Complications of Volar Locking Plates for Distal Radius Fractures: Experience of a District General Hospital

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Citation

Abstract
Background: The role of volar locking plates in the treatment of distal radial fractures is unsettled. The objective of this study is to evaluate the complications of this treatment method in a district general hospital setting.

Methods: We retrospectively reviewed the radiological and clinical records of 52 consecutive patients who were treated using volar locking plates between November 2004 and August 2006.

Results: Forty-eight patients were available for review at an average follow-up of 14 months (6-26 months). Fifteen patients had one or more complications; median nerve compression symptoms (nine patients), hard-ware related complications (four patients), superficial wound infection and stitch abscess (three patients), malunion (two patients), failure of fixation and loss of reduction (two patients) and complex regional pain syndrome (two patients). A total of seven re-operations were performed.

Discussion & Conclusions: Due to the high complication rate in this study, we recommend a more reserved attitude toward the use of distal radial volar locking plates.

INTRODUCTION
Distal radius fractures are the commonest upper limb fractures occurring in the elderly. Treatment options range from closed methods and cast immobilisation to percutaneous K wires, external fixator or open reduction and internal fixation via either a dorsal or volar approach. There is no consensus with regards to the optimal management of these fractures. Recently, volar locking plates have gained popularity for the treatment of these fractures but their role remains unsettled. Although some studies reported favourable outcomes with low complication rates, those were carried out in hand surgery centres. The purpose of this study is to evaluate the complications associated with the use of volar locking plates for distal radius fractures in a district general hospital setting.

MATERIALS AND METHODS
We conducted a review of all patients with distal radius fractures treated at our institution by open reduction and internal fixation using volar locking plates between November 2004 and August 2006. All other distal radial fractures which were treated non-operatively or operatively with a different fixation method were excluded. Charts were reviewed for demographic information, details of operative treatment, follow-up care and complications. Standard preoperative antero-posterior and lateral radiographs were reviewed to classify the fractures using the AO classification system and postoperative radiographs were reviewed for the evaluation of fracture alignment.

The procedure was performed under general anaesthetic in all cases except one where regional anaesthesia was used. Our standard practice was preoperative prophylactic intravenous cefuroxime and usage of tourniquet and bipolar diathermy for hemostasis. The radial styloid fragment was approached initially using an incision centred longitudinally over the flexor carpi radialis (FCR) tendon and then dissection between the flexor carpi radialis tendon and radial artery was performed. The Parona’s space underneath the
flexor tendons was developed and the distal and radial borders of pronator quadratus were lifted and retracted ulnarily. None of the patients had bone grafting. The plate used was I.T.S. (Forth Medical Ltd, UK) volar locking plate system. Image intensifier was used in theatre to assist the evaluation of fracture reduction and fixation. Typically, the wrist was immobilised in a below elbow splint. The patient was allowed to start wrist movements at the surgeon's discretion out of immobilisation at an average of three weeks postoperatively.

RESULTS
Fifty-two patients were identified during the study period. Four patients were lost to follow-up; three of them did not live locally and were followed-up at their local hospitals and one patient was noncompliant and refused to attend any follow-up appointments. Forty-eight patients were followed for a minimum of six months (mean 14 months, range 6-26 months) and comprised the study population. The mean age of the patients was 56 years +/- 19.5 (range, 18-90 years). Thirty were women and eighteen were men.

The operation was performed by a consultant in twenty-three cases, a trainee specialist registrar under supervision in eleven cases and a trainee specialist registrar without supervision in fourteen cases.

The timing of the operation was within two days of injury in forty patients. Six patients had their operations between the third and seventh day post-injury. The remaining two patients had their fractures fixed within two weeks of injury, one was initially managed with an external fixator and the other had an initial trial of non-operative management.

All the fractures were closed injuries except for one which was a grade one open fracture. Two patients had associated fractures of the ipsilateral neck of femur.

Fractures classified according to the AO classification are documented in Table 1. Preoperative radiographs for five patients were not available for review.

