FUNCTIONAL OUTCOME OF INTRAARTICULAR DISTAL RADIUS FRACTURE TREATED WITH OPEN REDUCTION AND INTERNAL FIXATION WITH DORSAL PLATE

Umash Karki¹, Shishir Lakhey², Rajeev Raj Manandhar³
¹Department of Orthopaedics, Nepal APF Hospital, Balambu, Kathmandu, Nepal
²Department of Orthopaedics, Nepal Mediciti Hospital, Kathmandu, Nepal
³Department of Orthopaedics, Kathmandu Medical College and Teaching Hospital, Sinamangal, Kathmandu, Nepal

ABSTRACT

Background: Distal radius fractures are among the most common fractures and there is considerable disparity among surgeons regarding the best way to treat these patients. Intraarticular fractures are treated with open reduction and internal fixation with either dorsal or volar plates. Dorsal plating is not much popular due to its reported complications of extensor tendon irritation and rupture. We conducted this study to assess the functional outcome of dorsal plating in intraarticular distal radius fractures.

Methods: A clinical prospective observational study was conducted at Kathmandu Medical College, Sinamangal. A total of 26 patients (male: 14; female: 12) of intraarticular distal radius fractures were enrolled and underwent open reduction and internal fixation using the dorsal plate. The functional outcome of dorsal plating was measured at 3 weeks, 3 months and 6 months follow up.

Results: All patients achieved a functional range of motion, with greater than 50 degrees of wrist flexion, 25 degrees of wrist extension, and 60 degree arc of pronation and supination. The functional outcome measured was found to be good to excellent with a mean Mayo Wrist score of 89.23 (75-100) and Quick Dash-9 score of 9.20 (2.75 to 22). There were 3 cases of extensor tendon irritation, which completely resolved and no cases of extensor tendon irritation at final follow up.

Conclusions: Dorsal plating is a safe and effective way of treating intraarticular distal radius fractures with good functional outcome.

INTRODUCTION

Distal radius fracture is one of the common injuries among adults and elderly encountered in emergency departments and comprises of up to 20% of all fractures.¹, ² The intraarticular fractures that heal with articular incongruity result in post-traumatic arthrosis.³ Displaced unstable intraarticular fractures are treated with reduction and fixation in anatomical position to maintain the articular congruity and hence decrease the chance of arthrosis.²,³ It is now generally accepted that the restoration of radial length, volar and radial tilt as well as articular congruency is required for the best chance of good functional outcome.⁴ The determination of the surgical approach is based on the initial displacement of the fracture.

Plating can be performed via a dorsal or volar approach.³ The choice of surgical approach depends on the location and direction of displacement of the fracture fragments. A displaced fracture of the volar rim is easily approached via a volar approach, whereas for dorsally displaced fragments, a dorsal approach is more beneficial. Benefits of the dorsal surgical approach include the potential for direct reduction and assessment of articular alignment, evaluation and management of concomitant intrinsic inter carpal ligament injury.¹ Both locking and non-locking plates are used for dorsal plating in distal radius intraarticular fractures. Non locking plates are cheaper and has the advantage of changing the angles of the screw during fixation.

This study was conducted to evaluate the outcome of dorsal non-locking plating of the intraarticular distal radius fractures.

METHODS

It was a hospital based prospective observational study conducted at the Department of Orthopaedics, Kathmandu Medical College, Sinamangal. Ethical clearance was obtained from the Institutional Review Committee of Kathmandu Medical College.

