

Volar plating of distal radius fractures using a locked anatomically contoured plate

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Abstract

Background Distal radius fractures are the most common injury to present to orthopaedic fracture clinics. Displaced extra- or intra-articular fractures require reduction to allow a good outcome. Historically fractures were treated with manipulation and casting, with or without wire fixation. Modern plating techniques allow accurate reduction and internal fixation with early mobilisation.

Methods Case series review of 40 distal radius fractures managed with the Orthofix volar plating system (VPS). We assessed radiological outcome, along with clinical data from hand therapy detailing our experience with this system providing the first reports of this particular implant in the literature.

Results All cases were performed using a volar incision through the bed of FCR. Six cases were lost to follow up leaving a total of 34 wrists available for radiological review. On review of the postoperative radiographs at 6–8 weeks the mean volar tilt was 9.22° (0–16.5) and the mean radial inclination was 20.8° (3.3–30). We identified five patients with poor radiographic position. Patients referred for hand therapy ($n = 22$) demonstrated good clinical results at the 8–12-week follow up. The mean flexion extension arc was 113.5° (60–150) with a mean pronation supination arc of 164.9° (20–180). The mean grip strength was 47.4 lb (12–110).

Conclusions The management of displaced distal radius fractures with a volar locking plate gives good radiological and functional outcomes in the short term.

Keywords Volar · Radius · ORIF · Fracture

Background

Distal radius fractures are the most common injury to present to orthopaedic trauma surgeons [7]. Displaced extra- or intra-articular fractures require reduction to allow a good outcome [4, 9, 12, 14].

Historically fractures were treated with manipulation and casting, with or without Kirschner (K) wire fixation. Modern plating techniques have been advocated to restore anatomical alignment and allow early mobilisation [5, 16]. The benefits of early mobilisation have recently been questioned [13] and there is still debate as to the best way to manage these injuries [8]. We wished to assess the outcome of volar locking plate osteosynthesis at our institution to confirm satisfactory reduction and functional outcomes.

Methods

We performed prospective data collection on a series of 39 consecutive patients (40 wrists) admitted to the Orthopaedic Department of Mid Staffordshire NHS Foundation Trust for internal fixation of an angulated and/or displaced distal radius fracture between March 2007 and February 2008. The patients were selected on a case by case basis by the treating surgeon following assessment of the degree of comminution, displacement and angulation. The mean dorsal angulation in the dorsally displaced group pre operatively

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was 20°; the mean articular step in the AO type B and C fractures was 2.4 mm.

During the same time period 37 unmatched patients were admitted for closed manipulation and casting of a displaced distal radius fracture and these were used as a comparison for the radiological outcomes.

All patients underwent open reduction and internal fixation (ORIF) under general anaesthesia and tourniquet control using the Orthofix volar plating system (VPS) Intavent Orthofix Limited, Maidenhead, Berkshire (Fig. 1), through a surgical approach utilising the bed of flexor carpi radialis [6]. Data on the frequency of complications, the position on initial and follow up radiographs and the postoperative range of motion were prospectively collected.

There were 40 wrist fractures in 39 patients. Six patients were lost to follow up leaving 34 wrists available for radiological assessment. Twenty-two (22) patients were referred for occupational hand therapy within 2 weeks of surgery at the clinical decision of the operating surgeon and have complete functional outcome results at 12 weeks postoperatively.

We had 13 male patients and 27 females with an age range of 16–76 years old (mean 52 years). There were 11 volar and 29 dorsal fractures; these were classified according to the AO classification system (Table 1). Twenty-two cases involved intra-articular fractures. All patients were reviewed at 2 and 6 weeks postoperatively. Follow up was then at the discretion of the treating surgeon.

In the unmatched cohort who underwent closed manipulation there were 10 males and 27 females with an average

age of 61 years (16–85) this was significantly older than the plating group. $P < 0.004$ Mann–Whitney.

Radiographs were reviewed by an independent clinician and angles and measurements calculated using the built in PACS software Centricity Enterprise Web V3.0 GE Medical Systems.

Results

On review of the radiographs the mean volar (lateral) inclination for dorsally angulated fractures was -20° (0–43 dorsal) preoperatively with mean radial inclination for all fractures of 14° (-9 to 32) and a mean radial height of 6 mm (0–17.7). The preoperative mean articular step was 2.4 mm (1–11.5 mm). At the time of last follow up the mean volar inclination for all fractures was 9.2° (0–16.5) and the mean radial inclination was 20.8° (3.3–30). The mean radial height was 9.5 mm positive (4.1–16.5) with the mean articular step of 0.4 mm (0–2.4 mm), this is a statistically significant reduction in articular step $P = 0.003$ (Mann–Whitney).

