Functional treatment of metacarpal fractures

100 randomized cases with or without fixation

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Totally, 100 hundred subcapital or diaphyseal fractures of the second through the fifth metacarpal were randomized to either a dorsal/ulnar plaster cast immobilizing the wrist and the joints of the involved digits or a functional cast allowing the wrist and the digits a free range of motion. Due to better retaining ability, functional casting reduced volar angulation by two thirds for metacarpal shaft fractures and by one third for metacarpal neck fractures when compared with plaster cast immobilization. Restriction of wrist, metacarpophangeal, and interphalangeal joint movements was more frequent in the cast group, but did not influence the overall function 3 months postinjury. Sick leave was reduced by two thirds after functional casting compared with the plaster cast group.

Functional disability after metacarpal shaft and neck fractures seems to be present only when the fractures heal with malrotation or ulnar/radial angulation (Holst-Nielsen 1976). There is no general agreement regarding the correct method of maintaining fracture reduction or as regards to the acceptable angulation at the fracture site (Hunter and Cowen 1970, Bloem 1971, Holst-Nielsen 1976, O'Brien 1982, Lowdon 1986, Moutet and Frére 1986).

Conventional treatment includes immobilization of the wrist metacarpophalangeal and proximal interphalangeal joints in an ulnar or dorsal plaster cast. We compared the results of this treatment with results after treatment with a functional cast allowing the wrist and digits a full range of motion.

Patients and methods

Totally, 100 consecutive patients with a shaft or neck fracture of the second through the fifth metacarpal bone were randomized to immobilization by either a plaster cast or a functional cast (Table 1). Patients with open fractures, multiple fractures, and patients with a previous fracture of the same or the contralateral hand were excluded.

Reduction was performed after injection of local anesthesia into the fracture hematoma using the method of Jahss (1938), with a maximally flexed MCP joint to stabilize the distal fragment. Twenty-three percent of the fractures were not displaced or only minimally displaced, and they needed no reduction.

The plaster cast was applied either as an ulnar gutter cast for the fifth metacarpal or as a dorsal cast for the second–fourth metacarpals. In both cases the MCP and PIP joints of the involved and the adjacent digits were immobilized. The wrist was held in 20°–30° of extension, the MCP joints in 70°–80° of flexion, and the PIP joints were extended.

The functional cast was made of Delta-Lite®, allowing the wrist and the digit joints a free range of motion (Figure 1). After application, reduction was performed, and the fracture was retained until the cast hardened. The injured finger was strapped to the adjacent finger with Velcrotape.

Both plaster and functional casts were removed after 3 weeks.

Patients were assessed clinically 1 week, 3 weeks, and 3 months after the injury. All the

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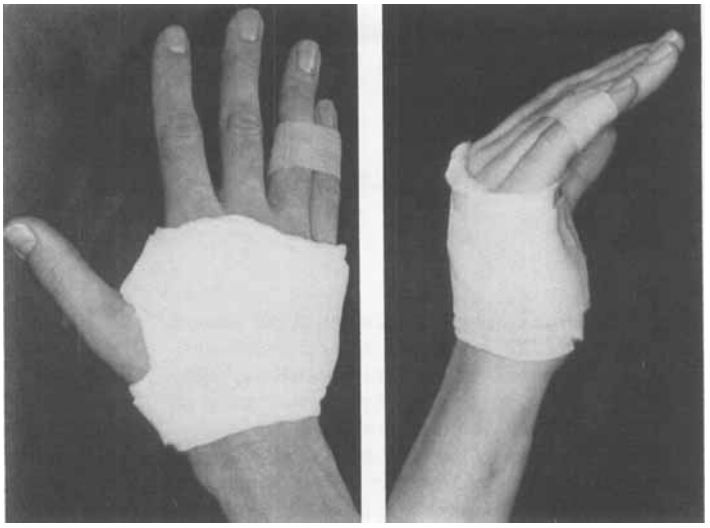

Figure 1. Functional splintage of a metacarpal fracture allowing the wrist and digits a free range of motion.

patients were examined 1 and 3 weeks postinjury and 93 patients 3 months postinjury, whereas the remaining 7 patients were interviewed by telephone. Subjective complaints of pain, cast inconvenience, end result, and the length of time before returning to work were recorded. Patients were divided into four work categories: (1) use of the hand could be avoided (students), (2) slight use of the hand was required (white-collar workers), (3) some hand power was required (light-equipment operators), and (4) work with a large demand on hand power (road-construction workers).

The presence of rotation or ulnar/radial angulation deformities was observed, and the range of motion of the involved joints and grip strength (Mygripper®) was tested upon cast removal and 3 months postinjury.

Anteroposterior and oblique radiographs were taken of both hands before and after cast application and upon removal of the cast after 3 weeks. Oblique projections were taken of both hands simultaneously using a pillow with symmetrically oblique sides. The fracture angulation was calculated as the angulation of the fractured side minus the angulation as measured in degrees for the contralateral hand.

For statistics, the Mann-Whitney U-test and Fisher's two-sided test were applied.

Results

Patient data for the two treatment principles are shown in Table 1. Reduction and retention were more efficient in the functional group as compared with the plaster cast group (Table 2).

