



## Complications after volar locking plate fixation of distal radius fractures



N.A. Johnson<sup>\*</sup>, L. Cutler, J.J. Dias, A.S. Ullah, C.J. Wildin, B. Bhowal

Leicester Royal Infirmary, Leicester, UK

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### SUMMARY

Volar locking plates are an increasingly popular treatment for distal radius fractures. We reviewed complications observed after volar locking plate fixation in a busy teaching hospital. The purpose of the study was to assess whether complication rates after volar locking plate use in general, routine trauma practice were higher than published literature from expert users.

A retrospective review was carried out of patients treated with a volar locking plate between January 2009 and December 2010. The series included 206 procedures in 204 patients (77 males and 127 females) with mean age of 55 years (range 16–94). Surgery was performed by 18 different consultant surgeons and 11 registrars.

A total of 22 complications were observed in 20 patients with an overall complication rate of 9.7%. Seven (3.4%) patients developed tendon problems including four (1.9%) tendon ruptures. Four (1.9%) patients required re-operation for metalwork problems; four patients developed complex regional pain syndrome (CRPS). Three fracture reduction problems were noted. A total of 16 further operations were carried out for complications.

The overall complication rate was low even when surgery was done by many surgeons, suggesting that this is a safe and reproducible technique. This study provides information which can be used to counsel patients about risks, including those of tendon and metalwork problems. This allows patients to make an informed decision. Surgeons must have specific strategies to avoid these complications and remain vigilant so that these can be identified and managed early.

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Wrist fractures are a common injury and with an ageing population the incidence is rising [1]. Six percent of women in the Western world will have suffered a distal radius fracture by the time they are 80 [2]. Volar locking plates were devised to allow direct reduction, solid fixation and early mobilisation of wrist fractures. The fixed angle construct provide a strong fixation in osteoporotic bone and comminuted fractures [3]. They exploit the anatomy of the volar distal radius and aim to avoid the soft tissue complications observed with dorsal plates. Early reports described few complications [4]. Subsequent studies have noted significant tendon and metalwork problems [5–7].

The purpose of this study was to carry out a review of complications observed after volar locking plate use in a typical general unit. In our centre, surgery is performed by a large number of surgeons of various grade and subspeciality. Much of the literature is from expert users in specialist centres [3,4].

Complication rates were compared to assess whether they were higher in this general trauma setting. This information can also be used to accurately discuss risks with patients prior to surgery and aid consenting.

### Materials and methods

A retrospective review was carried out of patients with a distal radius fracture treated with a volar locking plate in our institution between January 2009 and December 2010 inclusive. All patients of skeletal maturity managed this way were included.

Theatre books were reviewed to identify all suitable patients. As many as 208 procedures in 206 consecutive patients were identified. Two patients died after discharge from orthopaedic follow-up but were still included. Two patients did not attend follow-up and hence they were excluded from the study. The series included 206 procedures in 204 patients.

Surgery was carried out under general or regional anaesthesia with use of an arm tourniquet. Antibiotics were given according to local policy. A volar approach through the bed of the flexor carpi radialis was performed. The pronator quadratus was elevated to

<sup>\*</sup> Corresponding author at: Leicester Royal Infirmary, Orthopaedic Department, Infirmary Place, Leicester LE1 5WW, UK. Tel.: +44 0116 258 5657.

E-mail address: [nickjnajohnson@yahoo.co.uk](mailto:nickjnajohnson@yahoo.co.uk) (N.A. Johnson).

expose the volar distal radius. The fracture was reduced and held temporarily with k-wires according to the surgeon's preference. The plate was placed directly on to the radius and the position confirmed radiographically. Supplementary metalwork was used if considered appropriate for the specific fracture. Wound closure was according to the individual surgeon's preference. A plaster of Paris backslab was applied for pain relief. Mobilisation was started at 2 weeks unless there was an additional injury or concern regarding stability that prevented this.

Patients were followed up with serial radiographs and clinical assessment in the outpatients' clinic. Case notes were retrospectively reviewed for each follow-up attendance. The mean follow-up period was 36 months (range 24–48 months). All complications reported by patient or surgeon were recorded. All investigations or further interventions for complications were reviewed.

Fractures were grouped according to pre-operative radiographs as intra-articular or extra-articular. Volar tilt, radial inclination, radial height along with any intra-articular gap or step was measured on pre- and postoperative digital lateral and postero-anterior radiographs. Radiographic measurement was retrospectively carried out by a single observer.

Comparison between groups was performed with a *t*-test for parametric data and the Mann–Whitney *U* test for non-parametric data. The Chi-squared test was used for comparing nominal data.

