Malunited fractures of the distal radius with volar angulation

Corrective osteotomy in 6 cases using the volar approach

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We treated 6 patients with volarly angulated malunions after distal radius fractures by corrective radius osteotomy via the volar approach. No complications related to this approach were seen. Postoperatively, ulnar head pain was alleviated and forearm rotation was within 10 degrees of normal.

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Malunions after distal radius fractures are usually dorsally angulated. Corrective radius osteotomy is now an established treatment for symptomatic cases (Fernandez 1982, af Ekenstam et al. 1985). Malunions with a volar angulation are considerably less common, but between 1992 and 1994 we treated altogether 6 patients by osteotomy through a volar approach and now report the surgical outcome after a minimum of 1 year.

Patients and methods

4 women and 2 men with a mean age of 45 years were treated, all but 1 working full-time (Table 1). The dominant side was affected in 4 patients. 3 of the fractures were originally dorsally dislocated. These fractures were not overcorrected and were still in an acceptable position at 7–10 days, but nevertheless displaced into a volar angulation after removal of the fixation. 2 fractures were primarily volarly angulated, and 1 was comminuted, but only slightly displaced. 2 fractures also had an intraarticular die-punch fragment of the distal radius. The primary treatment was plaster immobilization in 5 patients and external fixation in case 2. At 10 days, dislocation in plaster prompted external fixation in case 5 and an attempt at volar buttressing in case 6 (Figure 1).

The indications for corrective surgery were pain around the ulnar head and/or functionally disabling limitation of rotation of the forearm, notably supination, attributable to incongruity of the distal radio-ulnar joint. The volar angulation was 6–31 degrees. The decision to operate was taken about half a year after the fracture, which included several months of physiotherapy. However, in 2 cases a grossly displaced fracture, ulnar pain and secondarily impaired hand function were indications for earlier surgery.

Operation

The surgery was done under general anesthesia, in a bloodless field and with the help of an image-intensifier. The approach was through the interval between the flexor carpi radialis and the palmaris longus tendons. The incision was extended to the carpal tunnel in the first 2 patients, but in the other 4 patients no incision extended distal to the flexor crease. The median nerve was gently retracted towards the ulnar side. The pronator quadratus was mobilized from the the radial border.

The suitable level of the osteotomy was determined from preoperative radiographs and intraoperative images. The osteotomy was wedged open to achieve correction. A full-thickness cortico-spongious graft from the iliac crest was fitted into the defect flush with the volar cortical surface and supplemented with cancellous bone impacted into remaining defects. In cases 3 and 5, a die-punch fragment of the distal radius was osteotomized under fluoroscopic control, elevated and grafted volarly. An oblique T-plate was added as a volar buttress (Figure 1). Once the osteotomy was fixed in an anatomical position, a more or less normalized forearm rotation was noted.

The wrist was immobilized in a dorsal plaster slab for 6 weeks in all cases except case 6 (2 weeks), in whom the preoperative range of motion was full. At 6 weeks, radiographs were taken and the plaster was removed. Free exercises were instituted.

Routine follow-up examinations were done at 6 weeks, 3 months and 1 year. An independent clinical examination (JS) was done 1–3.5 years postoperatively, which forms the basis of this report.