At cast removal, no patients had rotational or frontal plane angulation deformities. Twenty-eight

Table 1. Data of 100 patients with subcapital or diaphyseal metacarpal fractures randomized to two different treatments

Site	n	Age	Metacarpals				Hand[1]		Work category[2]			
		median (range)	2	3	4	5	D	non-D	1	2	3	4
Subcapital												
plaster cast	30	20 (12–62)	4	3	4	22	22	8	9	4	11	6
functional cast	28	23 (16–56)	0	2	4	26	19	9	8	6	9	5
Diaphyseal												
plaster cast	20	24 (14–60)	2	1	6	8	11	9	6	8	2	4
functional cast	22	22 (14–63)	2	4	8	4	9	13	9	4	2	7

[1] D, dominant hand; non-D, nondominant hand.
[2] 1, students; 2, white-collar workers; 3, light-equipment operators; 4, road-construction workers.

Table 2. Comparison of subcapital and diaphyseal metacarpal fracture angulation before and after reduction and splintage and after cast removal. Degrees are median and range

Site	Before reduction	After reduction	Cast removal
Subcapital			
plaster cast	27 (0–36)	27 (0–30) *	25 (0–37) *
functional cast	25 (0–30)	18 (0–34)	16 (0–30)
Diaphyseal			
plaster cast	15 (0–30)	12 (0–20) *	14 (0–25) **
functional cast	16 (0–24)	5 (0–10)	5 (0–10)

Plaster cast vs. functional cast, *$P < 0.05$; **$P < 0.01$.

Table 3. Time in days (median and range) before patients returned to work divided into groups according to treatment and work

Work categories	1	2	3	4
Plaster cast	7 (1–21) *	21 (14–27) *	24 (21–30)	21 (10–27)
Functional cast	1 (1–3)	7 (1–10)	10 (1–28)	8 (7–21)

Plaster cast vs. functional cast, *$P < 0.05$; For work categories, see footnote 1 in Table 1.

patients in the plaster cast group presented with a joint movement restriction of 25° (10°–70°) in the wrist and 24 patients of 20° (10°–50°) in the MCP joints. As a comparison, 4 patients in the functional group displayed wrist movement restriction of 10° ($P < 0.01$), and 14 with an MCP joint restriction of 20° (5°–45°) ($P < 0.05$). Sixteen plaster cast treated patients had a PIP joint restriction of 10° (5°–20°) as compared with 2 patients in the functional group, who had 10° ($P < 0.01$). Three months postinjury, 5 patients in the plaster cast group had an extension lag of the MCP joint of 10° (5°–20°). These were all subcapital fractures.

Grip strength at the time of cast removal was 66 (37–100) percent of the contralateral side in the plaster cast group and 81 (36–108) percent in the functional group ($P < 0.01$). Three months postinjury, the grip strength was 100 (93–104) percent and 100 (94–119) percent, respectively. All the patients had returned to their previous jobs. No signs of pressure necrosis of the skin were recorded in either of the groups. Eighteen patients in the plaster cast group and 6 in the functional group complained of the cosmetic result, with a depressed metacarpal head and a dorsal callus prominence.

In all the work categories, patients treated with functional casts were able to return to work earlier (Table 3). The functional group returned to work in one third of the time required by the plaster cast group.

Discussion

While there is general agreement as to the acceptance angulation of neck fractures of the second and third metacarpals as well as for shaft fractures of all the metacarpals (10°–20°; Bloem 1971, Flatt 1979, Smith and Peimer 1977, O'Brien 1982), the acceptable angulation for fourth and fifth metacarpal fractures varies from 20° (Kilbourne and Paul 1958, Bloem 1971) to 70° (Hunter and Cowen 1970, Holst-Nielsen 1976). This wide variation is partly due to the different methods of measuring the angulation, as pointed out by Lowdon (1986), but also partly represents differences in opinions. In our series, all the fractures were retained nonoperatively regardless of volar angulation. Reduction of the shaft and neck fractures is fairly easy when applying the principle of Jahss (1938), but maintaining the reduction with conservative treatment has proven difficult (Borgeskov 1967, Holst-Nielsen 1976, Arafa et al. 1986). In our series, splintage with a dorsal/ulnar plaster cast could not retain a reduced volar angulation, and fracture angulation at cast removal was practically the same as after the initial trauma.

Because fracture retention has proven difficult when using plaster casts, the need of immobilization has been questioned. Treatment of unrotated subcapital fractures of the fifth metacarpal with immediate mobilization has produced functional and cosmetic results comparable to plaster casting (Arafa et al. 1986, Moutet and Frére 1986, Ford et al. 1989).

Only in a study by Viegas et al. (1987) could fracture reduction be retained using a functional brace with pads and an adjustable strap.

In our study, functional splintage resulted in a reduction of fracture angulation by 68 percent for shaft fractures and by 36 percent for subcapital fractures when compared with dorsal/ulnar plaster cast immobilization. MCP extension lag at follow-up was rare, but excellent function is to be expected in spite of marked angulation (Hunter and Cowen 1970, Barton 1984, Arafa et al. 1986, Lowdon 1986, Ford et al. 1989).

Necrosis of the skin over the broken metacarpal, as experienced by Geiger and Karpman (1989) with a bandage with pads (Viegas et al. 1987), was not seen.

Functionally treated patients returned to work faster than did patients in studies of nonimmobilization (Hunter and Cowen 1970, Arafa et al. 1986, Ford et al. 1989), perhaps because the short, but solid, bandage gave a feeling of security and provided pain relief.

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