



## Original Article

# Percutaneous pinning versus volar locking plate fixation for dorsally displaced distal radius fractures- reoperation rates over an eight year period

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## ABSTRACT

**Purpose:** To compare reoperation rates between closed reduction with percutaneous pinning (CRPP) and internal fixation with a volar locking plate (VLP) for the treatment of distal radius fractures.

**Methods:** A retrospective review of all patients with dorsally displaced distal radius fractures presenting to a hospital over an eight-year period.

**Results:** 1364 procedures were reviewed after applying the exclusion criteria; 663 underwent CRPP and 701 underwent VLP. The results showed that CRPP had higher rates of revision surgery due to fixation failure than VLP ( $p = 0.003$ ), however there was no statistical significance in overall reoperation rates when all complications were considered ( $p = 0.060$ ). This was due to higher rates of tendon related problems ( $p = 0.003$ ), neurological complications ( $p = 0.005$ ) and hardware removal ( $p = 0.01$ ) in the VLP group.

**Conclusion:** Overall reoperation rates were similar between both techniques however there were differences in complication profile and nature of revision surgery. This information is useful when discussing treatment options with patients to help guide selection of the best procedure for that individual.

## 1. Introduction

Fractures of the distal radius are among the most common fractures seen by orthopaedic surgeons, accounting for up to 25% of fractures presenting to hospital.<sup>1–3</sup> The incidence of distal radius fractures increases with age, particularly in the female population due to osteoporosis.<sup>4</sup> The overall lifetime risk for a 50-year-old female to sustain a distal radius fracture (DRF) is estimated to be 16.6% versus 2.9% in a man of the same age.<sup>5</sup> As the population continues to age in developed countries, the incidence of a DRF is expected to increase.<sup>6</sup> This is likely to have significant cost implications for the National Health Service (NHS).

Fractures of the distal radius are either treated conservatively with reduction in plaster or, if anatomical alignment cannot be maintained, by operative fixation. Surgical fixation carries inherent risks for the patient and substantial cost implications for the health service. Two commonly adopted fixation methods for fractures of the distal radius are closed reduction with percutaneous pinning (CRPP) and volar locking-plate (VLP) fixation.<sup>7</sup> The main advantages of CRPP over VLP are the less invasive approach, lower economic cost and relative ease of procedure. The disadvantages are pin tract infection, mechanical failure of wires, prolonged immobilisation in a cast and adjacent joint stiffness. The theoretical advantages of VLP are optimal restoration of wrist

anatomy, direct visualisation of the fracture site, early functional recovery and maintenance of achieved reduction. Drawbacks include tendon injury, implant cost, hardware failure and removal, complex regional pain syndrome and carpal tunnel syndrome.<sup>8</sup> The theoretical advantages caused a rapid uptake of this technique shortly after its introduction and the rates of VLP increased as reported in the literature.<sup>9</sup>

There has been much debate regarding the relative efficacy of each technique. The VLP has recently become popular as it allows direct anatomical fracture reduction and fixation with early mobilisation. A number of studies have been undertaken to assess outcomes following CRPP versus VLP.<sup>10–13</sup> These studies have reported better radiological outcomes following VLP and improved early functional outcome in some cases. A study comparing the cost of each of these procedures estimated that each operation costs £662 for CRPP and £2212 for VLP.<sup>14</sup> Another study estimated that the total NHS resource cost to be £3,385 and £4,288 respectively, not including the social costs of each of the procedures.<sup>15</sup>

Most current studies focus on overall complication rates of one fixation method and have been limited by relatively small sample groups, powered to detect differences in patient reported outcomes measures (PROMs). There is currently a lack of large scale, pragmatic, observational studies that compare reoperation following CRPP and

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**Table 1**

Prevalence of complications in CRPP compared with VLP group resulting in reoperation (relative risk represents VLP vs CRPP ratio).

Revision Surgery Type	CRPP (n = 663)	VLP (n = 701)	P Value	Relative Risk (95% CI)
Loss of position-revision	27 (4.1%)	10 (1.4%)	P = 0.003	0.35 (0.17–0.72)
Tendon attrition/rupture	0 (0%)	9 (1.3%)	P = 0.003	17.0 (0.99–293)
Neurological symptoms	1 (0.2%)	11 (1.6%)	P = 0.005	10.4 (1.35–80.4)
Hardware complications	6 (0.9%)	19 (2.7%)	P = 0.010	3.00 (1.2–7.45)
DRUJ instability	0 (0%)	3 (0.4%)	P = 0.200	5.68 (0.28–13)
Vascular Injury	0 (0%)	1 (0.1%)	P = 0.700	1.89 (0.06–56.2)
Delayed wound closure	0 (0%)	1 (0.1%)	P = 0.710	1.89 (0.06–56.3)
Infection/haematoma	2 (0.3%)	2 (0.3%)	P = 0.960	0.96 (0.13–6.69)
Total	36 (5.4%)	56 (8.0%)	P = 0.060	1.47 (0.98–2.21)

VLP. A recent randomised controlled trial by Costa et al. did include complication rates of both fixation methods and demonstrated no significant differences in complications and also in functional outcome. Reoperation rates after VLP have been reported as up to 15% in some studies and 6% for CRPP.<sup>16,17</sup>

The aim of this study was to examine the prevalence of complications leading to reoperation in patients undergoing CRPP and compare it with those undergoing VLP. The secondary aim was to investigate the change in incidence of each procedure over a period of time.

## 2. Material and methods

### 2.1. Study design

This was a retrospective study performed at a University Teaching Hospital that provided orthopaedic cases to a metropolitan population of approximately 340,000 people. Referrals to the orthopaedic department came from an Emergency Department and a separate Minor Injuries Unit.

### 2.2. Search strategy

An electronic patient record database (“Bluesprier”) prospectively recorded data on all referrals to fracture clinic, along with operative records. This included demographic details, along with the anatomical location and nature of the injury. This database was retrospectively examined to identify all patients presenting with a fracture of the distal radius. All trauma cases presenting to hospitals within the local healthboard are included in this database.

### 2.3. Ethical approval

As this was classed as an observational study of routinely collected prospective data for audit purposes, research ethics committee (REC) was not required or sought. Approval was granted from the institution’s “Caldicott” guardian for permission to review patient records for audit purposes.

### 2.4. Inclusion and exclusion criteria

The inclusion criterion was any patient, aged 18 or over, who sustained an intra-articular or extra-articular distal radius fracture and underwent either CRPP or VLP during the study period. All pins included in the CRPP technique were 1.6 mm Kirschner wires as per standard AO technique. The type of VLP used for this study was the Stryker Variax VLP. Patients under the age of 18 were excluded from the study, along with fractures of the radius more than 3 cm from the joint line and open injuries. Compound fractures or fractures with volar displacement or an associated fracture of the ulnar diaphysis were also excluded. Furthermore, patients were excluded if they underwent a method other than a Variax volar locking plate (dorsal or radial plates, buttress plates, the use of multiple plates for fracture stabilisation or

external fixators). The electronic records of the remaining patients were examined to determine the frequency and nature of revision surgery.

### 2.5. Statistical analysis

Statistical analysis was undertaken using SPSS v 24 (SPSS Inc., Chicago, Illinois.) Chi-square test was used to determine whether there was a statistically significant difference in the reoperation rates between the two groups and also rates of common complications. We also presented the odds ratio and 95% confidence intervals for reoperation rates and for the rates of common complications that needed revision.

## 3. Results

There were 2185 procedures for a fracture of the radius performed between April 2008 and August 2016 were found. After applying the exclusion criteria, there were 1364 procedures in 1345 patients. A total of 663 of the procedures were managed by CRPP (mean age 50.7 (18–94) SD 17.3, 504 of whom were female) and 701 by VLP (mean age 56.5 (18–92) SD 17.1, 549 of whom were female). The mean follow-up period was 210.1 weeks (4–440 weeks) and the procedures were performed under the care of 24 different consultants.

Overall, 36 (5.4%) procedures required further surgery in the CRPP group compared with 56 (8.0%) procedures in the VLP group ( $p = 0.06$ ) (Table 1). There were a greater number of cases in the CRPP group (27, 4.1%) that required early revision for loss of fixation compared with the VLP group (10, 1.4%) (RR 2.86, 95% CI 1.39–5.85,  $p = 0.003$ ). In the CRPP group, the 27 patients with loss of fixation all underwent revision to VLP with 5 of these undergoing corrective osteotomies. In the VLP group, 10 patients underwent revision to another VLP with 5 undergoing corrective osteotomies for the same reason. In the VLP group 19 patients required revision surgery for hardware complications including loosening, prominence or malpositioning of hardware. In the CRPP group, 6 patients required revision surgery for this reason most commonly because of buried wires. Where there were 11 cases of carpal tunnel that required surgery in the VLP group, no cases in the CRPP group underwent revision surgery for this reason ( $p = 0.010$ ). There were 9 patients in the VLP group which required revision surgery for tendon attrition or rupture while there were none in the CRPP group ( $p = 0.003$ ). These involved 4 extensor pollicis longus ruptures and 2 flexor pollicis longus ruptures. In all these cases of tendon rupture, the treatment was implant removal and tendon transfer. There were other, less common reasons for return to theatre. Vascular injury (iatrogenic injury to the radial artery) occurred in 1 patient in the VLP group. Rates of wound problems requiring a return to theatre were low in both groups. A small number of patients in the VLP group returned to theatre because of residual instability in the distal radioulnar joint and one patient in this group returned to theatre for delayed wound closure because of intraoperative swelling during the primary procedure. There were no statistically significant differences between the rates of these complications in the two groups.

The proportion of procedures that were CRPP fell until 2013, where

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