

Prediction of instability of Colles' fractures

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The tendency of 267 consecutive Colles' fractures to dislocate during plaster-cast treatment was correlated with several parameters measured from the initial radiographs. Stepwise logistic regression analysis showed that radial axial shortening had the greatest prognostic power. The age of the patient and Lidström's class provided additional prognostic information. Initial radial axial shortening of 5 mm or more generally indicated an unfavorable anatomic end result.

Many Colles' fractures have a tendency to redisplace in a plaster cast, mainly during the first 2 weeks (Fenyö and Johansson 1974, Scott 1964). It has been shown that rereduction and renewed plaster fixation often lead to redisplacement (Collert and Isaksson 1978, Lidström 1959, and McAuliffe et al. 1987). Several authors have described the use of external fixation for redisplaced plaster-cast treated Colles' fractures (Cooney et al. 1979, Green 1975, Jakob 1980, and Kongsholm 1987). The assessment of potentially unstable fractures has been based mainly on the clinical experience of the surgeon.

The purpose of our study was to define radiographic criteria that can predict a redisplacement of a plaster cast-treated Colles' fracture. These unstable fractures might be treated with a more rigid type of primary fixation.

A radiographic examination with anteroposterior and lateral projections (Friebert and Lundström 1976) was performed initially, after reduction, after 11 days, after 4 weeks, and finally after 8 weeks. The fractures were classified according to Lidström (1959) and Frykman (1967; Table 1).

The degree of comminution in the fracture line was graded 1-4. Radial shortening, radial displacement, and radial angle were measured on the anteroposterior radiograph (Figure 1). Dorsal compression of the distal fragment, as well as its dorsal displacement, were measured on the lateral projection (Figure 2).

Table 1. Classification of 267 Colles' fractures according to the systems of Lidström (1959) and Frykman (1967)

| Classification | Percentage |
|---|------------|
| Lidström | |
| I Nondisplaced fractures | 19 |
| IIA Extraarticular fracture with dorsal angulation | 30 |
| IIB Intraarticular fracture with dorsal angulation | 17 |
| IIC Extraarticular fracture with severe displacement | 7.7 |
| IID Intraarticular fracture with severe displacement | 13 |
| IIIE Intraarticular comminution with severe displacement | 13 |
| Frykman | |
| 1 Extraarticular fracture | 6.1 |
| 2 As 1, with fracture of the ulnar styloid | 2.5 |
| 3 Fracture involving the radiocarpal joint | 2.5 |
| 4 As 3, with fracture of the ulnar styloid | 0.7 |
| 5 Fracture involving the radioulnar joint | 19 |
| 6 As 5, with fracture of the ulnar styloid | 24 |
| 7 Fracture involving the radiocarpal and radioulnar joint | 12 |
| 8 As 7, with fracture of the ulnar styloid | 33 |

Patients and methods

The study included 267 consecutive patients with a Colles' fracture who attended the emergency room at our hospital. There were 233 women and 34 men, with a mean age of 62 (18-97) years. All the displaced fractures were reduced under local anesthesia and were immobilized with a dorsal plaster cast for 4 weeks.

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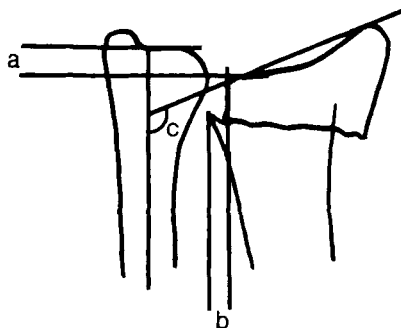


Figure 1. Anteroposterior radiographic parameters.

Axial radial shortening (a): the difference in level between the distal ulnar surface and the ulnar part of the distal radial surface.

Radial displacement (b): the dislocation of the distal fragment in relation to the radial shaft.

Radial angle (c): the angle of the distal surface in relation to the long axis of the radius.

