an anterior pin migration, which required an anterior approach to remove it at 6 weeks.

Clinical outcome

The average pain score was 9 points during the postoperative period (group 1: 9.5 points and group 2: 8.5 points) and 12.5 points at follow-up (group 1: 13 points and group 2: 12.5 points) with no significant difference between the groups. The analgesic administrations were similar in the groups during the postoperative period and at follow-up. The average range of motion at follow-up was the same in both groups (Table 2). Regarding the difference between the injured wrist and the opposite one in each group, the results were somewhat better after early mobilization, but this was statistically significant only for ulnar deviation \((p = 0.03)\). Grip strength was 25 kg in group 1 and 21 kg in group 2, with no statistically significant difference, and the differences from the uninjured side were similar in each group. Among the 39 patients who worked, the duration of sick leave was 7 weeks, with no statistical difference between groups 1 and 2. 14 patients had functional discomfort during their domestic chores at follow-up, with no significant difference between the 2 groups. Of the 22 sportsmen, 19 returned to their sporting activities free of discomfort, with no statistical difference between groups 1 and 2. There was no difference in the subjective outcome: 35 patients were entirely satisfied (17 patients in group 1 and 18 in group 2), 21 satisfied (10 patients in group 1 and 11 in group 2), 4 disappointed (3 patients in group 1 and 1 in group 2).

Radiographic outcome (Table 3)

The preoperative deformation and the adequacy of the postoperative reduction were similar in both groups. No fracture was overreduced. The postoperative radiographic assessment at 6 weeks and the radiographic evolution between the injury and the maximum follow-up were similar in both groups. At follow-up, no statistical difference was detected between groups 1 and 2.

Influence of the radial dorsal comminution on the clinical and radiographic outcomes

The degree of radial dorsal comminution did not af-

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Table 2. Range of motion of the injured and opposite wrists in both groups at follow-up, with comparison between the two groups, mean values

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Normal wrist mean difference a</th>
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<tbody>
<tr>
<td></td>
<td>group 1</td>
<td>group 2</td>
<td></td>
</tr>
<tr>
<td>Flexion</td>
<td>61°</td>
<td>57°</td>
<td>66°</td>
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<tr>
<td>Extension</td>
<td>56°</td>
<td>54°</td>
<td>60°</td>
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<tr>
<td>Supination</td>
<td>83°</td>
<td>79°</td>
<td>84°</td>
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<tr>
<td>Pronation</td>
<td>78°</td>
<td>78°</td>
<td>80°</td>
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<tr>
<td>Radial deviation</td>
<td>23°</td>
<td>19°</td>
<td>22°</td>
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<tr>
<td>Ulnar deviation</td>
<td>39°</td>
<td>37°</td>
<td>44°</td>
</tr>
</tbody>
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a Mean difference between normal and impaired wrist
fect the clinical outcome, but it modified the radiographic outcome. No statistical difference was noted between the 24 fractures with and the 36 without dorsal cortical comminutions regarding pain, range of mobility (except supination, better if no comminution existed, \( p = 0.03 \)) and grip strength. A statistical difference developed between the 2 groups in 1 radiographic parameter at follow-up: volar tilt. Loss of reduction was more important in case of a dorsal cortical comminution (\( p = 0.05 \)). The subjective outcome was better in the absence of a dorsal cortical comminution (\( p = 0.01 \)).

**Discussion**

Poor function after a Colles' fracture is partly correlated with a residual deformity (Gartland and Werley 1951, Bacorn and Kurtzke 1953, Lidsström 1959, Scheck 1962, Frykman 1967, Abbaszadegan et al. 1989, Rikli and Regazzoni 1996). Nevertheless, some authors have found that wrist function may be good in spite of a marked residual bone deformity (Cassbaum 1950, Smaill 1965, Dias et al. 1987).

Percutaneous Kirchner wire stabilization through the radial styloid prevents secondary displacement (Stein and Katz 1975, Mah and Atkinson 1992). This seems to be a real improvement as compared to closed plaster cast treatment (Stein and Katz 1975, Clancy 1984, Vidal et al. 1986), which frequently leads to a loss of reduction (Lidsström 1959, Frykman 1967, Szabo 1993). Gartland and Werley (1951) reported that 60% of the fractures in their series, treated with closed reduction and plaster immobilization, "healed in a position typical of a fresh unreduced Colles' fracture". Stewart et al. (1985) noted that any fracture that was sufficiently displaced to require manipulation reduction, whether it was intraarticular or comminuted, could be considered potentially unstable.

The second aim of the treatment of a Colles' fracture is early mobilization: perfect and rigid fixation of the fractures, with early mobilization of the adjacent joints. This has been widely advocated as having a positive influence on articular cartilage and function recovery (Müller et al. 1970, Salter et al. 1980). Many authors have advocated the use of early mobilization after a Colles' fracture (Sarmiento et al. 1975, Kapandji 1976, Docquier et al. 1982, McAuliffe et al. 1987, Vichard et al. 1994, Rikli and Regazzoni 1996). Jupiter and Lipton (1993) reported that "achieving early motion is a major goal of treatment" and Rayhack (1993) suggested that "ideally, the goals of percutaneous pinning are as follows: the least number of days in a cast or splint during the healing phase". Some studies have shown that short immobilization led to substantially less pain at the time of plaster removal and at 1 year (McAuliffe et al. 1987). Furthermore, maintaining the range of motion of the involved joints prevents adhesion of soft tissues, promotes nutrition and circulation to the healing bone and assists edema reduction (Collins 1993). Early mobilization of a Colles' fracture helps resolution of swelling and should prevent reflex sympathetic dystrophy (Kerboul et al. 1986, Weber 1987). In addition, immobilization of the wrist for 6 weeks in a plaster is inconvenient for an elderly person living alone and the patients greatly appreciated reduction of this period to a minimum (McAuliffe et al. 1987). Nevertheless, it is common practice to join the trans-styloid K-wire fixation to a short-arm cast plaster for an average of 6 weeks (Stein and Katz 1975, Kapandji 1976, Vidal et al. 1986, Desmanet 1989, Mah and Atkinson 1992, Delattre et al. 1994, Lenoble et al. 1995).

Because of the small number of patients in our series, care must be taken in drawing any conclusion. Nevertheless, we think it not necessary to add a plaster cast immobilization of the wrist after trans-styloid K-wire fixation to a short-arm cast plaster for an average of more than two articular fragments.


