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FRACTURES OF THE CARPAL BONES

By

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Among the fractures of the wrist most interest attaches to those of the scaphoid bone, in respect to frequency as well as prognosis.

In most clinics the treatment of recent scaphoid fractures is a circular plaster cast, from the distal joint of the thumb to the elbow (*Bunnell* 1956, *Böhler* 1953, *Watson-Jones* 1958), but occasionally mention is made of a more active treatment, in the form of osteosynthesis (*Spotoft* 1963) or extension of the plaster cast beyond the elbow (*Gregersen* 1965, *Verdan* 1960). On this background we felt that it would be of interest to submit a series of conservatively treated recent carpal fractures from the Surgical Out-patient Department of the University Hospital, Copenhagen, from the period 1951–1960.

MATERIAL

The material comprises 137 patients with 143 fractures. As all were out-patients, the series does not include fractures complicated by dislocation in the wrist or major injuries to soft tissues. The distribution on the individual carpal bones is given in Figure 1.

SCAPHOID FRACTURES

A total of 100 patients had 102 scaphoid fractures. All such fractures, except those which showed signs of cyst formation, avascular necrosis, or pseudarthrosis at the institution of treatment, were included regardless of the length of time after the injury that it was instituted. The fractures were grouped according to site on the basis of the anatomical localization (Figure 2).

The age distribution of the 80 males and 20 females with scaphoid fractures is shown in Figure 3. This fracture is rare in children under

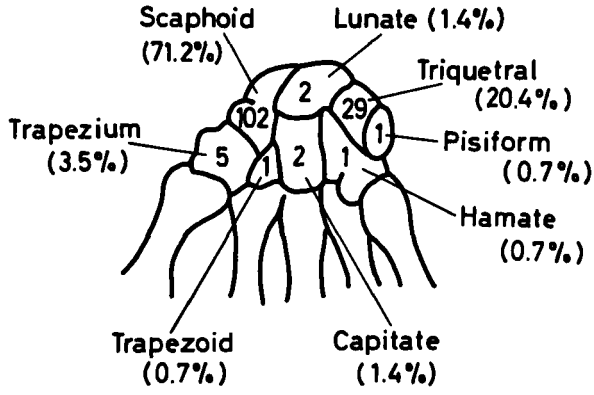

Figure 1. Distribution of carpal fractures on the individual carpal bones.

10 years of age and in elderly persons over 70. Moreover, the incidence among the males decreases steeply from the age of 40. Two patients had two fractures of the scaphoid on the same side; one of them had a fracture through the middle as well as the proximal third, while the other one had a fracture through the distal part and through the middle third or waist.

There were no bilateral and no complicated fractures. In 29 cases the injury was sustained during work, in 11 cases during games; 34 were due to traffic accidents (as a rule falling off a bicycle, etc.), while in 26 cases the genesis was mixed (falls, playing, etc.).

In 7 cases it was impossible to confirm the diagnosis radiologically

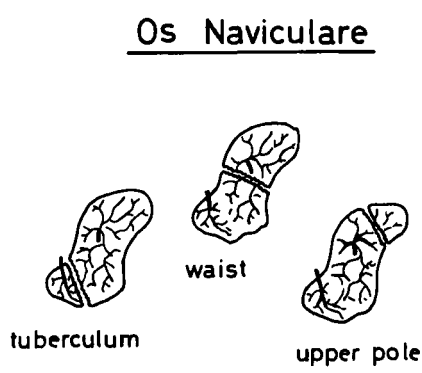

Figure 2. Vascular supply and site of fracture in the carpal scaphoid.

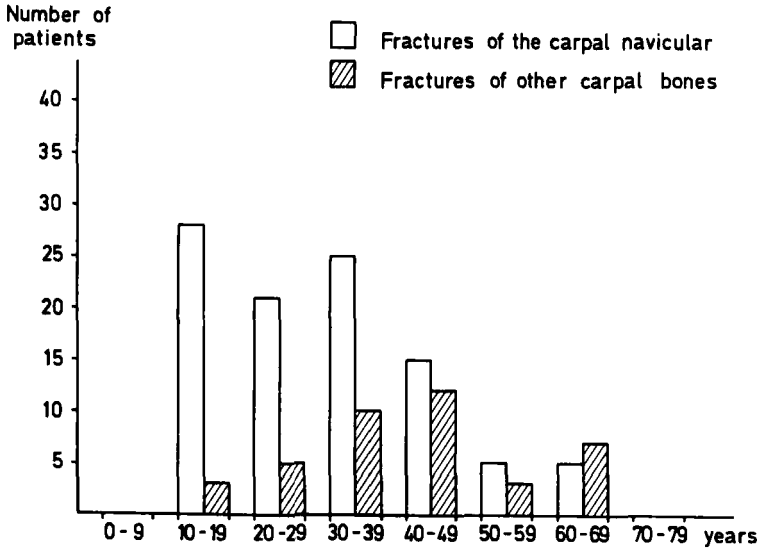

Figure 3. Age distribution of patients with fracture of the scaphoid and of other carpal bones.