<table>
<thead>
<tr>
<th>AO type</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>7</td>
</tr>
<tr>
<td>A3</td>
<td>6</td>
</tr>
<tr>
<td>B3</td>
<td>2</td>
</tr>
<tr>
<td>C1</td>
<td>2</td>
</tr>
<tr>
<td>C2</td>
<td>15</td>
</tr>
<tr>
<td>C3</td>
<td>11</td>
</tr>
</tbody>
</table>

Thirty-three patients had uneventful postoperative period. Fifteen patients suffered twenty two complications; nine patients developed one complication, five patients developed two complications and one patient developed three complications.

COMPLICATIONS

MEDIAN NERVE COMPRESSION SYMPTOMS
Nine patients developed median nerve compression symptoms. The mean time of onset of symptoms was six week postoperatively (range, 3 days - 16 weeks). Five patients fully recovered from their symptoms without requiring operative intervention. Four patients underwent carpal tunnel release either alone or along with other procedures. The carpal tunnel release was performed at 3 days, 1, 4 and 6 months postoperatively. All four patients recovered from their symptoms after the carpal tunnel release.

HARD-WARE RELATED COMPLICATIONS
Four patients had hard-ware related complications. Three patients developed skin irritation at the wrist as a result of a prominent plate; two of them required removal of the implants (Figure 1). In one patient, a screw backed out and the patient presented with median nerve irritation symptoms which required removal of the metal work and carpal tunnel release.
Malunion

Loss of alignment and fracture malunion occurred in two patients. One patient healed with marked valgus angulation at the fracture site. In another patient, the fracture settled resulting in loss radial length (Figure 2). In both cases the deformity was accepted and neither of them underwent further operations.

Failure of Fixation

Two patients suffered loss of reduction and failure of fixation. In the first case, there was volar subluxation of the carpus on the radius. In the second patient, there was dorsal angulation at the fracture site with separation of the distal radius bony fragment from the plate and one of the screws was broken. Both patients required revision surgery.

Wound Complications

A superficial wound infection occurred in two patients; both were successfully managed with oral antibiotics. One patient developed a stitch abscess which settled after removal of the suture material.

Complex Regional Pain Syndrome (CRPS)

Two patients presented with symptoms of CRPS at two and four months postoperatively. One patient had already undergone median nerve decompression on the third postoperative day. The other patient had median nerve decompression at the same time of initial surgery and subsequently required revision surgery.
There was a higher incidence of complications when a consultant was present during the operation (35% vs. 21%) but the difference was not statistically significant. (p = 0.5). Table 2 documents the incidence of complications by surgeon’s grade.

**Figure 4**

Table 2: Complications by Surgeon’s grade

<table>
<thead>
<tr>
<th>Surgeon grade</th>
<th>No of Patients</th>
<th>No of patients who developed complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultant</td>
<td>23</td>
<td>7</td>
</tr>
<tr>
<td>Supervised Trainee</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Unsupervised Trainee</td>
<td>14</td>
<td>3</td>
</tr>
</tbody>
</table>

Overall, seven patients required repeat surgical procedures because of the complications. Re-operations are documented Table 3.

**Figure 5**

Table 3: Re-operations

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal of metal work</td>
<td>2</td>
</tr>
<tr>
<td>Carpal Tunnel Release &amp; removal of metal work</td>
<td>2</td>
</tr>
<tr>
<td>Carpal Tunnel Release</td>
<td>1</td>
</tr>
<tr>
<td>Revision, application external fixator &amp; Carpal Tunnel Release</td>
<td>1</td>
</tr>
<tr>
<td>Revision &amp; application external fixator</td>
<td>1</td>
</tr>
</tbody>
</table>

**DISCUSSION**

A number of available studies report on the complications of volar locking plates. The rate of complications reported varies from 8% to 32% \(^{12,5,7,10}\). The global complication rate in our study (22 complications in 48 cases) is higher than noted in other reports especially reports from specialised hand surgery centres, such as that of Chung \(^2\) and Rampoldi \(^7\). Table 4 documents the complication rates reported in the literature.