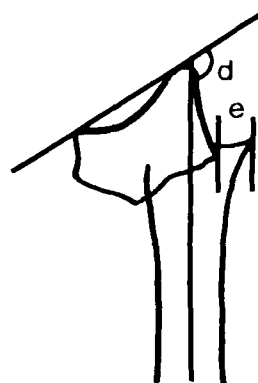


Figure 2. Lateral radiographic parameters.

Dorsal angle (d): the angle of the distal radial surface in relation to the long axis of the radius.

Dorsal displacement (e): the distance between the distal radial fragment in relation to the radial shaft.

Table 2. The initial step in the regression analysis. *F*-values indicate the prognostic impact. All the *P*-values were < 0.001

| Parameter | <i>F</i> to enter |
|--------------------|-------------------|
| Age | 12 |
| Lidström's class | 37 |
| Axial compression | 87 |
| Frykman's class | 6.2 |
| Radial compression | 19 |
| Dorsal compression | 45 |
| Comminution | 46 |

Table 3. The second step in regression analysis. *F*-values indicate the prognostic impact

| Parameter | <i>F</i> to enter | <i>F</i> to remove | <i>P</i> -value |
|--------------------|-------------------|--------------------|-----------------|
| Age | 6.2 | | 0.002 |
| Lidström's class | 6.9 | | 0.001 |
| Axial compression | | 48 | 0.0001 |
| Frykman's class | 1.6 | | 0.14 |
| Radial compression | 2.7 | | 0.1 |
| Dorsal compression | 5.5 | | 0.02 |
| Comminution | 5.5 | | 0.02 |

The 11-day radiographic examination included the uninjured wrists. If the other wrist had previously been fractured, the mean values of all the other intact wrists were used for a comparison.

At 8 weeks, anatomic failure was defined as radial axial shortening of 4 mm or more, or dorsal compression of 30° or more (Lidström 1959). All the fractures that were rereduced and externally fixated because of an unsatisfactory anatomic position within the first 2 weeks were included in this group. The statistical evaluation was performed by stepwise logistic regression analysis. The calculations were performed at the Department of Medical Information Processing at the Royal Caroline Institute with a BMDP program (BMDP Statistical Software, CA, USA). The degree of prognostic power of a variable is characterized by an *F*-value.

Results

The most important prognostic parameter was initial shortening (Table 2). After extraction of all the prognostic information from this parameter, a second calculation was performed on the remaining variables. The prognostic power of the remaining variables (Table 3) was then much decreased owing to covariation with radial shortening. The second most important variable was the Lidström class, and the third one was the age of the patient.

For the sake of simplicity, we used only radial axial shortening for prediction. The probability of re-displacement for every millimeter of radial axial shortening recorded in the material (range 0–15 mm) was calculated. The probability of an acceptable anatomic end result as a function of shortening was less than 0.2 if the radial axial shortening was 5 mm or more (Figure 3).