until a few weeks had passed. In 2 of these cases the fracture was not visible on the films until 5 weeks after the trauma. Only 3 of these patients were treated with a plaster cast immediately after the trauma, the others with supporting bandages.

55 fractures were right-sided and 47 left-sided. Four patients also had fracture of adjacent bones (Bennett's fracture, fracture of the triquetrum (2), and fracture of the lunate bone).

Table 1. Site of scaphoid fractures.

Site	Right	Left	Total
Distal third	13	13	26
Middle third	34	32	66
Proximal third	8	2	10

Table 1 gives the distribution of the various types of fracture. It will be seen that two-thirds affected the middle of the bone. In 18 cases there was slight displacement of the fragments, and in 3 of these cases a small wedge of bone had been displaced. All the patients had a history of adequate trauma. 68 were seen immediately after the trauma and

had plaster casts applied within the first 24 hours, while 9 did not have plaster casts until more than 4 weeks after the trauma (Table 2).

The first plaster cast was in many cases a dorsal plaster splint which was replaced, on the next day, by circular plaster from high on the forearm to the knuckles, including the proximal phalanx of the thumb.

Table 2. Time of application of plaster cast in relation to trauma (scaphoid fractures).

Site of fracture	Within 24 hours	1–7 days after the trauma	1–4 weeks after the trauma	more than 4 weeks after the trauma	Number of patients
Distal third	16	5	2	2	25
Middle third	48*	7	4	6	65
Proximal third	4§	2	3	1	10
Total	68	14	9	9	100

* 1 patient also had fracture of the distal third.
§ 1 patient also had fracture of the middle third.

Table 3. Duration of plaster cast in weeks (patients with scaphoid fractures).

Site	<3	3–6	7–10	11–12	13–16	>16	Number of patients
Distal third	1	7	14	1	1	1	25
Middle third	1	8	28*	11	13	4	65
Proximal third	0	2	3	1§	1	3	10
Total	2	17	45	13	15	8	100

* 1 of the patients also had fracture of the middle third.
§ This patient also had fracture of the distal third.

It was endeavoured to maintain the plaster cast until X-rays showed the fracture line to be blurred by callus. As far as fractures of the distal third of the bone are concerned, Table 3 shows that more than half were in plaster for 7–10 weeks, while patients with fracture affecting the middle third were kept in plaster for 7–16 weeks, in most cases about 10 weeks. In the event of fracture affecting the proximal third of the bone the duration of the plaster treatment varied widely.

Only 1 patient had radiologically confirmed avascular necrosis of the proximal fragment. This patient was treated by plaster cast for 5 montths after which union had occurred.

FRACTURES OF OTHER CARPAL BONES

This group comprises 40 patients. One had fracture of the trapezium as well as trapezoid. 3 patients also had fracture of the scaphoid.

Thirty patients were males and ten females. The age distribution is listed in Figure 3.

Practically all the fractures of this group were due to falls. They often presented themselves radiologically as chips, especially from the dorsal aspect of the triquetrum. The distribution of the fractures on the individual bones is shown in Figure 1. In one case there was a transverse fracture of the triquetrum, in one case of the trapezium, and in one case of the trapezium as well as trapezoid. The last-mentioned case represented the sequelae of a direct trauma.

21 fractures were right-sided and 19 left-sided.

The treatment was by dorsal plaster splint, in most cases for 3 or 4 weeks, but it should be mentioned that in 15 cases the plaster was left for 6 weeks or longer.

FOLLOW-UP ON PATIENTS WITH SCAPHOID FRACTURES

The average follow-up period is roughly 8 years. Out of the 100 patients 3 have died and 5 have gone abroad. Of the remaining 92 we succeeded in examining 76 clinically, in their homes or in the out-patient department, while 71 also had radiographic examination, comprising anteroposterior, lateral and oblique views. Sixteen patients could not be examined, either because they refused or because they could not be found in the national registry.

