AO and Frykman's classifications of Colles' fracture

No prognostic value in 652 patients evaluated after 5 years

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We retrospectively assessed hand and forearm symptoms of 652 patients with a Colles' fracture, 5 years after the fracture, using a questionnaire. The contralateral forearm, which was free of major injuries or illnesses, was used as control. Forearm and hand symptoms were common and only one quarter of the fractured forearms were completely free of symptoms at the time of review, whereas four fifths of the control forearms had no symptoms. Nearly half of the patients complained of impairment in various activities and 8% had had to give up leisure activities or make special arrangements at work. Demographic, and most of the fracture-related factors, were not associated with the symptoms. Neither AO nor Frykman's radiographic classifications of the primary fracture were of any use for predicting the clinical outcome.

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Submitted 97-01-25. Accepted 97-09-14

Long-term outcome after Colles' fracture is often reported to be good or satisfactory and the effect of the fracture on a patient's functional activities is usually regarded as minimal (Altissimi et al. 1986, Kaukonen et al. 1988, Field et al. 1992, Kopylov et al. 1993, Warwick et al 1993). However, some patients have substantial residual symptoms and impairment of function (Bacorn and Kurtzke 1953, Cooney et al. 1980, Strange-Vognsen 1991). The ability of various classification systems of distal radius fractures to describe the severity of the injury and consequently predict the outcome is debatable (Older et al. 1965, Frykman 1967, Solgaard 1984, Altissimi et al. 1986, Geissler et al. 1996). We have assessed forearm symptoms and their effects on patients' activities after Colles' fracture, with special reference to the prognostic value of the often-used AO and Frykman's fracture classifications.

Material and methods

1109 patients with 1137 Colles' fractures were treated between 1989 and 1994 at our hospital. Their mean age was 56 (20–93) years and mean follow-up time was 5 (2.5–7.5) years. Four fifths (846) of the fractures occurred in women. The patients were retrospectively evaluated from case records (Table 1).

All fractures were radiographically classified according to Frykman (1967) and AO/ASIF (Müller et al. 1990). Only AO main groups were used. Classification was basically assessed from primary radiographs, but in some dislocated fractures, radiographs taken after reposition were also used. The classification was made by a single investigator (TF) (Table 2).

Table 1. Fracture related data of the patients

		Number	%
Cause of injury	Slipping or tumbling	853	72.1
	Falling	115	10.0
	Falling downstairs	34	3.0
	Traffic	50	4.4
	Sports	57	5.0
	Other	16	1.4
Associated injuries	No	1025	90.2
	Yes	100	8.8
Repositions	0	251	22.1
	1	681	59.9
	2 or more	193	17.0
Side	Right	468	41.2
	Left	657	57.8
Treatment	Cast	1070	94.1
	External fixation	49	4.3
	Internal fixation	9	0.8

12 patients' (1.1%) data missing

Table 2. Distribution of AO main classes and Frykman's classes in the 1,137 fractures. In 95 cases (8.4%) ,radiographs were missing. 28 patients had fractures of both forearms during the 5-year period

	Class	Number of fractures	%
AO	A2	330	29.0
	A3	219	19.2
	C1	215	19.0
	C2	132	11.6
	C3	146	12.8
	missing	95	8.4
Frykman	1	216	19.0
	2	338	29.7
	3	38	3.3
	4	60	5.3
	5	66	5.8
	6	118	10.4
	7	37	3.3
	8	169	14.9
	missing	95	8.4

A questionnaire asking for demographic data, medical history, former and later injuries to forearms, wrists or hands was sent to the patients. Forearm and hand symptoms (pain during rest, pain during exercise, pain after exercise, stiffness, restriction in range of motion, swelling, numbness of fingers, reduced grip power and deformity of the wrist) were evaluated separately for right and left limbs, using a four-stage scale (normal, mild, moderate, severe). Each symptom was scored from 0 to 3. The sum was calculated and was called the forearm symptom severity score. A new scale was formed from this score to grade the severity of the symptoms:

0 completely free of symptoms
1–6 mild symptoms
7–12 moderate symptoms
13–18 severe symptoms
19–27 very severe symptoms

On the basis of case reports, 875 patients were presumed to have a healthy contralateral arm, which could be used as a control, and the questionnaire was mailed to them. It was returned by 758 subjects (87%). After excluding those who had died, had illnesses affecting upper arms or who filled out the questionnaire incompletely, outcome data were available from 652 patients with Colles' fracture in one forearm and a healthy contralateral arm, serving as a control for the basis of our study (Table 3).

The variables were not normally distributed and nonparametric $\chi 2$-tests, Wilcoxon signed rank tests, median tests and Spearman's correlation were employed. The SPSS for Windows® (SPSS Inc.) program was used. $P < 0.05$ was considered significant.

The demographic and fracture characteristics and the distribution of AO and Frykman's classes of the 652 patients with the outcome data available did not differ significantly ($\chi 2$-test, $p > 0.05$) in any respect from the original material.

