Radiographic evaluation of closed reduction and cast splintage of distal radius fracture

Muhammad Inam, Abdul Satar, Ayub Nawaz, Muhammad Arif

Department of Orthopedic Surgery, Postgraduate Medical Institute, Hayatabad Medical Complex, Peshawar, Pakistan

**Objective**
To evaluate radiographically the results of closed reduction and cast splintage for the treatment of distal radius.

**Patients and Methods**
This descriptive study was performed in Department of Orthopedics Surgery, Hayatabad Medical Complex, Peshawar, Pakistan. One hundreds consecutive patients with age above 40 years, having distal radius fracture were included in the study. After close reduction, radial inclination, volar tilt, radial length and intra-articular step-off were evaluated on posteroanterior (PA) and lateral radiographs.

**Results**
Out of 100 patients, there were 55 female and 45 male. Age ranged from 40 to 80 years (average 54 years). Acceptable post reduction radial inclination was noted in 75 (75%) patients, radial length in 83 (83%), volar tilt in 87 (87%) and intra-articular step was noted in 11/13 (84.6%) patients. Two patients with intra-articular step did not improve in second attempt of close reduction and no further reduction was tried, as the involved side was not dominant hand.

**Conclusion**
A large majority of the distal radius fractures can achieve good results after treatment by closed reduction and cast immobilization, for which conservative treatment should be the first choice. (Rawal Med J 2012;37:325-328).

**Key Words**
Colles fracture, radius, closed reduction, radius fracture.

**INTRODUCTION**
In the time of Hippocrates and Galen, distal radius fractures (DRFs) were thought to be wrist dislocations.¹ These were termed as Pouteau fractures in the French-speaking world.² The Irish surgeon Abraham Colles described DRFs in the 1814 and Colles based his descriptions on clinical examinations alone because radiography had not yet been invented.³ The distal radius is especially susceptible to fracture because it comprises approximately 80% of the wrist joint surface and bears nearly the full load from a fall on the outstretched hand.⁴ These injuries are commonly occur in the elderly population with osteoporosis, typically caused by a fall on outstretched hand.⁵ There are a wide variety of fracture patterns, and no single form of treatment applies for all of these fractures.⁶ The nature and location of this fracture, compounded by the multi-directional forces that exert on this joint in daily life, often requires proper healing to restore anatomic alignment of this important bone. In general, the less invasive treatment achieves goals of satisfactory alignment and stable reduction of the fractured bone fragments results in a better functional outcome and patient satisfaction.⁷ That is why most of these fractures are still managed by closed reduction and cast splintage under adequate analgesia and/or haematoma block.⁸ As closed reduction is done without fluoroscopic control, there is high chance of unacceptable reduction which not only hampers the functions of hand but there is also visible deformity that is not acceptable to patients.⁹ The objective of this study was to evaluate radiographically the results of closed reduction and cast splintage for the treatment of distal radius fracture.

**PATIENTS AND METHODS**
This prospective hospital based observational study was performed from May, 2009 to April 2011, in
Orthopedic Unit of Hayatabad Medical Complex, Peshawar, Pakistan. One hundred consecutive patients of either gender with age above 40 years, having distal radius fracture were included in the study. All came through the emergency department. After stabilization, informed consent was taken and they were treated in emergency room. Using intravenous diazepam 10mg and tramadol 50mg, the fracture fragments were manipulated into proper alignment without exposing the fracture. A plaster splint or cast was applied and molded to the patient's forearm and hand. Following closed reduction and cast application, the limb was suspended in sling so that the hand was in elevated position. Immediately after cast application, slandered PA and lateral radiographs of the both forearm were taken and assessed for acceptable reduction. When unacceptable reduction was found, a second attempt was made to reduce it. Intra articular step of 1mm or more were accepted in non dominant hand in second attempt of close reduction. The following four parameters determined the normal radiographic relationships of the distal radius.

**Radial Inclination:** This represents the angle between a line joining the tip of the radial styloid and the ulnar corner of the articular surface at the distal end of the radius and a line drawn perpendicular to the long axis of the radius. The radial inclination ranges from 13º to 30º (although this range varies considerably between authors). Average radial inclination is around 23º. Acceptable reduction is thought to be greater than 15º.

**Radial Length:** Measured from the PA radiograph, this is the distance between two perpendiculars to the long axis of the radius, one drawn at the tip of the radial styloid process and one drawn at the distal articular surface of the ulna, which should be 11 to 12 mm. Normal value ranges from 8-18mm.

**Palmar (Volar) Tilt:** This represents the angle between a line joining the dorsal and volar margins of the articular surface and the long axis of the radius, from the lateral film. Palmar or volar tilt ranges from 0 to 28º. Average is around 11º. Acceptable reduction is thought to be 0-20º volarily.

**Intra-articular step-off:** In fractures involving the articular surface, the incongruity seen on PA view should not be greater than 2mm. The data was analyzed using SPSS v 10.