## Results

Between January 2009 and December 2010, as many as 206 acute distal radius fractures in 204 patients were treated with volar locking plates. All surgery was performed by experienced orthopaedic registrars or consultant surgeons. The mean patient age was 55 years with a range from 16 to 94 years. There were 127 females and 77 males in the study group. A total of 109 fractures occurred in the left wrist with 97 on the right. The mean time to surgery was 8 days with a range from 0 to 36 days. As many as 67 fractures were extra-articular with 139 being intra-articular. Two types of plating systems were used: the VariAx plate (Stryker, Mahwah, NJ, USA) in 136 (66%) cases and the Aptus plate (Medartis, Exton, PA, USA) in 70 (34%) cases.

Five patients in the series were treated with combined volar locking plate and radial styloid plate to reduce a large displaced radial styloid fragment. Distal ulna fractures were treated in three patients with tension band wiring due to a large displaced ulna styloid fragment or concerns about distal radioulnar joint (DRUJ) stability during intra-operative examination.

A total of 176 cases were carried out by 18 different consultant surgeons and 30 cases by 11 orthopaedic registrars. Difficult fractures tended to be triaged towards the three hand consultants on the trauma rota who performed 115 of the procedures. Four upper-limb consultants and 11 orthopaedic consultants of other specialities carried out the other 61 consultant-led procedures.

A total of 22 complications were seen in 20 patients, with an overall complication rate of 9.7% (Table 1). Four patients developed a CRPS and were referred to a pain specialist for further treatment.

**Table 1**  
Complications of volar locking plate surgery.

Complication	Number of cases
Tendon	7
Metalwork	4
Fracture reduction	3
CRPS	4
Wound	1
Nerve	1
Other	2

The mean time to diagnosis was 15 weeks with a range of 3–38 weeks. One superficial wound infection was observed 2 weeks postoperatively. This was successfully treated with a course of oral antibiotics. One patient developed an acute carpal tunnel syndrome 1 day postoperatively. This was treated with emergency decompression of the carpal tunnel with evacuation of haematoma.

Seven (3.4%) patients developed tendon problems including four (1.9%) tendon ruptures. Extensor pollicis longus (EPL) rupture was observed in three patients and a flexor pollicis longus (FPL) rupture in one patient. Three tendon ruptures were treated with removal of metalwork and tendon transfer. An extensor indicis pollicis-to-EPL transfer was performed for the two EPL ruptures treated operatively. The FPL rupture was reconstructed using a palmaris longus graft. One elderly patient refused further surgery due to minimal loss of function and was treated conservatively. All three EPL ruptures were diagnosed within 8 weeks of fracture fixation. The single FPL rupture was identified nearly 12 months after surgery. Three patients had exploration of tendons due to loss of function. Tenosynovitis of FPL was observed in two patients and EPL tenosynovitis secondary to a prominent screw in the third patient. There was no tendon rupture. All metalwork was removed. In all three cases with FPL problems, the volar plate was observed to be prominent and distally placed intra-operatively. One of the EPL ruptures was secondary to a prominent screw tip, whilst in the other case there was residual dorsal displacement of the fracture impinging on the tendon.

Problems with fracture reduction or displacement were observed in three (1.5%) cases. Two fractures had a large radial styloid fragment, which follow-up radiographs showed had displaced (Fig. 1). In both cases, revision surgery was performed with a radial styloid plate to reduce and hold this fragment. One patient with an extra-articular fracture was initially fixed with significant radial translation and hence underwent revision surgery.

Four (1.9%) patients required re-operation for metalwork problems. Two patients with intra-articular fractures treated with a volar locking plate and supplementary radial styloid plates had ongoing problems with pain and limitation of movement despite extensive physiotherapy. Both underwent removal of all metalwork with subsequent improvement in their symptoms. One patient was noted to have a screw in the radiocarpal joint and one patient had a screw into the DRUJ (Fig. 2). Both patients were treated with removal of this single screw only.

Two (1%) patients with large ulna styloid fragments treated with tension band wiring along with volar locking plates for a distal radius fracture (Fig. 3) developed pain and tenderness over the prominent ulna metalwork. The ulna metalwork was removed but the volar locking plate was left *in situ*.

No significant difference in complication rates was demonstrable for age of patient, grade of surgeon, time to surgery and type of plate. The VariAx system was used in 70% of those with complications and in 74% of those with no complications ( $P = 0.96$ ). The mean patient age was 49 (range 30–70) in the complication group compared to 53 (range 16–94,  $P = 0.29$ ) in the non-complication group. Patients in the complication group waited for a mean of 6 days (range 2–18) to surgery compared to 8 days (range 0–36,  $P = 0.30$ ) for those without complications. Hand surgeons carried out 50% of the cases in the complication group and 63% of the cases in the non-complication group ( $P = 0.76$ ).

Analysis of radiographs showed similar fracture characteristics. No significant difference was found between any pre-operative radiologically measured parameter (Table 2). Seventy percent of fractures in the complications group were intra-articular and 75% were dorsally angulated compared to the no complications group

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