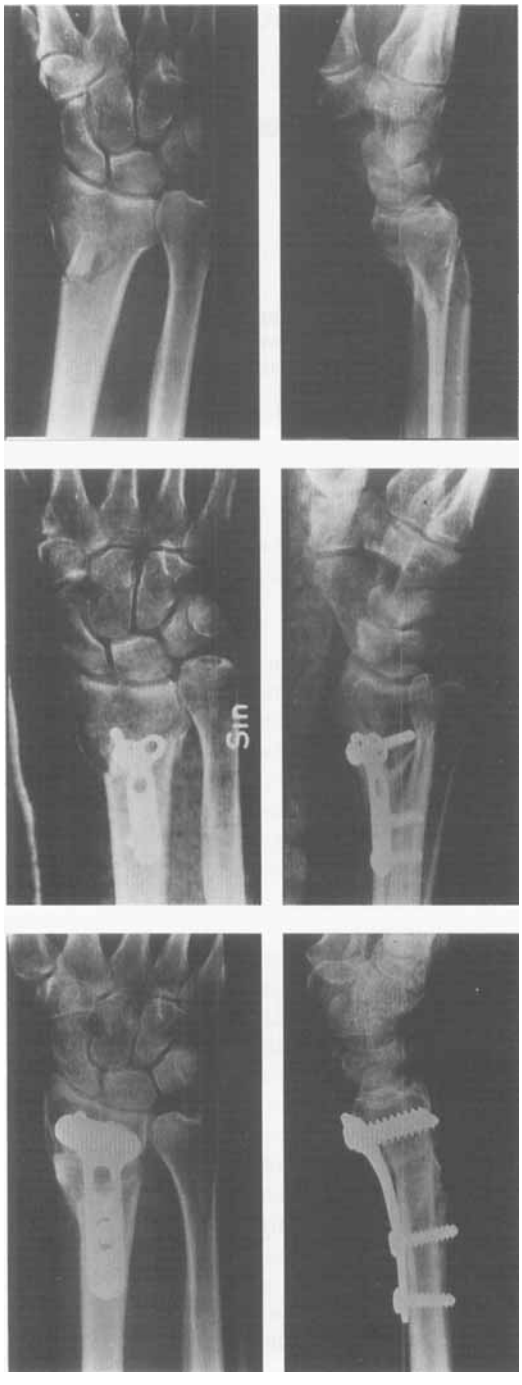

Figure 1. Case 6. A 45-year-old nurse who sustained a comminuted but only slightly displaced distal radius fracture of her non-dominant arm (top). The fracture displaced in plaster and she had surgery which failed to reduce and retain the fracture (middle). She was then referred because of pain around the ulnar head—the mobility however, was well preserved. 6 weeks after correction osteotomy by a volar approach (bottom), the osteotomy is healed and the wrist completely free of pain and fully mobile. The patient is again working full-time as a nurse.

Results

All osteotomies healed in a satisfactory position, without loss of reduction. Mean ulnar variance was 0 (0–2) mm, radial angulation 27 (23–34) degrees, and volar tilt was 8 (2–13) degrees (Table 1).

There were no postoperative complications in the form of median nerve palsy, wound complications, flexor tendon adhesions, non-union of the graft or plate breakage. No plate has had to be removed. At 6 weeks, radiographs showed bridging of the host-graft junction both proximally and distally in all cases.

All patients who had a job have returned to their work-place postoperatively, some having been sick-listed for 1/2–1 year preoperatively. At the latest follow-up, 5 of the 6 patients are pain-free. No patient has a forearm rotation deficit of more than 10 degrees.

The patients were asked if they would consider the same operation again, given identical symptoms. All answered in the affirmative.

Discussion

The subgroup of volarly angulated malunions of the distal radius seemed to benefit as much from corrective osteotomy as those with dorsal angulation. Pain was a prominent preoperative complaint; this may be due both to incongruity of the distal radio-ulnar joint and to impingement of the ulnar part of the carpus on the ulnar head. Postoperative pain relief was complete in 5 patients and was marked in the sixth.

In addition to its pain-relieving effect, the operation also normalizes forearm rotation. In 2 of our cases, the wrist was more or less locked in a slightly pronated position preoperatively. In another 2, the supination was only 20 degrees. Postoperatively, no patient has a supination deficit of more than 10 degrees. Impaired supination is more disabling than is generally appreciated. Apart from causing an inability to perform tasks needed in certain jobs, it also makes personal hygiene difficult to carry out. Case 3 is a case in point: an electrician who was unable to use a screw-driver because of pain and impaired mobility was considered for another job; postoperatively he is working full-time in his previous occupation. Functional impairment due to reduced supination should be actively inquired about by the clinician and would indicate a need for surgery.