**RESULTS**

Out of 100 patients, there were 55 female and 45 male patients. Age ranged from 40 to 80 years (average 54 years). Right side was involved in 60 patients while left in 40 patients. (Table 1).

| Table 1. Statistics of Post Reduction of Distal Radius Fracture (n=100) |
|------------------|-----------------|----------------|-----------------|------------------|
| Age of the Patient | Radial Inclination (degrees) | Palmar (Volar) Tilt (degrees) | Radial Length (Millimeter) | Intra-articular step-off (Millimeter) |
| No | 100 | 100 | 100 | 100 | 13 |
| 0 | 0 | 0 | 0 | 0 | 87 |
| Mean | 54.70±1.06 | 16.88 | 5.73 | 9.58 | 1.85 |

Acceptable (more than 15º) post reduction radial inclination was noted in 75 (75%) patients while unacceptable reduction was noted in 15(15%) patients. Minimum post reduction radial inclination was 5º while maximum was 25º with average 16.8º (Table 2).

| Table 2. Radial inclination in degrees (n=100). |
|------------------|----------------|----------------|
| Radial Inclination | Number | Percent |
| 5 | 8 | 8.0 |
| 10 | 6 | 6.0 |
| 12 | 1 | 1.0 |
| 15 | 32 | 32.0 |
| 17 | 8 | 8.0 |
| 18 | 6 | 6.0 |
| 19 | 6 | 6.0 |
| 20 | 16 | 16.0 |
| 22 | 1 | 1.0 |
| 23 | 2 | 2.0 |
| 25 | 14 | 14.0 |
| Total | 100 | 100.0 |

Acceptable (8-18mm) post reduction radial length was noted in 83 (83%) patients while unacceptable
radial length was noted in 17 (17%). Minimum post reduction radial length was 5mm while maximum was 15mm with average 9.58mm (Table 3).

**Table 3. Radial length in millimeter (n=100).**

<table>
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<th>Radial Length</th>
<th>Number</th>
<th>Percent</th>
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<tbody>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100.0</strong></td>
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Acceptable (0-20°) post reduction volar tilt was noted in 87 (87%) patients while unacceptable volar tilt was noted in 7 (7%) patients. Minimum post reduction volar tilt was -7° while maximum was 15° with average 5.7° (Table 4).

**Table 4. Palmar (volar) tilt in degrees (n=100).**

<table>
<thead>
<tr>
<th>Volar Tilt</th>
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<tr>
<td><strong>Total</strong></td>
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Acceptable (less than 2 mm) post reduction intra articular step was noted in 11/13 (84.6%) patients while unacceptable radial length was noted in 2/13 (15.6%). Minimum post reduction radial length was 5mm while maximum was 15mm.

Close reduction was attempted again in 17 patients in which only two patients with intra articular step was remained 1 mm and was accepted as such as that was non dominant hand of the patients.

**DISCUSSION**

Distal radius fractures are common and poor outcome is more likely when the fracture is initially much displaced, when the distal radioulnar joint is involved, and when the radiocarpal joint is comminuted. Reflex sympathetic dystrophy and finger stiffness occur to some degree in as many as one out of three patients. Loss of motion is also common, but unpredictable. Median nerve compression may develop early or late following this fracture. Tendon rupture may follow this injury. Posttraumatic arthritis may also develop. In a study of 124 fractures, there was an overall secondary displacement rate of 78% in fractures were treated by closed reduction and cast. In our study, the secondary displacement was 17%. Földhazy et al noted considerable fracture displacements in his study with mean dorsal angulation of 13 degrees in <60 year and 18 degrees in >60 year patients, mean radial shortening was 2 mm in <60 year and 3 mm in >60 year patients. In our study, closed reduction and plaster improved dorsal angulations but not radial shortening.

In a study on 74 patients with mean age of 68.5 years, 71% had at least one "unacceptable" radiographic deformity by traditional criteria. Acceptable reduction varied from 60-99% depending on which single index was reported, and 44% of patients had more than two indices reported as unacceptable. In this study, the overall acceptable reduction is comparable to our study while more than two indices had high rate of...
acceptable reduction the current study which is less than 50% in Jaremko et al study. Schneiders et al did a study on 211 patients, in which 28 (13%) had a step-off in the articular surface of over 1 mm, resulting in a 24% reduction of the range of motion compared to the non-injured wrist. Twelve (5.68%) patients with a radial shortening of more than 3 mm had a 21% reduction of pronation and supination compared to the non-injured side. This study is also comparable to the current study in which the intra articular step-off 15.6%. In Li et al study, the general rate of accepted results of the 103 patients was 69.9% and a large majority of them displayed instability within a week after the closed reduction and cast immobilization while in current study the overall accepted reduction was 82%.

CONCLUSION
A large majority of the distal radius fractures can achieve good results after treatment by closed reduction and cast immobilization, for which conservative treatment should be the first choice. However, due to variation of these radiographic parameters between individuals, obtaining a precise measurement requires radiograph of both wrists in order to compare the measurements of the injured and the non-injured wrists.

REFERENCES