After obtaining written informed consent, a total of 26 patients were enrolled for the study meeting the inclusion criteria of...
Table 1: Incidence of various complications across different follow up times (n=26)

<table>
<thead>
<tr>
<th>Time</th>
<th>Nerve injury</th>
<th>Extensor tendon irritation</th>
<th>Infection</th>
<th>CRPS</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of injury</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 weeks Post-op</td>
<td>0</td>
<td>3 (11.5%)</td>
<td>1 (3.84%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6 weeks</td>
<td>0</td>
<td>1 (3.84%)</td>
<td>1 (3.84%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 months</td>
<td>0</td>
<td>1 (3.84%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6 months</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

intra articular fractures AO Type B1, B2, C1, C2 presenting within 2 weeks of injury. Volar Barton fracture, severely comminuted fracture, metabolic diseases, bilateral fracture, ipsilateral upper extremity injury and with nerve and vascular injury and contralateral wrist arthritics and with prior history of wrist injury were excluded from the study.

Proper history taking and clinical examination was done and the patient was taken up for surgery explaining all the possible complications. Standard dorsal approach was used and the fracture was fixed with a non-locking T plate. The patient were followed up at 6 weeks, 3 months and 6 months. The wrist range of motion was measured with the help of a goniometer and the functional outcome was measured using Mayo Wrist Score and Quick DASH-9 during each follow up.

Data entry was done in Microsoft Excel and analyzed in SPSS version 20. Mayo wrist score, Quick DASH-9 score and wrist range of motion were calculated and compared with the normal wrist. The occurrence of any complications was noted and analyzed for statistical significance. Independent sample t-test for comparison of means was used. p value was set at below 0.05.

RESULTS

Out of 26 patients that were taken for this research study, 14 (53.8%) patients were male and 12 (46.2%) patients were female. The mean age of the patient that suffered from distal radius fracture was 43.88 years with minimum being 18 years and maximum age being 73 years old. Patients from different occupational background were part of this research study, with housewife being the dominant one (30.7%) and students being the second dominant one (19.2%). Out of 26 patients involved in this research study, 22 (84.6%) distal radius fractures resulted from fall on outstretched hand, 3 (11.5%) from road traffic accident and 1 (3.8%) from sports related injury. Dominant side of limb (right) was fractured in 15 patients (57.7%) and non-dominant side (left) in 11 patients (42.3%).

Radiographs of the patients were used for classification of the fracture patterns. Out of 26 patients, 14 people (53.8%) had AO C1 type fracture, 9 people (34.6%) had AO C2 type fracture, 2 cases (7.7%) had AO B1 fracture and 1 patient had AO B2 type fracture.

Regarding the complications, there was no incidence of extensor tendon irritation at time of injury in any of the patients. However, 3 out of 26 patients i.e. 11.5% cases had extensor tendon irritation in post-op examination at 3 weeks which resolved completely in final follow ups.

One patient (3.8% cases) had a superficial wound infection during post-op examination and was treated with oral antibiotics and pin tract care. The infection persisted until 6 weeks follow up examination. In subsequent follow up examination at 3 months, the patient was free of infection. No incidence of complex regional pain syndrome (CRPS) was noted in any of the patients.

Apart from the above-mentioned complications, no other complications were seen at any point of time. There were no cases of delayed tendon rupture. There were no instances of delayed or nonunion. The incidence of overall complication at different point of time is summarized in Table 1.

All patients achieved a functional range of motion, with greater than 50 degrees of wrist flexion (average value of 64.77 degrees), 25 degrees (average value of 58.50 degrees) of wrist extension, and 60 degree arc of pronation (average value of 71.69 degrees) and supination (average value of 72.62 degrees).

While comparing the injured wrist with the uninjured wrist, there was loss in degrees of flexion, extension, arc of pronation and supination and radial and ulnar deviation. The summary of comparison of the injured and uninjured wrist ROM at final follow up is shown in Table 2. This indicates that the major loss of range was in flexion followed by extension. Statistically, the independent sample t-test that was applied for this analysis showed a significant difference between injured and uninjured wrist in terms of range of motion however the functional outcome proved to be good in all patients by the value of Mayo wrist score and DASH score.