Table 4. Observations

| A | B | C | D | E | F | G | H | I | J | K | L | M | N | A | B | C | D | E | F | G | H | I | J | K | L | M | N | | |
|----|----|---|----|----|----|-----|-----|-----|-----|----|-----|-----|-----|-----|-----|----|---|----|----|------|------|-----|-----|----|-----|-----|-----|----|---|
| 1 | 45 | 1 | 8 | 2d | 5 | 8 | 110 | 0 | 80 | - | -2 | 95 | 1 | 134 | 56 | 1 | 8 | 2d | 1 | 0 | 100 | 0 | 104 | - | -2 | 95 | 1 | | |
| 2 | 85 | 1 | 7 | 1 | 0 | -2 | - | - | - | - | -8 | 89 | 2 | 138 | 75 | 1 | 8 | 2d | 1 | -3 | 100 | -2 | 90 | - | -2 | 95 | 1 | | |
| 3 | 71 | 1 | 8 | 1 | 0 | -1 | 87 | - | - | - | -4 | 100 | 1 | 138 | 22 | 2 | 1 | 1 | 0 | -2 | 80 | - | - | - | -2 | 75 | 1 | | |
| 4 | 73 | 1 | 8 | 2d | 1 | -2 | 95 | -2 | 80 | - | -7 | 79 | 1 | 137 | 87 | 1 | 8 | 2d | 1 | -4 | 115 | 0 | 86 | - | -2 | 75 | 1 | | |
| 5 | 74 | 1 | 2 | 2d | 2 | -5 | 112 | -2 | 101 | - | -3 | 111 | 2 | 138 | 47 | 1 | 8 | 2d | 2 | -3 | 108 | 2 | 94 | - | -2 | 97 | 1 | | |
| 6 | 79 | 2 | 8 | 2d | 3 | 0 | 108 | 0 | 85 | - | -1 | 92 | 1 | 138 | 87 | 2 | 8 | 2d | 1 | -3 | 109 | 2 | 100 | - | -2 | 93 | 1 | | |
| 7 | 72 | 1 | 1 | 0 | 0 | -1 | 85 | - | - | - | 0 | 108 | 1 | 142 | 83 | 2 | 8 | 2d | 1 | 0 | 82 | - | - | - | -2 | 87 | 1 | | |
| 8 | 56 | 2 | 7 | 1 | 1 | 0 | 102 | - | - | - | 0 | 103 | 1 | 141 | 41 | 2 | 2 | 3 | 1 | 0 | 0 | 78 | - | - | -2 | 78 | 2 | | |
| 9 | 71 | 1 | 8 | 1 | 0 | 0 | 109 | - | - | - | 0 | 108 | 1 | 142 | 25 | 2 | 8 | 2d | 1 | 0 | 123 | 0 | 102 | - | - | 0 | 107 | 1 | |
| 10 | 65 | 1 | 15 | 1 | 0 | 1 | 104 | 1 | 82 | - | - | 0 | 109 | 1 | 143 | 78 | 2 | 8 | 1 | 0 | 2 | 87 | - | - | - | -2 | 88 | 1 | |
| 11 | 70 | 2 | 8 | 2d | 1 | -1 | 100 | -2 | 88 | - | -4 | 92 | 1 | 145 | 25 | 2 | 7 | 1 | 1 | 3 | 86 | - | - | - | -2 | 88 | 2 | | |
| 12 | 63 | 1 | 3 | 2d | 3 | 0 | 112 | 0 | 102 | - | -3 | 105 | 1 | 145 | 71 | 1 | 4 | 2c | 3 | -2 | 110 | 0 | 80 | - | -3 | 100 | 1 | | |
| 13 | 78 | 1 | 7 | 2d | 2 | -7 | 100 | -4 | 98 | - | -6 | 110 | 1 | 146 | 84 | 1 | 7 | 2d | 0 | 2 | 118 | 2 | 80 | - | -4 | 102 | 1 | | |
| 14 | 72 | 2 | 8 | 2d | 2 | -8 | 114 | -8 | 87 | - | -8 | 104 | 1 | 149 | 41 | 3 | 8 | 2d | 1 | 0 | 84 | - | - | - | -2 | 105 | 1 | | |
| 15 | 62 | 2 | 8 | 2d | 2 | -2 | 123 | 0 | 85 | 18 | 0 | 97 | 1 | 148 | 60 | 1 | 8 | 2d | 2 | -9 | 114 | -2 | 92 | - | -2 | 95 | 1 | | |
| 16 | 70 | 2 | 8 | 2d | 2 | 0 | 127 | 0 | 87 | - | -8 | 92 | 1 | 149 | 41 | 3 | 8 | 2d | 1 | 0 | 108 | 1 | 74 | - | -2 | 112 | 1 | | |
| 17 | 68 | 2 | 7 | 2d | 3 | -4 | 130 | 0 | 183 | - | -5 | 100 | 1 | 150 | 41 | 1 | 1 | 1 | 0 | 2 | 83 | - | - | - | -2 | 84 | 2 | | |
| 18 | 66 | 2 | 1 | 1 | 0 | 1 | 80 | - | - | - | 0 | 84 | 2 | 151 | 85 | 2 | 8 | 2d | 0 | 8 | 101 | - | 84 | - | -2 | 105 | 1 | | |
| 19 | 68 | 2 | 1 | 1 | 0 | -2 | 82 | - | - | - | -2 | 82 | 1 | 152 | 95 | 1 | 8 | 2d | 0 | -3 | 80 | - | 84 | - | -7 | 102 | 1 | | |
| 20 | 40 | 1 | 1 | 1 | 0 | -2 | 82 | - | - | - | -2 | 82 | 1 | 153 | 60 | 1 | 8 | 2d | 2 | -4 | 102 | -2 | 86 | - | -1 | 104 | 1 | | |
| 21 | 75 | 1 | 7 | 1 | 0 | 0 | 85 | 0 | 88 | - | - | 0 | 108 | 1 | 154 | 54 | 2 | 8 | 2d | 1 | -2 | 102 | -2 | 86 | - | -4 | 94 | 1 | |
| 22 | 72 | 1 | 3 | 1 | 0 | -1 | 89 | - | - | - | -1 | 85 | 1 | 155 | 35 | 2 | 0 | 2d | 0 | 1 | 113 | 2 | 87 | - | -1 | 90 | 1 | | |
| 23 | 72 | 1 | 8 | 2d | 1 | 0 | 85 | - | - | - | - | 0 | 102 | 2 | 156 | 45 | 2 | 6 | 2d | 0 | 0 | 112 | 4 | 80 | - | -0 | 102 | 2 | |
| 24 | 71 | 1 | 2 | 2d | 0 | 0 | 117 | 5 | 100 | - | -9 | 108 | 1 | 157 | 18 | 1 | 8 | 2d | 1 | -2 | 117 | 0 | 87 | - | -0 | 103 | 1 | | |
| 25 | 85 | 1 | 6 | 2d | 1 | 0 | 90 | - | - | - | - | 0 | 103 | 1 | 158 | 63 | 1 | 8 | 2d | 2 | 0 | 112 | 0 | 85 | - | -3 | 112 | 1 | |
| 26 | 69 | 2 | 8 | 2d | 1 | 0 | 118 | 0 | 94 | - | -1 | 90 | 1 | 158 | 47 | 2 | 7 | 2d | 0 | 0 | 88 | 0 | 87 | - | -2 | 105 | 1 | | |
| 27 | 79 | 2 | 7 | 2d | 1 | 0 | 1 | 88 | - | - | 1 | 94 | 1 | 160 | 64 | 1 | 7 | 1 | -1 | 82 | 0 | 82 | - | -1 | -2 | 77 | 1 | | |
| 28 | 80 | 1 | 7 | 2d | 3 | -7 | 126 | -6 | 102 | - | -12 | 124 | 2 | 161 | 80 | 2 | 7 | 2d | -3 | -8 | 115 | 2 | 82 | - | -11 | 114 | 2 | | |
| 29 | 79 | 2 | 8 | 2d | 3 | -8 | 133 | -3 | 119 | 14 | -3 | 111 | 1 | 162 | 68 | 1 | 8 | 2d | -4 | -120 | 0 | 100 | - | -2 | 120 | 1 | | | |
| 30 | 72 | 1 | 8 | 2d | 1 | 0 | 100 | - | - | - | -7 | 112 | 1 | 163 | 78 | 1 | 8 | 2d | 1 | -4 | 110 | 0 | 102 | - | -2 | 102 | 1 | | |
| 31 | 65 | 1 | 5 | 2d | 1 | -4 | 117 | 0 | 92 | - | -4 | 98 | 1 | 164 | 62 | 2 | 6 | 2d | 1 | -4 | 111 | 0 | 87 | - | -5 | 101 | 1 | | |
| 32 | 82 | 1 | 6 | 1 | 0 | 0 | 88 | - | - | - | 0 | 102 | 2 | 166 | 73 | 1 | 8 | 2d | 1 | 0 | 101 | 0 | 89 | - | -2 | 94 | 1 | | |
| 33 | 72 | 1 | 3 | 1 | 0 | -1 | 84 | - | - | - | -1 | 82 | 1 | 166 | 86 | 2 | 8 | 2d | -1 | -1 | 82 | - | - | - | -3 | 113 | 1 | | |
| 34 | 60 | 2 | 1 | 1 | 0 | 0 | 80 | - | - | - | 1 | 85 | 1 | 167 | 80 | 1 | 3 | 2d | 0 | 0 | 124 | -2 | 115 | 6 | -3 | 80 | 1 | | |
| 35 | 74 | 1 | 8 | 2d | 1 | 0 | 85 | - | - | - | - | 0 | 102 | 1 | 168 | 87 | 1 | 8 | 2d | -7 | -128 | -2 | 105 | - | -2 | 102 | 1 | | |
| 36 | 72 | 2 | 8 | 2d | 1 | 0 | 118 | 1 | 82 | - | -0 | 114 | 1 | 168 | 78 | 1 | 8 | 2d | 2 | -3 | 107 | -2 | 83 | 10 | -1 | 85 | 1 | | |
| 37 | 68 | 2 | 8 | 2d | 1 | 0 | 100 | - | - | - | - | 0 | 102 | 1 | 170 | 85 | 1 | 8 | 2d | 0 | -8 | 113 | 0 | 83 | - | -2 | 102 | 1 | |
| 38 | 58 | 2 | 8 | 2d | 3 | -7 | 121 | -3 | 97 | - | -7 | 100 | 1 | 171 | 54 | 2 | 8 | 2d | 3 | -15 | 111 | -8 | 87 | -3 | -4 | 85 | 1 | | |
| 39 | 60 | 2 | 6 | 2d | 1 | 0 | 119 | 0 | 87 | - | -8 | 112 | 1 | 172 | 78 | 1 | 8 | 2d | 2 | -6 | 100 | -8 | 88 | - | -8 | 80 | 1 | | |
| 40 | 61 | 1 | 8 | 2d | 1 | -8 | 146 | -2 | 168 | 11 | - | - | 112 | 1 | 173 | 74 | 2 | 2 | 1 | -1 | 86 | -2 | 115 | 4 | 82 | -12 | -1 | 85 | 1 |
| 41 | 87 | 1 | 5 | 1 | 0 | -2 | 85 | - | - | - | -11 | -4 | 103 | 1 | 174 | 63 | 2 | 2 | 1 | 0 | 1 | 80 | - | - | - | -1 | 85 | 1 | |
| 42 | 67 | 1 | 8 | 2d | 2 | 0 | 104 | - | - | - | - | 0 | 102 | 1 | 175 | 80 | 2 | 8 | 2d | -1 | 0 | 83 | - | - | - | -1 | 85 | 1 | |
| 43 | 54 | 1 | 15 | 1 | 0 | -4 | 76 | - | - | - | -4 | 74 | 1 | 175 | 70 | 2 | 8 | 2d | 2 | -9 | 112 | 0 | 83 | 11 | 0 | 80 | 1 | | |
| 44 | 82 | 2 | 1 | 1 | 0 | 0 | 82 | - | - | - | - | 0 | 88 | 1 | 177 | 87 | 2 | 8 | 2d | 1 | 0 | 102 | - | 83 | - | -2 | 108 | 1 | |
| 45 | 70 | 2 | 8 | 2d | 3 | -3 | 127 | 0 | 106 | - | -3 | 117 | 1 | 178 | 82 | 1 | 8 | 2d | 1 | 0 | 85 | 0 | 85 | - | -0 | 80 | 2 | | |
| 46 | 72 | 1 | 8 | 2d | 2 | 0 | 84 | - | - | - | -1 | 100 | 1 | 180 | 86 | 2 | 8 | 2d | -2 | -6 | 102 | 3 | 80 | - | -3 | 114 | 1 | | |
| 47 | 60 | 2 | 8 | 2d | 2 | 0 | 115 | 0 | 80 | - | - | 0 | 102 | 2 | 180 | 86 | 2 | 8 | 2d | 0 | 0 | 88 | - | 84 | - | -3 | 87 | 1 | |