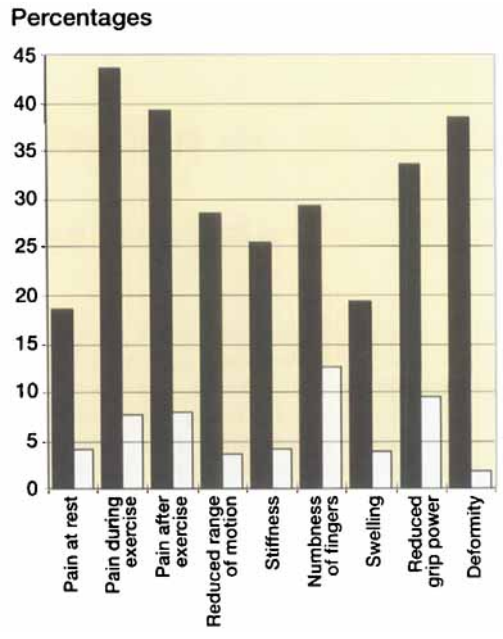

Figure 1. Distribution of symptoms in both forearms.

Results

All symptoms were commoner in the fractured arm than in the control arm (Figure 1). The commonest symptom in the fractured forearm was pain during exercise, experienced by 43%, and numbness of the fingers on the control side, experienced by 13%.

No symptoms were present in the fractured forearms in 182 (28 %) cases, 344 (52%) had mild symp-

Table 3. Exclusion criteria from the outcome analysis. The 457 patients excluded had 485 fractures

	Number of patients
Death	71
Refracture	23
Rheumatoid arthritis	8
Bilateral forearm fractures (simultaneous or different trauma)	130
Carpal injury	17
Severe psychic illness	14
Permanent institutional care	26
Osteotomy, Darrach procedure	14
Stroke	18
Other neurologic disorder	6
No answer	117
Obscure answer	14

Table 4. Impairment and effect of the fracture on patients' activities

		Number	%
Impairment	No	354	54.3
	Heavy work	64	9.8
	Carrying, lifting	59	9.1
	Forearm rotation	41	6.3
	Domestic work	30	4.6
	Handwork	19	2.9
	Sports	17	2.6
	Other	68	10.4
Effect	None	600	92.0
	Work arrangements	8	1.2
	Handwork	15	2.3
	Sports	14	2.2
	Domestic work	10	1.5
	Other	5	0.8
Analgesics	None	560	86.8
	Occasional	92	14.1

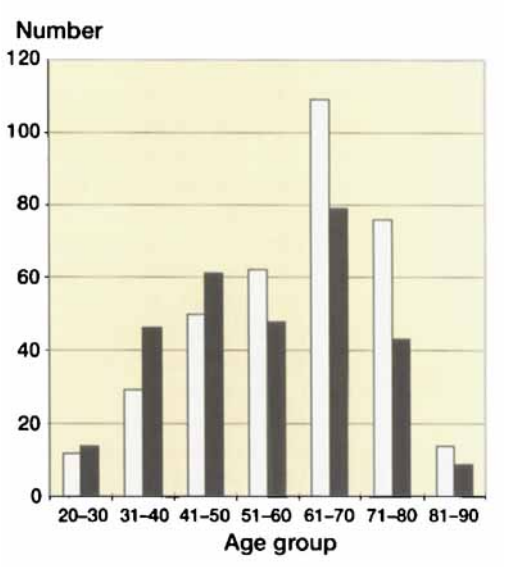

Figure 3. Impairment in age groups.

toms, 84 (13%) moderate, 34 (5.2%) severe and 8 (1.2%) very severe symptoms. No symptoms were present in the control forearm in 527 (81%) of the cases, 106 (16 %) had mild, 16 (2.5%) moderate and 3 (0.5%) had severe symptoms. The difference between forearms was statistically significant (Wilcoxon signed rank test, $p < 0.0001$).

298 (46%) patients complained of impairment because of forearm symptoms. The life of 52 patients (8.0%) was considerably affected by the fracture. 92 patients (14%) reported occasional use of analgesics because of forearm symptoms (Table 4).

Sex, age, duration of follow-up, side of the fracture, hand dominance, cause of injury, associated injuries, number of repositions, type of treatment and whether working or retired had no statistically significant ($\chi 2$-test, $p > 0.05$) correlation to individual symptoms, forearm symptom severity score or impairment experienced. The symptom severity score in the fractured arm correlated significantly to the score in the control arm (Spearman's correlation coefficient = 0.37, p = 0.001). With age, the symptom severity score tended to increase in the control forearm, but the correlation was not statistically significant (Spearman's correlation coefficient p = 0.07).

There were no significant differences in forearm symptom severity scores between Frykman's classes (median test, p = 0.5) or AO main groups (median test, p = 0.09) (Figure 2). There was no significant difference in symptom severity score between intra- and extra-articular fractures ($\chi 2$-test, p = 0.6). The impairment experienced by patients decreased inversely to age, although the symptom severity scores showed no decrease (Figure 3).