It is interesting to note that in 3 fractures that were originally dorsally angulated, the malunion was volarly angulated. This was not due to overreduction of the fracture, or to an early volar dislocation in plaster. Possibly, a too early removal of the plaster in

Table 1. General table

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	59	f	1	A2:2	4	3.5	6	0	14	25	15	6	2	0	60/60/60	–10/80/90	60/40/80	–15/40/80	15/5/5	5/20/30	30	60
2	58	f	1	A 3:1	6	2	8	2	15	26	15	13	2	0	10/65/75	–10/80/80	30/70/80	–10/70/80	–/20/25	–/45/50	25	30
3	32	m	1	C1:2	12	1.5	5	1	24	28	19	2	2	0	70/70/70	45/70/70	35/55/65	20/55/65	15/25/30	5/55/65	55	70
4	50	f	2	A2:2	6	1.5	3	0	16	34	17	9	0	0	70/70/70	20/90/90	50/60/50	20/60/50	0/25/20	25/40/50	25	30
5	25	m	1	C2:1	3	1	6	0	9	26	31	8	2	1	70/75/75	20/90/90	20/50/75	55/50/75	15/20/25	25/55/55	50	55
6	45	f	2	A2:3	24	1	5	0	10	23	6	8	1	0	70/70/70	90/90/90	40/20/50	35/20/50	25/20/25	50/45/50	40	50

A Age at time of fracture
B Sex
C Fractured side
  1 dominant
  2 non-dominant
D AO fracture classification
E Interval fracture - osteotomy (months)
F Follow-up time (years)
G Ulna plus before osteotomy (mm)
H Ulna plus after osteotomy (mm)
I Radial inclination (degrees) before osteotomy
J Radial inclination (degrees) after osteotomy
K Volar angulation (degrees)of radius before osteotomy
L Volar angulation (degrees)of radius after osteotomy
M/N Ulnar pain before/after osteotomy
  0 nil
  1 slight
  2 severe

Mobility before/after osteotomy/sound side
O Pronation
P Supination
Q Palmar flexion
R Dorsal extension
S Radial deviation
T Ulnar deviation
U Grip strength (mPa) at follow-up, operated side
V Grip strength (mPa) at follow-up, sound side

combination with active flexion exercises made the fracture tilt volarly and then heal in a stable compressed position. This position of a subluxed carpus, apart from its unsightly appearance, often led to weakness of finger flexion—in fact, in case 5 a flexion deficit of 3 cm. Correcting the length and inclination of the wrist resolved the problems within a matter of weeks.

In our hands, the volar approach to the radius has been safe and there is no need to hesitate to use it in appropriate cases. It is in many ways more helpful to the surgeon than the dorsal approach used for dorsally angulated malunions. The volar cortex is strong and can resist strong distraction. The stability of the graft is impressive once it has been impacted to the level of the cortex. Osteotomy of the articular surface of the distal radius can be done through the same incision as in our 2 cases with a malunited die-punch fragment. The pronator quadratus covers the volarly applied plate, and so there is little contact between the plate and overlying long tendons, as opposed to the case on the dorsum of the wrist. If needed, division of the carpal ligament can be done by slightly lengthening the incision.

In no case were the ligaments of the distal radio-ulnar joint reconstructed and there was no complaint of persistent symptoms at this site. Instability of this joint was not a problem in our patients, partly at least because anatomical congruity was restored. Our material is too small to determine whether the distal radio-ulnar joint can be left alone in all cases of malunion. Obviously, the goal of joint congruity can be reached by osteotomy of the radius alone, by a combined correction of the radius and ulna (Jupiter and Masem 1988, Möllenhoff et al. 1991) or by isolated shortening of the ulna (Hove and Mölster 1994), which has to be determined from case to case.

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