Table 2: Comparison of wrist ROM between the injured and uninjured wrist at final follow up

<table>
<thead>
<tr>
<th>Wrist ROM</th>
<th>Injured wrist</th>
<th>Uninjured wrist</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td>64.77±7.63</td>
<td>76.65±6.15</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Extension</td>
<td>58.50±11.60</td>
<td>74.50±6.93</td>
<td>0.006</td>
</tr>
<tr>
<td>Supination</td>
<td>72.62±6.54</td>
<td>83.88±3.91</td>
<td>0.009</td>
</tr>
<tr>
<td>Pronation</td>
<td>71.69±7.29</td>
<td>83.04±5.45</td>
<td>0.009</td>
</tr>
<tr>
<td>Radial deviation</td>
<td>17.35±1.93</td>
<td>21.31±1.82</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ulnar deviation</td>
<td>21.85±2.52</td>
<td>29.81±2.84</td>
<td>0.004</td>
</tr>
</tbody>
</table>

The functional results, at the final follow-up, according to the Mayo wrist score were either excellent or good. Similarly, QuickDash-9 score also showed excellent or good functional
outcome in the patients. Mean Mayo wrist score improved progressively in subsequent follow ups as shown in Table 3.

Table 3: Mayo wrist score for injured joint at different follow-ups 
(n=26)

<table>
<thead>
<tr>
<th>Time</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 weeks</td>
<td>55.38 ± 3.98</td>
</tr>
<tr>
<td>3 months</td>
<td>71.15 ± 4.07</td>
</tr>
<tr>
<td>6 months</td>
<td>89.23 ± 4.62</td>
</tr>
</tbody>
</table>

Similarly, mean QuickDASH-9 score for injured joint gradually decreased which implies a gradual improvement in functional outcome as shown in Table 4.

Table 4: QuickDASH-9 score for injured joint at different follow-ups 
(n=26)

<table>
<thead>
<tr>
<th>Time</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 weeks</td>
<td>45.03 ± 12.10</td>
</tr>
<tr>
<td>3 months</td>
<td>22.28 ± 6.99</td>
</tr>
<tr>
<td>6 months</td>
<td>9.20 ± 3.29</td>
</tr>
</tbody>
</table>

DISCUSSION

Distal radius fractures with metaphyseal comminution usually collapse in dorsal direction and dorsal plating provides structural support in the direction of collapse. Dorsal approach has the advantages of ease of dissection, visualization of entire articular surface for fracture reduction and dorsal buttressing. However due to the fear of complications like extensor tendon irritation and rupture, dorsal plating is not widely used. In our study, we obtained a very good functional outcome and wrist range of motion with very few complications.

All our patients achieved a functional range of motion, with greater than 50 degrees of wrist flexion (average value of 64.77 degrees), 25 degrees (average value of 58.50 degrees) of wrist extension, and 60 degree arc of pronation (average value of 71.69 degrees) and supination (average value of 72.62 degrees). A few degree loss in the range of motion showed a statistical significant p value however the functional outcome was good in all patients.

Our results are comparable and even superior to those obtained by Ring et al where they obtained an average wrist flexion of 40 degrees (61% of contralateral side), extension of 45 degrees (64% of contralateral side), pronation of 76 degrees (94% of contralateral side) and supination of 65 degrees (81% of contralateral side), radial deviation of 14 degrees (range 0 to 30 degrees, 72% of contralateral wrist) and ulnar deviation of 21 degrees (range 5 to 30 degrees, 74% of contralateral side). Our results are similar to those obtained by D. A. Campbell where they obtained a median recovery of 60% of wrist extension and 90% of forearm supination. They obtained an average wrist flexion of 40 degrees (range 20 to 80 degrees), average extension of 60 degrees (range 30 to 90 degrees), average supination of 90 degrees (range 50 to 90 degrees) and average pronation of 90 degrees (range 40 to 90 degrees). Wrist extension and flexion were similar to those in the study done by Carter et al but the supination and pronation were lower in our study, however the flexion and extension arc when compared in percentage of uninjured wrist was similar in our study (81.5% of uninjured wrist) and their study (82% of uninjured wrist). One of the goals of the dorsal plate is to treat complex fractures of the distal radius easily while minimizing complications like extensor tendon irritation and rupture thus making this procedure an attractive procedure. We had a very few complications as compared to similar studies in the literature.