| 48 | 72 | 1 | 8 | 2d | 1 | 0 | 84 | - | - | - | - | 1 | 100 | 1 | 181 | 83 | 2 | 5 | 2d | 2 | -3 | 106 | 0 | 84 | - | -3 | 87 | 1 | |
| 49 | 60 | 2 | 8 | 2d | 2 | -5 | 132 | 0 | 85 | - | -6 | 98 | 1 | 182 | 61 | 2 | 8 | 2d | 1 | -1 | 109 | 0 | 87 | - | -3 | 97 | 1 | | |
| 50 | 87 | 2 | 7 | 2d | 1 | 0 | 120 | 1 | 80 | - | -4 | 99 | 1 | 184 | 81 | 2 | 8 | 2d | -2 | -8 | 108 | -2 | 84 | - | -2 | 100 | 1 | | |
| 51 | 87 | 2 | 7 | 2d | 1 | 0 | 120 | 1 | 80 | - | -4 | 99 | 1 | 185 | 78 | 2 | 8 | 2d | 1 | -1 | 82 | 0 | 89 | - | -2 | 90 | 1 | | |
| 52 | 64 | 2 | 4 | 2d | 2 | 0 | 87 | - | - | - | - | 0 | 80 | 1 | 185 | 68 | 1 | 8 | 2d | 2 | -2 | 104 | 2 | 83 | - | -2 | 88 | 1 | |
| 53 | 41 | 1 | 8 | 2d | 3 | -5 | 103 | -1 | 82 | - | -6 | 115 | 1 | 187 | 63 | 1 | 8 | 2d | 1 | 10 | 102 | 0 | 84 | - | -3 | 102 | 1 | | |
| 54 | 32 | 1 | 1 | 0 | 0 | 0 | 82 | - | - | - | 0 | 80 | 1 | 188 | 71 | 1 | 8 | 2d | 1 | -1 | 105 | 1 | 88 | - | -3 | 102 | 1 | | |
| 55 | 38 | 2 | 1 | 1 | 0 | 0 | 82 | - | - | - | 0 | 80 | 1 | 188 | 71 | 1 | 8 | 2d | 1 | -1 | 105 | 1 | 88 | - | -3 | 102 | 1 | | |
| 56 | 59 | 2 | 8 | 2d | 1 | -10 | 118 | -10 | 100 | - | -2 | 100 | 2 | 189 | 85 | 2 | 8 | 2d | 0 | 0 | 102 | 0 | 85 | - | -2 | 98 | 1 | | |
| 57 | 58 | 2 | 8 | 2d | 1 | 2 | 130 | 1 | 91 | - | -2 | 100 | 1 | 190 | 78 | 2 | 8 | 2d | 1 | -1 | 100 | - | - | - | -0 | 118 | 1 | | |
| 58 | 87 | 2 | 8 | 2d | 3 | -3 | 113 | -1 | 79 | - | -3 | 100 | 1 | 191 | 60 | 2 | 8 | 2d | 3 | -4 | 117 | 0 | 87 | - | -4 | 116 | 1 | | |
| 59 | 70 | 1 | 7 | 2d | 3 | -4 | 144 | -2 | 104 | - | -3 | 104 | 1 | 192 | 57 | 2 | 8 | 2d | -2 | -115 | -1 | 84 | - | -2 | 84 | 1 | | | |
| 60 | 29 | 1 | 1 | 0 | -1 | 0 | 83 | - | - | - | -2 | 85 | 1 | 193 | 74 | 2 | 8 | 2d | 2 | -6 | 106 | 0 | 82 | - | -4 | 94 | 2 | | |
| 61 | 71 | 1 | 8 | 2d | 1 | 0 | 85 | - | - | - | - | 0 | 80 | 2 | 194 | 65 | 1 | 8 | 2d | 0 | 0 | 121 | 0 | 86 | - | -4 | 112 | 1 | |
| 62 | 79 | 2 | 8 | 2d | 2 | -1 | 80 | - | - | 18 | -4 | 102 | 1 | 195 | 45 | 2 | 6 | 2d | 2 | -11 | 112 | 1 | 86 | - | -0 | 85 | 1 | | |
| 63 | 82 | 1 | 8 | 2d | 2 | 0 | 85 | - | - | - | - | 0 | 80 | 1 | 195 | 45 | 2 | 6 | 2d | 2 | -11 | 112 | 1 | 86 | - | -0 | 85 | 1 | |
| 64 | 99 | 1 | 8 | 2d | 3 | -8 | 127 | -4 | 91 | - | -4 | 78 | 2 | 197 | 64 | 2 | 8 | 2d | 1 | -3 | 130 | 3 | 100 | - | -1 | | | | |

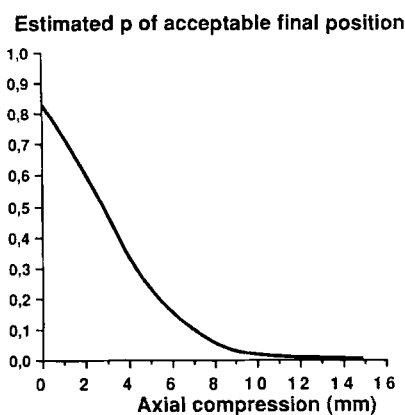


Figure 3. Estimated probability of an acceptable final anatomic position of a Colles' fracture as a function of radial axial shortening.

Discussion

The optimal treatment of Colles' fracture remains controversial. A poor functional end result is partly correlated with the residual deformity (Gartland and Werley 1951, Bacorn and Kurtzke 1953, Lidström 1959, Frykman 1967, and Solgaard 1985). Several studies have been performed concerning the possible advantages of different techniques for the plaster-cast treatment of Colles' fracture (Older et al. 1965, Blichert et al. 1971, Stewart et al. 1985, and Vaughan et al. 1985), but the results achieved have not been uniform. The risk of redisplacement seems high with all types of plaster-cast treatment (van der Linden and Ericsson 1981). Better fixation has been shown with other techniques, for example, pins and a plaster cast (Green 1975), ligamento-taxis external fixation (Cooney et al. 1979, Jakob 1980, Jonsson 1983, Kongsholm 1987), and osteotaxis external fixation (Jenkins et al. 1987). The application of rigid fixation primarily for these unstable fractures would be an advantage in the following aspects. First, a primarily applied external fixation will reduce the

total fixation time as compared with initial plaster-cast treatment followed by rereduction and external fixation. Further, it is generally not possible to reduce a Colles' fracture to a good anatomic position after 12 days. Finally, there are Colles' fractures that redislocate late, i.e., after 10-12 days (Abbaszadegan et al. 1988), and these fractures will end up malpositioned if not treated with a more stable fixation from the beginning.

A crucial question in deciding which fracture should primarily be treated with a stable but more time-consuming technique is what degree of final malposition could be accepted. A definite answer to this question is difficult to find because of the different clinical evaluation methods used. Lidström (1959) found that a dorsal angulation exceeding 20° was associated with poor function. Even a 3-6 mm radial shortening caused decline in final function. These results are supported by Frykman (1967), who used the same radiographic criteria and almost the same clinical criteria. In the present series, we regarded dorsal angulation of more than 30° and/or axial shortening of 4 mm or more as unsatisfactory. This does not imply that we expect all of these malpositioned fractures to end up as clinical failures, but that the risk of poor function will be substantial.

In our study the risk of redislocation was most strongly correlated with the degree of initial radial axial shortening. The predictive ability could theoretically be somewhat increased if the fracture type according to Lidström's classification system was taken into account. The third most important and independent factor for the risk of redislocation was the age of the patient. These results accord with those of Solgaard (1985), who found that a classification system based on radial shortening and on type of dislocation (Older et al. 1965) had a greater prognostic value for good final radiographic results than a classification system based on the location of the fracture lines.

Our results suggest that external fixation should be considered when radial shortening exceeds 4 mm.

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