We identified five patients in the VPS group with a poor radiographic position at follow up. Four cases had been mal



Fig. 1 Orthofix volar plating system

Table 1 Classification of fractures (AO)

AO type	Number of cases
A2	12
A3	3
B1	1
B2	4
B3	1
C1	8
C2	9
C3	1



Fig. 2 Intra-operative reduction



Fig. 3 Loss of reduction

reduced at the time of surgery and remained in a mal reduced position on postoperative X-rays. One patient developed loss of position on the lateral radiograph at subsequent review with loss of volar inclination, Figs. 2 and 3. Figure 4 demonstrates a satisfactory radiological outcome for comparison.

In comparison the unmatched cohort who underwent closed manipulation had poorer radiological results. The position of the fracture was deemed unacceptable in 17 patients $P = 0.013$ (Fishers exact).

At a mean time since surgery of 72 weeks (58–106) we have had four clinical complications (4/40). There was one case of carpal tunnel syndrome that required surgical release, one case of compartment syndrome necessitating fasciotomy at 1-day postoperatively. We had one infection which underwent removal of metalwork following fracture union and remained well afterwards. Only one patient who had a poor radiological outcome developed clinical symptoms, in the form of pain following fracture union with collapse of the fracture and development of osteoarthritis.

The group of patients ($n = 22$) referred for hand therapy demonstrated good clinical results by the 12-week follow up. The mean range of flexion was 56.5° (20–77) and extension was 57 (27–75) the flexion extension arc was 113.5° (60–150). The mean supination was 83.8 (10–90) with a mean pronation supination arc of 164.9° (20–180). The mean grip strength was 47.4 lb (12–110) (Table 2).

Fig. 4 Good postoperative result



Table 2 Postoperative range of movement

Case	F/E	P/S	R/U	Grip (lb)
1	65/65	90/90	30/20	40
2	75/75	90/90+	35/20	50
3	65/55	90/90	30/20	40
4	45/45	90/90	30/30	60
5	70/57	90/90	30/20	110
6	60/45	80/85	25/15	32
7	65/62	90/90	30/20	55
8	60/60	90/80	30/35	45
9	60/40	80/90	30/20	30
10	45/46	90/90	16/15	12
11	45/30	70/70	17/17	47
12	60/60	80/90	40/20	46
13	77/65	80/90	20/20	75
14	38/27	77/69	10/10	27
15	49/71	73/90	24/28	94
16	66/65	90/88	22/30	26
17	45/65	80/90	24/31	27
18	58/68	73/90	23/23	76
19	20/40	80/70	20/20	NR
20	73/74	90/90	32/27	35
21	49/66	90/90	19/39	39
22	54/73	90/90	19/39	30

F flexion, E extension, P pronation, S supination, R radial deviation, U ulna deviation, grip grip strength

At a mean time since surgery of 72 weeks (58–106) we have had four clinical complications (4/40). There was one case of carpal tunnel syndrome that required surgical release, one case of compartment syndrome necessitating fasciotomy at 1-day postoperatively. We had one infection which underwent removal of metalwork following fracture union and remained well afterwards. One patient with a poor radiological result developed severe pain and central carpal collapse.

Discussion

Our findings are the first to report on this particular implant and correlate well with other recent papers by Lozano-Calderón [13] and Chung [5] both demonstrating good radiological and clinical results with volar locking fixation of distal radius fractures. The various methods to treat this fracture have in the past failed to meet our clinical expectations hence the progression from simple manipulation and casting, through pin and plaster [10], K wiring, external fixation [2, 15] and now ORIF [5, 13, 16]. The results of treatment in plaster with manipulation from Bacorn [3]

demonstrated poor results associated with poor reduction, this correlates with Gartland's 1951 paper [9]. McQueen [14] demonstrated poor results of plaster immobilisation in elderly patients with late collapse of the fracture after the period of immobilisation had ended. The use of a fixed angle locking construct prevents this late collapse [18] and is one of the reasons for its growing popularity.

Open reduction is not without its problems and complications have been reported. Tendon irritation [11, 12], intra-articular screw placement [1] and infection have all been implicated. Our study shows a clinical complication rate of 10% (4/40) which is comparable to other recent reports of locking plates in the literature [17, 19] and lower than some [1]. We have had no cases of tendon irritation. The series includes our learning curve and this is demonstrated by the four cases of malreduction identified radiologically. Fortunately only one mal reduced fracture developed clinical symptoms as a consequence. Clearly not every fracture of the distal radius should be operated on; a decision must be taken based on the degree of displacement or deformity and the functional level of the patient. This study demonstrates that a good radiological and clinical outcome can be achieved with the use of volar locking plate fixation in angulated or displaced fractures with or without intra-articular disruption.

Our study has several limitations, the cases were consecutive presentations and the decision to treat with ORIF was taken by the treating surgeon on a case by case basis, this will inevitably lead to a selection bias. Despite this our results are encouraging and add to the growing body of evidence in favour of ORIF for distal radius fractures using a volar locking plate construct and provide the first reports in the literature using this specific plate system.

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