There were 3 cases of extensor tendon irritation and 1 case of wound infection. However, at final follow up, their problems had resolved. Nerve complications and complex regional pain syndrome (CRPS) was not noted in any of the patients.

Our overall complication rate is lower or comparable to other series using internal dorsal plate fixation method. Different studies show that complication rates are often high with the dorsal exposures. Axelrod and McMurtry found 15% early and 35% late complications, including five cases of extensor tenosynovitis. However, in our study, 3 cases (out of 26) had extensor tendon irritation and 15.38% complication rate. Jupiter and Lipton, found problems with the wrist extensors after dorsal fixation, noting one EPL rupture and one case of extensor tenosynovitis. Likewise, Hove et al found two cases of EPL rupture in a group of 31 patients who underwent dorsal T-plate fixation and were followed up for 3-7 years. However we had no cases of EPL rupture in our study. Complication rate in the study by Hove et al. was 19.35% which was also slightly higher than that of ours (15.38%). 2 in 42 patients were found to have EPL rupture in a study conducted by Suckel et al. The complication rate was also found to be 23.8% in their study which was also much higher than that obtained in our study (15.38%).

Different researchers use different scoring systems for evaluating the functional outcome of the distal radius fractures. There is no universal acceptance about which scoring system is superior, therefore different researchers use different scoring methods in their studies. In our study, we have used the Mayo Wrist score which is a physician-based scoring system the Quick DASH-9 score which is a patient-based scoring system to assess functional outcome. Our results using the Mayo wrist score and QuickDASH-9 score compare well to other series of internal fixation and are generally better than with external fixation. Regardless of the scoring methods used, the functional results documented within the follow-up period of this research study can be considered comparable to those of other studies examining complex distal radius fractures.

In our study, at the final follow-up, the functional results according to the Mayo wrist score were excellent in 80.7%, good in 11.53% and satisfactory in 7.69% of our cases. Similarly, the QuickDASH-9 score also revealed excellent or good functional outcomes in all our patients. Mean QuickDASH-9 score at 6 weeks follow up was calculated to be 45.03. On
subsequent follow up at 3 months, the mean QuickDASH-9 score decreased to 22.28 and finally reached 9.20 at final 6 months follow up. (The lower the value of the score in the range 0-100, better the outcome).

The results of our functional outcome are similar to those obtained by Suckel et al., Heron et al., and Kamath et al. in their studies. In comparison to a study by Lozano-Calderón et al., where the average modified Mayo wrist score was 75 points, and the average DASH score was 15 points our results were found to be better. Similarly our results were superior as compared to the study by Rein et al., where the average DASH score was found to be 17±15 points in dorsal plating group. Likewise, in another study by Rozenfeld et al, the mean score on the DASH questionnaire was 14.5 points (range: 10 to 28.5 points) which was again higher than what we got in our study. In a study done by Matzon et al the average DASH score at latest follow-up was 6 (range, 0-25). The better DASH score might be due to the follow up of a longer duration. The patients were followed for a minimum of 1 year, and mean follow-up was 27 months (range, 12-74). Our follow up period was shorter and of 6 months duration. This depicts that our functional outcome was either comparable or superior to those obtained by other authors in their studies.

CONCLUSION

Dorsal plating of the distal radius is an effective and safe way of treating dorsally displaced distal radius fractures. Dorsal plating of distal radius fracture is a viable option for the treatment of intra-articular distal radius fractures with a good functional outcome and a satisfactory functional range of motion with few complications.

ACKNOWLEDGEMENT

The authors would like to thank all the participants and Kathmandu Medical College, Department of Orthopaedics for their support and Dr Prabal KC for his help regarding the statistical analysis.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

REFERENCES:


