UNSTABLE COLLES' FRACTURES IN ELDERLY PATIENTS

A RANDOMISED TRIAL OF EXTERNAL FIXATION FOR REDISPLACEMENT

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We report the results of a prospective randomised controlled trial of the management of 101 Colles' fractures in patients over the age of 55 years. Within two weeks of initial reduction 43 fractures had displaced with either more than 10° dorsal angulation or more than 5 mm radial shortening. These patients were randomly divided into two groups: 21 were remanipulated and held by an external fixator; in the control group of 22 patients, the redisplacement was accepted and conservative treatment was continued.

Patients treated with external fixation had a good anatomical result, but their function was no better than that of the control group. We found no correlation between final anatomical and functional outcome, and concluded that the severity of the original soft-tissue injury and its complications are the major determinants of functional end result.

Colles' fracture is a very common injury, but reports on treatment methods and results are conflicting. Treatment may be by conservative or functional methods, such as plaster immobilisation and braces or by operation. Conservative management often includes the acceptance of some degree of displacement or redisplacement and emphasis is placed on function (Sarmiento et al 1975; Sarmiento, Zagorski and Sinclair 1980; Gibson and Bannister 1983; Stewart, Innes and Burke 1984; de Bruijn 1987). Other authors stress the importance of anatomical correction and choose various methods of external fixation (Cooney, Linscheid and Dobyns 1979; Forgon and Mammel 1981; Jonsson 1983; Waddell 1984; Nakata et al 1985; Vaughan et al 1985; Clyburn 1987). K-wire fixation has been used alone, in combination with external fixation, or with plaster (Green 1975; Clancey 1984; Wagner and Jakob 1985; Pring and Williams 1986).

The choice of treatment is frequently determined by the surgeon's opinion on the correlation between the anatomical and the functional end result. Some authors have reported a positive correlation (Cassebaum 1950;

Gartland and Werley 1951; Bacorn and Kurtzke 1953; Lidström 1959; Golden 1963; van der Linden and Ericson 1981), while others have not substantiated these findings (Dowling and Sawyer 1961; Spira and Weigl 1969; Thorn 1984; Stewart, Innes and Burke 1985; Dias et al 1987; McAuliffe et al 1987). A recent prospective review showed that significant radial shortening reduced grip strength and concluded that "this should be an indication to adopt a more effective method of holding the radius out to length" (Villar et al 1987).

Many of the reports on external fixation lack a control group, and often confuse different types of distal radial fractures in young patients, sustained in high-energy traffic accidents, with those in older osteoporotic patients sustained in a simple fall. McQueen, MacLaren and Chalmers (1986) showed clearly that remanipulation and plaster after secondary displacement of Colles' fractures did not benefit patients over 60 years of age, and other studies have shown that the early mobilisation of the elderly patient even with a displaced fracture is of benefit (Dias et al 1987; McAuliffe et al 1987).

In an attempt to clarify this situation we designed a prospective study of the management of redisplacement of typical Colles' fractures in elderly patients. We compared the functional results of secondary reduction and external fixation with those of accepting the displaced position.

PATIENTS AND METHODS

From November 1987 to March 1989, a prospective study was made of 126 consecutive patients over the age of 55 years with a displaced Colles' fracture sustained in a simple fall and requiring reduction. Of these, 17 were

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lost to follow-up, five had severe psychiatric or neurological disorders, one had a refracture, and two died. The remaining 93 women and eight men had a mean age of 70.1 years.

In all cases the fracture was reduced under local anaesthesia within six hours of injury and a plaster backslab was applied. Review was at one day, one week and two weeks, and patients were then placed in one of three groups on radiological findings and randomisation. **Primary group (P).** When dorsal angulation was 10° or less and radial shortening 5 mm or less compared to the opposite wrist, the patients remained in their current plaster.

External fixation (EF) and control (C) groups. Patients with dorsal angulation more than 10°, or radial shortening more than 5 mm were randomly assigned into either an external fixation group (EF) or a control group (C) in which plaster treatment was continued. The EF group had a remanipulation under regional anaesthesia and an Ace Colles Fixator (Ace Orthopaedic, Los Angeles, USA) was applied.

Patients in groups P and C had five weeks in plaster, while patients in the EF group had five weeks external fixation after their remanipulation. Radiographs were taken after remanipulation and application of external fixation, and after removal of the plaster or fixation.

Displacement was measured by comparison with a radiograph of the opposite wrist. We measured volar angle, radial shortening, radial angle and radial shift, and classified the fractures according to Frykman (1967) and Sarmiento and Latta (1981). The anatomical end result was scored from the last radiograph using the classifications of Lidström (1959) and of Sarmiento et al (1980). We also used a new score: dorsal angulation in degrees plus twice the radial shortening in millimetres.

A functional score was calculated at each review, using the complex system described by de Bruijn (1987), and at 26 weeks the end result was defined using the Lidström (1959) classification. The cosmetic appearance was not taken into account. Grip strength was measured using a Jamar Dynamometer (Model 2a, Asimov Engineering Co, Santa Monica, USA), allowing for a 10% difference in normal grip strength between the dominant and non-dominant wrists.

Statistical analyses used the Kruskal-Wallis test for comparison of group means; correlations were calculated by Spearman correlation coefficients. Probability values of less than 0.05 were regarded as significant.

RESULTS

There were 58 patients in the primary group P, 21 in the external fixation group EF, and 22 in the control group C. The distribution of fracture types is given in Table I. All but two of the fractures were intra-articular into the radio-ulnar joint, while in 70 cases there was an accompanying fracture of the ulna.

Table I. Fracture types (Frykman 1967; Sarmiento and Latta 1981) related to treatment group (see text)

Treatment group	Frykman type								Total
	I	II	III	IV	V	VI	VII	VIII	
Primary	—	2	—	—	14	21	7	14	58
External fixator	—	—	—	—	3	6	1	11	21
Control	—	—	—	—	5	9	1	7	22

Treatment group	Sarmiento type			Total
	2	4		
Primary	37	21		58
External fixator	9	12		21
Control	14	8		22

Table II. The anatomical end-result of 101 Colles' fractures by the Lidström (1959) classification

Treatment group	Anatomical result					Total
	Excellent	Good	Fair	Poor		
Primary	16	28	8	6		58
External fixator	7	9	4	1		21
Control	—	—	13	9		22

Table III. The functional end-result of 101 Colles' fractures by the Lidström (1959) classification

Group	Excellent	Good	Fair	Poor	Total
Primary	21	20	14	3	58
External fixator	7	5	5	4	21
Control	13	6	1	2	22

Fig. 1

Relationship between the anatomical and the functional result. The anatomical score is the sum of the dorsal angulation in degrees plus twice the radial shortening in millimetres (see text). Function is assessed by the scoring system of de Bruijn (1987). Spearman coefficient: 0.18; $p > 0.05$.

There was no significant difference in initial displacement between the three treatment groups with reference to volar angle (mean -23.3°), radial shift or radial angle. The average initial radial shortening was 5.2 mm in group P and 8.3 mm in groups EF and C combined (all those with redisplacement). This difference between group P and groups EF plus C was significant at $p = 0.0013$. We found no significant difference in the quality of reduction between the three groups.

Table IV. Relationship between the anatomical and functional end-results (Lidström 1959) in 101 Colles' fractures. The Spearman coefficient was 0.21; $p > 0.05$

Anatomy	Function				Total
	Excellent	Good	Fair	Poor	
Excellent	14	5	4	0	23
Good	12	15	6	4	37
Fair	11	6	6	2	25
Poor	4	5	4	3	16

Fig. 2

Anatomical results (Lidström 1959) in 101 patients with Sarmiento 2 (extra-articular) or Sarmiento 4 (intra-articular) Colles' fractures. There is no clear correlation between fracture type and anatomical outcome.

Fig. 3

Functional results (Lidström 1959) in 101 patients with Sarmiento 2 (extra-articular) or Sarmiento 4 (intra-articular) Colles' fractures. There is no clear correlation between fracture type and functional outcome.

The anatomical end results (Lidström 1959) of the three groups are shown in Table II. Scoring 1 for excellent, 2 for good, 3 for fair and 4 for poor results, the mean values were $P = 2.07$, $EF = 1.95$ and $C = 3.40$. This suggests that treatment with the external fixator gave good anatomical results, while the control group results were between fair and poor. In group P, where the anatomical result at two weeks was by definition excellent or good it is interesting to note that the final anatomical outcome in 14 patients (24%) was fair or poor. The correlation between the Lidström scale, the Sarmiento scale and our new score were very good (Spearman coefficient > 0.90 , $p < 0.0001$), indicating that the scoring methods are interchangeable.

The functional end results at 26 weeks on the Lidström scale are shown in Table III. The results were satisfactory in 71.2% of the whole series. There was a clear correlation between the Lidström classification, the de Bruijn (de B) score and the measured grip strength (Spearman coefficient > 0.80 , $p < 0.0001$).

The mean values in group P were 1.98 (de B: 13.6) with 69% power; in group EF 2.29 (de B: 20.9) and 64%, and in group C 1.64 (de B: 9.0) with a power of 77%.

Irrespective of the treatment group the relation between final anatomical and functional result is shown in Table IV and Figure 1. There is no clear correlation (Spearman coefficient 0.18, $p > 0.05$). We found no correlation between Sarmiento fracture types 2 or 4 and the anatomical or functional end results (Figs 2 and 3).

The main complication was reflex sympathetic dystrophy (RSD) as recently defined by Goris (1985). This was seen in 14 patients, five being severe enough to lead to a very poor functional end result, with an average de Bruijn score of 54, and a grip strength of only 30%. Two of these cases were in group P, two in group EF and one in group C. The nine other cases of RSD had fair results with an average de Bruijn score of 33 and grip of 50%. There were six in group P; two in group EF and one in group C. We found no correlation between the development of RSD and the anatomical end result. The fracture type was Sarmiento 2 in eight cases and Sarmiento 4 in six.

Carpal tunnel syndrome, confirmed by EMG, was seen in 12 patients; surprisingly, none of them had RSD. Seven patients had persistent symptoms and required a release operation; the other five made a spontaneous recovery during follow-up. We found no correlation with initial or final displacement.

Twelve patients had 16 digits affected by stenosing tenosynovitis which required operative release. The most commonly affected digits were the middle and ring fingers. Two patients in group C had spontaneous rupture of the extensor pollicis longus tendon, but both refused operation. Two patients in group EF had pin loosening, but no pin track infections were seen.

At 26 weeks, 36% of all patients had some persisting pain. We distinguished three types: continuous pain,

even at rest; pain on movement; and ulnar compression pain, with or without one of the other types. Of the patients in group P with persisting pain, one had continuous symptoms, 11 had pain on activity, and 17 had ulnar compression pain. From group EF one patient had continuous pain, two had pain on movement and six had ulnar pain. In group C no patient had continuous pain, four had pain during activity, and three had ulnar pain. We found no special relationship with the type of fracture, the anatomical end result or the initial displacement.

DISCUSSION

The premiss of our study was that remanipulation and plaster for redisplacement of Colles' fractures in elderly patients was of no value (McQueen et al 1986); if anatomical correction was desired then external fixation should be used. We could find no previous report of a prospective clinical trial.

Our results clearly show that the restoration of normal anatomy by the use of an external fixation does not necessarily lead to improved function. A review of the literature suggested that external fixation resulted in good functional end results in 80% to 97% of patients. In our series only 57% had good or excellent results. This difference may be explained by the fact that in many series different types of fractures in patients of all ages were compared, and some studies included radiological and cosmetic assessments in their scoring systems. In our series patients with redisplacement of these fractures (group C), who had no remanipulation, had better functional results (86% satisfactory) than those treated by external fixation. Indeed, their results were comparable to those with more stable fractures (group P had 71% satisfactory).

We have shown that there is no significant correlation between the final anatomical and final functional outcome in elderly patients with a displaced Colles' fracture. We consider that efforts to improve the functional outcome by restoring the anatomy with external fixation are doomed to fail. This confirms the findings of previous studies in concluding that the end result is independent of the method of conservative treatment (van der Linden and Ericson 1981; Gibson and Bannister 1983; Thorn 1984; Stewart et al 1985).

Our results do not show the correlation between the severity of initial displacement and the functional outcome which has been reported by others (van der Linden and Ericson 1981; Stewart et al 1985; Villar et al 1987), but we did find that the greater the radial shortening at injury the greater was the chance of significant redisplacement within two weeks. However, we found no significant correlation between dorsal angulation, radial angle and radial shift and secondary displacement.

We found that objectively measured grip strength,

corrected for the dominant wrist, correlated significantly with more complex functional scoring systems, such as those of Lidström and de Bruijn. Our new, easily calculated anatomical assessment (dorsal angle plus twice radial shortening), also correlated very well with other existing scoring systems. The advantage of these simpler assessments is that they are easily and quickly available.

We agree with Dias et al (1987) that the severity of the soft-tissue injury and its complications probably are the major determinants of functional outcome. This is underlined by the fact that five of our nine patients with a poor outcome had severe reflex sympathetic dystrophy, with a total incidence of 14%. Other authors have reported incidences of 1.4% to 16%, undoubtedly depending on the definition used (Bacorn and Kurtzke 1953; Lidström 1959; Frykman 1967; Cooney, Dobyns and Linscheid 1980; Waddell 1984; Goris 1985). From the patients' point of view the final result is largely determined by the presence or absence of persistent pain. In our series 36% of the patients had some form of persistent pain, similar to other series in which 27% and 39% were reported (Castaing 1964; Frykman 1967). Our patients had pain at rest only in association with reflex sympathetic dystrophy. Pain on movement, especially during pronation and supination, was noted by 17 patients, nine having a reflex sympathetic dystrophy and four a carpal tunnel syndrome. We found no correlation with the type of fracture nor with the extent of initial displacement.

We conclude that external fixation is not indicated for the treatment of redisplacement of a Colles' fracture in an elderly patient. Even severe secondary displacement can be accepted; it will not necessarily lead to poor function. In the light of the fact that 24% of the initially stable fractures in group P at two weeks showed redisplacement at five weeks, we question the role of check radiographs during follow-up. Emphasis should probably be placed on the soft-tissue injury and its complications.

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REFERENCES

- Bacorn RW, Kurtzke JF. Colles' fracture: a study of two thousand cases from the New York State Workman's Compensation Board. *J Bone Joint Surg [Am]* 1953; 35-A:643-58.
- Cassebaum WH. Colles' fracture: a study of end results. *JAMA* 1950; 143:963-5.
- Castaing J. Les fractures récentes de l'extrémité inférieure du radius chez l'adulte. *Rev Chir Orthop* 1964; 50:581-696.
- Clancey GJ. Percutaneous Kirschner-wire fixation of Colles' fractures. *J Bone Joint Surg [Am]* 1984; 66-A:1008-14.
- Clyburn TA. Dynamic external fixation for comminuted intra-articular fractures of the distal end of the radius. *J Bone Joint Surg [Am]* 1987; 69-A:248-54.
- Cooney WP III, Dobyns JH, Linscheid RL. Complications of Colles' fractures. *J Bone Joint Surg [Am]* 1980; 62-A:613-9.
- Cooney WP III, Linscheid RL, Dobyns JH. External pin fixation for unstable Colles' fractures. *J Bone Joint Surg [Am]* 1979; 61-A:840-5.

- de Bruijn HP. Functional treatment of Colles' fractures. *Acta Orthop Scand* 1987; 58(suppl):223.
- Dias JJ, Wray CC, Jones JM, Gregg PJ. The value of early mobilisation in the treatment of Colles' fractures. *J Bone Joint Surg [Br]* 1987; 69-B:463-7.
- Dowling JJ, Sawyer B Jr. Comminuted Colles' fractures: evaluation of a method of treatment. *J Bone Joint Surg [Am]* 1961; 43-A:657-8.
- Forgon M, Mammel E. The external fixateur in the management of unstable Colles' fracture. *Int Orthop* 1981; 5:9-14.
- 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.
- Gartland JJ Jr, Werley CW. Evaluation of healed Colles' fractures. *J Bone Joint Surg [Am]* 1951; 33-A:895-907.
- Gibson AGF, Bannister GC. Bracing or plaster for Colles' fractures? A randomised prospective controlled trial. *J Bone Joint Surg [Br]* 1983; 65-B:221.
- Golden GN. Treatment and prognosis of Colles' fracture. *Lancet* 1963; i:511-5.
- Goris RJ. Treatment of reflex sympathetic dystrophy with hydroxyl radical scavengers. *Unfallchirurg* 1985; 88:330-2.
- Green DP. Pins and plaster treatment of comminuted fractures of the distal end of the radius. *J Bone Joint Surg [Am]* 1975; 57-A:304-10.
- Jonsson U. External fixation for redislocated Colles' fractures. *Acta Orthop Scand* 1983; 54:878-83.
- Lidström A. Fractures of the distal end of the radius: a clinical and statistical study of end results. *Acta Orthop Scand* 1959; Suppl 41.
- McAuliffe TB, Hilliar KM, Coates CJ, Grange WJ. Early mobilisation of Colles' fractures: a prospective trial. *J Bone Joint Surg [Br]* 1987; 69-B:727-9.
- McQueen MM, MacLaren A, Chalmers J. The value of remanipulating Colles' fractures. *J Bone Joint Surg [Br]* 1986; 68-B:232-3.
- Nakata RY, Chand Y, Matiko JD, Frykman GK, Wood VE. External fixators for wrist fractures. *J Hand Surg* 1985; 10-A:845-51.
- Pring DJ, Williams DJ. Bipolar fixation of fractures of the distal radius: a comparative study. *J Bone Joint Surg [Br]* 1986; 68-B:666.
- Sarmiento A, Pratt GW, Berry NC, Sinclair WF. Colles' fractures: functional bracing in supination. *J Bone Joint Surg [Am]* 1975; 57-A:311-7.
- Sarmiento A, Zagorski JB, Sinclair WF. Functional bracing of Colles' fractures: a prospective study of immobilization in supination vs. pronation. *Clin Orthop* 1980; 146:175-83.
- Sarmiento A, Latta LL. *Closed functional treatment of fractures*. Berlin, etc: Springer-Verlag, 1981.
- Spira E, Weigl K. The comminuted fracture of the distal end of the radius. *Reconstr Surg Traumat* 1969; 11:128-38.
- Stewart HD, Innes AR, Burke FD. Functional cast-bracing for Colles' fractures: a comparison between cast-bracing and conventional plaster casts. *J Bone Joint Surg [Br]* 1984; 66-B:749-53.
- Stewart HD, Innes AR, Burke FD. Factors affecting the outcome of Colles' fracture. *Injury* 1985; 16(5):289-95.
- Thorn BJ. Colles' fracture in the over-sixty age group. *J Bone Joint Surg [Br]* 1984; 66-B:613.
- van der Linden W, Ericson R. Colles' fracture: how should its displacement be measured and how should it be immobilized? *J Bone Joint Surg [Am]* 1981; 63-A:1285-8.
- Vaughan PA, Lui SM, Harrington IJ, Maistrelli GL. Treatment of unstable fractures of the distal radius by external fixation. *J Bone Joint Surg [Br]* 1985; 67-B:385-9.
- Villar RN, Marsh D, Rushton N, Greatorex RA. Three years after Colles' fracture: a prospective review. *J Bone Joint Surg [Br]* 1987; 69-B:635-8.
- Waddell JP. Roger Anderson fixation for fractures of the distal radius. (A.A.S.T. abstracts). *J Trauma* 1984; 24:690.
- Wagner HE, Jakob RP. Operative treatment of fractures of the distal radius using external fixation. *Unfallchirurg* 1985; 88:473-80.