**Figure 6**

Table 4: Complication Rates

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of cases</th>
<th>Complications (rate %)</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wong et al (^10)</td>
<td>26</td>
<td>7 (22%)</td>
<td>Orthopaedics, Traumatology, Department General Hospital</td>
</tr>
<tr>
<td>Drobetz et al (^5)</td>
<td>59</td>
<td>15 (25%)</td>
<td>Department of Trauma Surgery, General Hospital</td>
</tr>
<tr>
<td>Chung et al (^2)</td>
<td>87</td>
<td>9 (10%)</td>
<td>Plastic, Hand Surgery, Sidde University Hospital</td>
</tr>
<tr>
<td>Rampoldi et al (^7)</td>
<td>60</td>
<td>7 (12%)</td>
<td>Hand Surgery Unit, Trieste Centre</td>
</tr>
<tr>
<td>Azzoll et al (^1)</td>
<td>225</td>
<td>31 (22%)</td>
<td>Department of Trauma Surgery, Level I, University Centre</td>
</tr>
</tbody>
</table>

We had an especially high rate of median nerve compression symptoms (9/48) with four patients requiring carpal tunnel decompression. The incidence of median nerve compression neuropathy following conservatively treated distal radius fractures has been reported as 4.2% \(^6\). Chung et al \(^2\) studied eighty-seven patients and reported that only one patient developed median nerve compression symptoms that required nerve decompression. Wong et al \(^10\) reported that two of thirty patients developed carpal tunnel syndrome soon after injury and were treated conservatively. Our surgical approach could have resulted in neurapraxia of the median nerve as a result of excessive traction. Modifying our approach so as to dissect between the FCR tendon and the median nerve instead could have reduced the incidence of this complication. We also reported all the cases with transient symptoms that recovered spontaneously. This also could have contributed to the high incidence of median nerve compression symptoms in this study.

The incidence of hardware related complications was higher than other studies. The prominent radial end of the plate at the wrist caused skin irritation in three patients. Rupture of flexor tendons because of prominent plates is another potential complication \(^3,8\). None of the investigators in Table 3 reported skin irritation from prominent plates requiring removal of metal work.

Two of the cases in this study were complicated by failure of fixation and loss of reduction requiring revision surgery. The first case was of a highly comminuted fracture (AO type C3) in an eighteen years old male patient which was operated within 24 hours of injury. The loss of reduction was noted on the first follow-up visit at two weeks. The patient developed median nerve compression symptoms as well. He underwent revision and application of external fixation along with carpal tunnel release at four weeks postoperatively.

The second case was of an AO type A3 fracture in a fifty-four years old female patient who had median nerve compression symptoms at the time of injury. The operation (volar plating and carpal tunnel release) was performed within 24 hours of injury. The patient developed superficial wound infection which was successfully treated with oral antibiotics. Loss of reduction and failure of fixation developed after she started mobilisation out of plaster. Vigorous physiotherapy at an early stage and osteoporosis could have contributed to the outcome. The patient underwent revision surgery and bone grafting after six months of the index procedure. Rampoldi et al \(^7\) reported one case in their study that required repeat internal fixation after loss of reduction. Similar complications were not reported by the other investigators in Table 3.

There were two cases of CRPS in this study, which is comparable to the rate reported by other investigators such as Arora \(^1\) (5 cases in 114 fractures) and Drobetz \(^5\) (3 cases in 50 fractures). The incidence of CRPS in conservatively
treated distal radius fractures was reported as 1% \(^6\) .

There were no cases of tendon irritation or rupture in our study. This is interesting as other researchers reported complications related to tendon irritation or rupture as the commonest complication. Drobetz et al. reported seven cases of flexor or extensor tendon rupture and one case of tendon adhesions in their study \(^5\) . Five of these cases required repeat operations for repair or tenolysis. More than half of the complications in Arora et al. study were tendon ruptures or tenosynovitis with an incidence of 16% \(^1\) . Careful drilling and choice of screw length is important to avoid these complications.

Our study has several weaknesses, particularly in that it is a retrospective review. In addition, our patient population was heterogeneous in terms of their age and type of fracture.

However, this study raises concerns that the use of volar locking plates for distal radius fractures is not as safe as results from specialised centres suggest. The complication rate in this study was higher than reports from other centers. Due to the high complication rate, we recommend a more reserved attitude towards distal radius volar locking plates.

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References

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