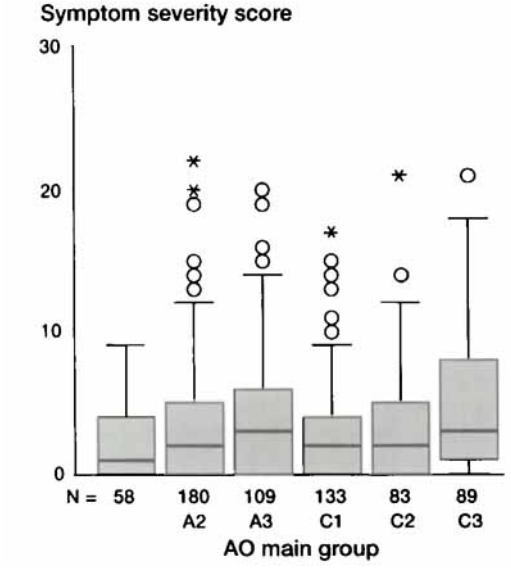

Figure 2. Boxplot diagram showing symptom severity score in various AO main groups. Extereme values are shown as dots and asterisks.Differences between groups are not significant statistically (median test, p=0.09).

Discussion

Forearm symptoms and minor impairments are common after Colles' fracture. The effect of distal radius fractures in young adults on their later activities has been reported to be minimal when functional outcome

scales have been used (Kopylov et al. 1993). In our study, 8% of patients reported a change in leisure activities or work, a remarkable figure, bearing in mind how common the fracture is. The lower activity level in elderly people accounts for the lower degree of impairment in such age groups, despite symptoms equal to those in younger age groups.

Our findings cannot be directly compared to those in other studies because of the different assessment methods. We used a questionnaire to measure outcome. Amadio et al. (1996) reported that, in a study based on standardized questionnaires and physical examination measures, impairments after distal radius fracture may be only partially recognized by physical measurements, and questionnaires could be better in that respect. Our findings support this. It may, however, be difficult for patients to distinguish between three sorts of pain or stiffness and restriction in range of motion. The validity of our questionnaire has not been tested, unlike recently used outcome tools such as SF-36 (Amadio et al. 1996).

There is a possible bias arising from the fact that outcome data were obtained from only 61% of the patients. The distribution of both fracture classifications and demographic and fracture-related factors did not differ in these two groups, which makes it unlikely that an unknown selection bias in the patients would affect our findings.

Symptoms in the control forearm were also common and figures similar to ours have been published in other questionnaire-based studies (Fransson-Hall 1995). The significant asociation between forearm symptoms indicates that they in part are caused by factors other than fracture-related ones. This may partly explain the impairment after fracture.

We found no evidence that either AO or Frykman's classifications predict subjective outcome after Colles' fracture. The usefulness of a classification of distal radius fractures for predicting outcome is debatable. Frykman (1967) reported that, with his classification, the type of fracture correlated to the outcome, being worst in fractures involving the distal radioulnar joint (Frykman classes 5–8). Older et al. (1965) found their classification useful for predicting functional outcome and this was later confirmed by other studies (Solgaard 1984). Older's classification also correlated to early displacement of the fracture (Solgaard 1986). Trumble et al. (1994) reported a correlation between AO classification and severity of the injury based on an injury scoring system and outcome, measured as a combined rating in intra-articular distal radius fractures. Doczi and Frohlich (1996) studied the instability of the fracture during cast immobilization in 633 patients, using AO main groups for classification, and their experience was that the AO classification helps to predict secondary displacement with closed treatment, and they recommended its use. As regards Frykman's classification, they found no use in this respect. Altissimi et al. (1986) observed no correlation between Frykman's classification and long-term functional outcome of fractures of the distal radius in their analysis of 297 patients.

There may be several reasons why some fracture classifications fail to predict outcome. The AO classification does not cover the degree of dislocation, which may be a substantial factor indicating the severity of the trauma. In Older's classification, which has been shown to predict both radiographic and clinical outcomes, the key point is shortening of the radius (Older et al. 1965, Solgaard 1988). Associated soft-tissue lesions and damage to the cartilage, not revealed by radiographs, lead to poor function (Geissler et al. 1996).

Another factor that might influence the prognostic power of the fracture classifications is reproducibility. Johnstone et al. (1993) reported a small series of patients with poor interobserver reliability of the AO classification, regardless of the observers' experience. Andersen et al. (1996) also reported poor interobserver reliability and intraobserver reproducibility when using the detailed AO classification.

Reducing the categories to main groups did not improve the agreement. Kreder et al. (1996), in contrast, reported good inter- and intraobserver reproducibility of the AO classification, when using AO main groups and experienced interpreters, but they reported progressive worsening of reproducibility, when going down to subgroups. Hence they regarded the reproducibility of the complete AO classification as only fair or moderate. Our experience accords with this. AO main group classification can be done with relative accuracy, but substantial problems arise when using subgroups. Andersen et al. (1996) reported poor interobserver reliability of Frykman's classification.

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