Of the 71 patients who were examined clinically as well as radiographically, 15 were females and 56 males. Only these 71 patients will be included below. One patient having fracture of the proximal third as well as of the waist is listed in the tables only as a fracture of the proximal third. The 5 patients for whom we lack radiographic follow-up were symptom free.

In 45 patients the clinical examination showed normal conditions, and 42 of these patients also showed normal X-ray appearances at follow-up (Table 4). A total of 55 had normal X-ray appearances, but 13 of this group had complaints.

Functionally (subjectively) ideal results, *i.e.* no complaints, were found in 46 patients. In 22 cases there were occasional complaints

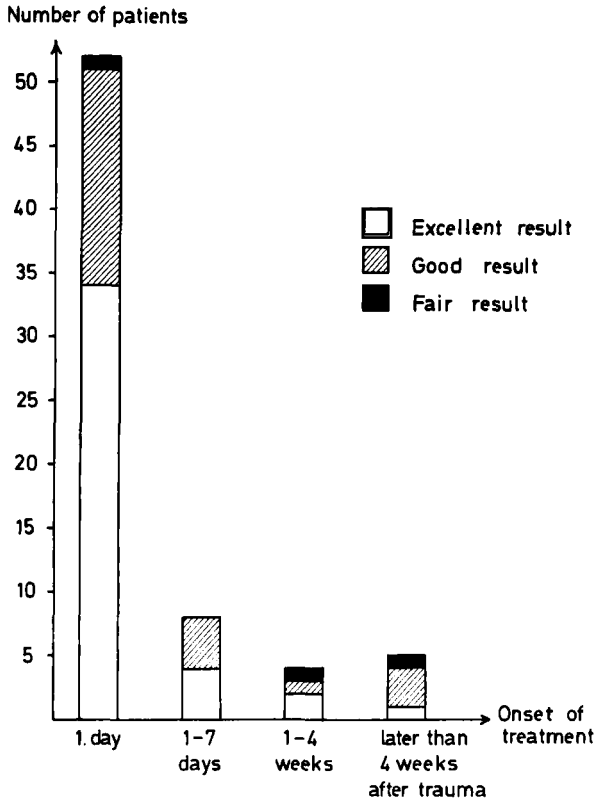

Figure 4. Relation between functional result and the time of institution of treatment in patients with fracture of the scaphoid bone.

Table 4. Clinical, radiological, and functional results at follow-up in 71 patients with scaphoid fracture. (The figures in brackets indicate patients who showed normal conditions clinically as well as radiologically).

Site	No.	No clin. abnorm.	No radiol. abnorm.	No funct. abnorm.	Functional result good	Functional result fair	Functional result poor
Distal third	17	11(10)	14	11	5	1	0
Middle third	44	31(30)	36	32	11	1	0
Proximal third	10	3(2)	5	3	6	1	0
Total	71	45(42)	55	46	22	3	0

(functionally good results), usually in the form of pain upon forced dorsal flexion and on overstrain, but these complaints did not affect the patients' working capacity.

Only 3 patients (fair functional results) had complaints severe enough to reduce their working capacity. Functionally poor results (necessitating a change of occupation) were not found among the followed patients. Fig. 4 presents the functional result in relation to the time of treatment.

Table 5. 29 patients having sequelae of scaphoid fracture at follow-up. (The figures in brackets indicate patients in whom treatment was instituted later than 1 weeks after the accident).

Site	No. of patients	Treatment instituted later than 1 week after the accident	No clin. abnorm.	No radiol. abnorm.	Pseud-arthrosis
Distal third	8	3	1	3(1)	2(1)
Middle third	14	3	1	6(1)	2(1)
Proximal third	7	3	1	4	0

Table 5 lists the 29 patients who did not show normal conditions at follow-up, clinically or radiologically. Sixteen of these patients had been treated on the day of the accident, 4 within the first week, 4 within 2–4 weeks, while the remainder were not seen until 6 weeks—5 months after the accident. In 10 cases there had been minor interruptions of the treatment. This applies to only 5 patients of the group of 42 showing completely normal conditions at follow-up.

The most outstanding symptoms are pain on weight-bearing and pain on forced dorsal flexion in the wrist, but in nearly all the cases these complaints were very slight.

Limited mobility, in the form of a 15–20° extension defect in the wrist, was found in 8 cases.

The radiological appearances were normal in about half the patients who had symptoms. Among the remainder 9 showed a slightly disturbed level of the joint surface, 4 showed pseudarthrosis, and 7 osteoarthritis.

One patient had been treated for pseudarthrosis by extirpation of the proximal fragment (fracture affecting the proximal third), but still had complaints as before.

Table 6. Functional result in relation to time of institution of treatment and duration of plaster cast in patients with scaphoid fractures.

Site		No. of pts.	Time of institution of treatment		Duration of plaster cast			Interruption of the treatment
			< 1 week	later	3–6 weeks	7–12 weeks	> 12 weeks	
Distal third	I	11	10	1	5	6	0	1
	G+F	6	4	2	1	5	0	3
Middle third	I	32	30	2	7	19	6	4
	G+F	12	10	2	0	6	6	8
Proximal third	I	3	3	0	1	1	1	1
	G+F	7	5	2	1	3	3	1
Total		71	62	9	15	40	16	18

I: Ideal. G: Good. F: Fair.

In 3 of the 29 patients the treatment had been complicated by reflex dystrophy, as compared with 1 case in the group of symptomless patients. It applies to the group of patients suffering from sequelae that only 64 per cent were treated within the first 24 hours, while this was done in 83 per cent of the patients without sequelae. The percentage of patients seen more than 4 weeks after the trauma is also higher among patients having symptoms at follow-up than among those who were symptomless. On the other hand, there does not appear to be any major difference between the duration of the plaster cast treatment in the two groups (Table 4).

FOLLOW-UP ON PATIENTS WITH FRACTURES OF THE OTHER CARPAL BONES

In the group of patients having fractures of the other carpal bones 2 had died during the follow-up period. Of the remaining 38 we examined 30. Six had complaints in the form of mild pain on exertion, and these patients were X-rayed. Normal appearances were found in 4, while in 2 there was non-union of the avulsed fragment. Five of these six patients had been immobilized for more than 7 weeks, and all had been treated on the day of the accident.

DISCUSSION

The most common juxta-carpal fracture is Colles' fracture. Its ratio to scaphoid fracture has been stated by *Scudder* (1938) as 10: 1. The other carpal bones are more rarely fractured. The reported frequency differs somewhat, probably depending upon how often a distortion of the wrist is X-rayed. Among 175 carpal fractures *Kellam & Goey* (1945) found 6 per cent to affect the triquetrum, while in our series these fractures made up 20 per cent. *Andersen & Therkelsen* (1949) found the scaphoid to be fractured 4–5 times as often as all other carpal bones together, a ratio which in our series is only 2–3 times.

After the treatment described above, we found at follow-up of the patients with scaphoid fractures that about 60 per cent exhibited completely normal conditions, clinically as well as radiologically. Four patients (6 per cent) had developed pseudarthrosis at the site of the fracture, while 94 per cent had united. This corresponds to the healing rate found by others (*Böhler* 1963, *Soto-Hall & Haldeman* 1941, *Stewart* 1954, *Watson-Jones* 1958) after an average treatment period of 8–10 weeks.

An analysis of the 4 cases of pseudarthrosis revealed that in 1 patient with fracture of the proximal third the treatment was instituted on the day of the accident, but concluded only 6 weeks later, when the fracture had united clinically, but not radiologically. One patient failed to attend for further treatment, and one did not present himself until 5 months after the accident, and non-union persisted in spite of plaster cast for another 5 months. In 1 patient, who presented himself for treatment 4 weeks after the accident the fracture united in 9 weeks, but follow-up radiography revealed pseudarthrosis and incipient osteoarthritis. A later injury was not known to have occurred. In 2 of the cases the plaster cast could and should have been continued for a longer period.

Like others before us, we found all fractures of the distal third of the scaphoid to have united, regardless of the duration of treatment or the time of its institution. However, 6 of the patients included in the follow-up had complaints after fractures of this site, and radiography showed that 3 had healed with slight displacement.

Better clinical results might perhaps have been obtained by a stricter treatment, like *e.g. Böhler's* (1953) who considers that even a short-lasting removal of the plaster, *e. g.* for radiography, compromises the treatment. At least, the patients with a history of late institution of

treatment and interruptions in the treatment belong mostly to the group having sequelae.

Figure 4 sets out graphically the functional result in relation to the time of treatment for the 71 patients with scaphoid fractures who were included in the clinical and radiological follow-up. The earlier the treatment is instituted the greater are the chances of an ideal result. This is in complete agreement with *e.g. Andersen & Therkelsen* (1949). Half of their patients treated with plaster cast started on the treatment more than 1 weeks after the accident, and correspondingly their rate of radiological union was as low as 80 per cent.

In spite of the fact that 26 patients showed clinical sequelae at follow-up, the functional result was good in practically all cases, as only 3 patients had complaints interfering with their working capacity.

Where the fractures of the other carpal bones are concerned, we found among the common fractures of the triquetrum predominantly minor chip fractures. This accords with *e.g. Fairbank* (1942) who found these to amount 90 per cent of the fractures affecting this bone.

Bandaging for a few weeks usually results in completely normal clinical conditions, and radiological non-union does not, as in fractures of the waist or proximal third of the scaphoid, bear any relation to the final therapeutic result (*Mark* 1960). *Wagner* (1959), who recommends immobilization for 4–6 weeks, emphasizes the importance of early immobilization. All the patients included in the present follow-up showed functionally ideal or good results; the few patients who had mild complaints at follow-up had been bandaged immediately after the accident, and the immobilization had been continued for 6–7 weeks.

Thus, long-lasting immobilization does not appear to be required in the treatment of fractures of the carpal bones—except in dealing with fractures of the waist and proximal third of the scaphoid.

SUMMARY

A series of 137 patients with carpal fractures is presented. The main stress is on a clinical and radiological follow-up on 71 patients with fracture of the scaphoid. The follow-up period averaged 8 years. The treatment was conservative, a plaster cast reaching to the elbow.

At follow-up 94 per cent of the patients exhibited radiological union, while 6 per cent (4 patients) had pseudarthrosis. 60 per cent showed completely normal conditions, clinically as well as radiologically. 25

patients (35 per cent) had subjective complaints, but only 3 so severe as to interfere with their working capacity.

The authors point out the importance of instituting treatment as early as possible and of continuing it without interruption until radiological union has occurred.

Among 30 patients with fracture of other carpal bones only 6 had negligible subjective complaints; this applied int. al. to 4 with normal radiological appearances.

On the basis of the present series these fractures do not appear to need long-lasting immobilization.

RESUME

Une série de 137 malades avec fractures carpiennes est présentée. Le plus important est un examen complémentaire clinique et radiologique de 71 malades avec fractures du scaphoïde. La période d'observation a été en moyenne de 8 ans. Le traitement avait été conservateur, un plâtre allant jusqu'au coude.

A l'examen 94 pour cent des malades présentent une soudure radiologique, tandis que chez 6 pour cent (4 malades), on constata une pseudarthrose. 60 pour cent montrèrent des conditions entièrement normales cliniquement et radiologiquement. 25 malades (35 pour cent) avaient des plaintes subjectives, mais chez 3 seulement si graves qu'elles influaient sur la capacité de travail.

L'auteur souligne l'importance d'instituer le traitement aussi vite que possible et de le continuer sans interruption jusqu'à ce que la soudure radiologique se soit faite.

Parmi 30 malades avec des fractures d'autres os carpiens six avaient des plaintes subjectives négligeables à faire; cela s'applique en particulier à 4 chez lesquels l'aspect radiologique était normal.

Sur la base de la présente série, il ne semble pas qu'il soit nécessaire pour ces fractures d'utiliser une immobilisation qui dure trop longtemps.

ZUSAMMENFASSUNG

Eine Reihe von 137 Patienten mit karpalen Brüchen wird vorgestellt. Das Hauptgewicht wird auf eine klinische und röntgenologische Nachuntersuchung von 71 Patienten mit Naviculare bruch gelegt. Der Zeitraum der Nachuntersuchung war im Durchschnitt 8 Jahre. Die Be-

handlung war konservativ und bestand in einem bis zum Ellenbogen reichenden Gipsverband.

Bei der Nachuntersuchung zeigten 94 pro zent der Patienten Bruchheilung, während 6 pro zent (4 Patienten) Pseudarthrosen hatten. 60 pro zent wiesen sowohl klinisch als auch röntgenologisch vollständig normale Verhältnisse auf, 25 Patienten (35 pro zent) hatten subjektive Beschwerden, doch nur bei dreien waren sie so schwer, dass sie die Arbeitsfähigkeit beeinträchtigten.

Die Verfasser heben die Wichtigkeit eines möglichst frühzeitigen Behandlungsbeginns und der ununterbrochenen Fortsetzung der Behandlung bis zur röntgenologisch nachweisbaren Heilung hervor.

Von 30 Patienten mit anderen carpalen Knochenbrüchen hatten nur 6 leichte subjektive Beschwerden; dies war der Fall int. al. bei vieren mit normalen röntgenologischen Befunden.

Auf Grund der vorliegenden Reihenuntersuchung scheinen diese Brüche keine langdauernde Ruhigstellung zu benötigen.

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