

## Prospective Clinical Functional Outcome Assessment of Fracture of Distal End of Radius Managed with Locking Compression Plates

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### Abstract

**Aim:** This study was conducted to assess the functional outcome of fracture of distal end of radius managed with locking compression plates.

**Methodology:** A prospective study was conducted in Department of Orthopedics, JLNMCH, Bhagalpur during the period of 6 months. All cases presenting to the outpatient and emergency department fulfilling the below mentioned criteria were recruited for the study. Patients more than 18 years of age presenting with simple and/or compound radial fractures without vascular injury were included in this study. All the patients were followed up for a period of 6 months after surgical procedure.

**Results:** The age and gender wise distribution of the study subjects shows that majority of the patients (50%) were in the age group between 30 and 50 years and the mean age was 37.8 years and the males outnumbered females with a male: female ratio of 2:1 approximately. The distal end radius fractures were classified based on Frykman's classification which has types and among them type III found to be more common (28%) in our patients which is intra-articular fractures involving the radio carpal joint followed by type I which is a transverse metaphyseal fracture. Fracture was also further classified based on AO classification and among them A3 (Extra-articular radius, multi fragmentary), B3 (partial articular radius, frontal, volar rim) and C1 (complete articular simple metaphyseal) were found to be the more common types. Only 3 patients had complications in our entire study subjects, all the 3 patients had developed arthritis. The outcome evaluation was measured based on demerit score system of Gartland and Werley and for 94% of the patients the results was in the range of good and excellent and for only 3 patients, it was fair and none of the patient had a poor result.

**Conclusion:** Volar application of a locking compression plate for dorsally displaced distal radial fracture is a safe alternative. It provides stable fixation to dorsally displaced fractures of the distal radius with excellent radiographic and functional results and minimal complications.

**Keywords:** Radius, fractures, articular, volar compression plates.

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## Introduction

Distal radius fractures are the most frequently seen upper extremity fractures among people with all age group. Fractures of the distal radius are among the most common fractures of the upper extremity and account for approximately one sixth (16%) of all fractures seen and treated in emergency rooms [1-3]. The type, direction and amount of displacement are the most important factors relating to treatment [4]. The main objective of its treatment is the re-establishment of anatomic integrity and functioning. In unstable intra-articular fractures, re-establishment of interarticular integrity of the wrist and maintaining the radial length are often not possible with closed methods. The surgical approach depends on the direction of the displacement of the distal fragment. Dorsal plating has been an option for patients with dorsally angulated distal radial fractures; however, the complication rate of this approach remains high [5-7]. Although double plating has been advocated for unstable distal fractures of the radius, loss of reduction related to comminution and osteoporosis is common [8, 9]. A volar approach has been developed for fixing a dorsally angulated fracture of the distal radius. It has several advantages, including the more spacious volar aspect of the distal radius, the avoidance of both dorsal dissection and its attendant complications of the extensor tendons, and the possible deprivation of blood supply to the dorsal metaphyseal fragments [10, 11]. The intrinsically stable locking compression plate utilises a threaded screw head that locks into the plate holes when the screws are tightened, providing angular and axial stability and minimising the possibility of screw loosening. This is particularly useful in the prevention of secondary displacement of the unstable fracture in elderly patients with osteoporotic bone [10, 11]. Internal fixation of metaphyseal bending fractures has become increasingly popular due to its direct control and

maintenance of physiologic palmar tilt, prevent collapse with external fixation and avoid bridging the radiocarpal joint [12]. The distal fragment typically has sufficient size and integrity to provide adequate purchase and may be approached from either a dorsal or a volar approach. Palmar plating is usually preferred as the screws directly buttress against collapse and may lead to loss of palmar tilt. With smaller and more distal fragments, a dorsal plate has to be positioned distally on the dorsum of the radius making extensor tendon injury more likely [13]. There are two types of plates for fractures of distal radius one is conventional plates, and the other is fixed angle locking compression plates. Using conventional plates has some disadvantages like comminution must be less and they poorly hold the cancellous bone fragments and due to the toggle of screws in the distal holes of the plate it leads to settling and loss of reduction of the fracture. With conventional plates and screws, stability is achieved by compression of plate by using bicortical screws [14, 15]. With fixed angle locking plates the locking screws support the subchondral bone and resist axial forces and the additional benefit of using the fixed angle construct is it provides additional strength to fixation by constructing a scaffold under the distal radial articular surface [16]. In the modern era volar fixed angle locking plates found to be an effective treatment for unstable extra articular distal radius fractures as it allows early post-operative rehabilitation and because of its angular stability of locking compression plates, reduction can be maintained over times so that secondary displacement is no longer a problem. Primary stability achieved with locking screw in a plate prevents secondary displacement irrespective of the condition of the bone either in osteoporotic bones or in young patients it enables excellent results [17]. Intra-articular and extra-articular malalignment can lead to various

complications like post traumatic osteoarthritis, decreased grip strength and endurance, as well as limited motion and carpal instability [18]. Many methods like closed reduction and casting, pins and plaster, percutaneous pinning, external fixation with ligamentotaxis, internal fixation, combined internal and external fixation and arthroscopically assisted reduction have come up for treating the fractures in the distal end of radius [19]. When the reduction is lost certain complications such as a shortened, dorsally angulated carpus with subsequent poor function and early changes of osteoarthritis secondary to articular incongruity may occur resulting in poor functional and cosmetic outcome [20, 21]. This study was conducted to assess the functional outcome of fracture of distal end of radius managed with locking compression plates.

#### **Materials and Methods:**

A prospective study was conducted in Department of Orthopedics, JLNMC, Bhagalpur during the period of 6 months. All cases presenting to the outpatient and emergency department fulfilling the below mentioned criteria were recruited for the study.

#### **Inclusion criteria:**

Patients more than 18 years of age presenting with simple and/or compound radial fractures without vascular injury

#### **Exclusion criteria:**

Patients with less than 18 years of age and compound fractures associated with vascular injury were excluded from the study

#### **Surgical procedure:**

All the patients presented with elbow flexed and the wrist supported by the other hand. Careful inspection of the deformity, swelling and ecchymosis were done. Clinically tenderness, bony irregularity,

crepitus and relative position of radial and ulnar styloid process were elicited. Movements of the wrist and forearm were checked and found to be painful and limited. Distal vascularity was assessed by radial artery pulsations, capillary filling, pallor and paraesthesia over fingertips. The involved forearm was immobilised with a below elbow POP and kept elevated. Pain and inflammation were managed using analgesics. X-rays of PA and lateral view were taken for confirmation of the diagnosis and to assess the type of fracture. The fracture fragments were analysed and involvement of radiocarpal and distal radioulnar joints were assessed and classified according to the Frykman's and AO classification. The duration from the date of injury to the date of operation ranged from 1 – 6 days. All the routine blood investigations were done and the fitness from physician and anaesthetist were obtained. The patient was placed supine on the operating table. The affected limb was elevated for 2-3 minutes and exsanguinated. Then a mid-arm pneumatic tourniquet was applied, and the limb was placed on a side arm board. The incision for volar fixation of the distal radius is typically performed through the distal extent of the Henry's approach. An incision is made between the flexor carpi radialis tendon and the radial artery. After exposure and debridement of the fracture site, the fracture is reduced and provisionally fixed under fluoroscopy with K-wires, reduction forceps or suture fixation. The appropriate plate is selected following the fracture reduction. First a standard cortical screw was applied to the most distal oval hole of the vertical limb of the plate in order to temporarily secure the plate to the proximal fragment. This allowed concomitant proximal and distal plate adjustment. After fixing the distal fragment with subchondral locking screws, radial length was gained when necessary, by passing the plate distally. The first standard screw can be either left insitu or

exchanged with another locking screw; the oval hole is a combination hole designed for locking head screw placement at the distal end and standard screw placement at the proximal end of the same hole. The optimal placements of the distal screws were important; they were inserted at the radial styloid, beneath the lunate facet and near the sigmoid notch. The distal screws can be of either monocortical or bicortical engagement. More volar tilt was achieved during distal screw placement when the wrist is volarly flexed as much as possible by an assistant. Moreover, radial length was further improved by pushing the whole plating system distally while using the oval plate hole and screw as a glide. The final position of the plate was confirmed using fluoroscopy. Once stable fixation was achieved and hemostasis secured, the wound was closed in layers and sterile compression dressing was applied. The tourniquet was removed, and

capillary refilling was checked in the fingers. The operated limb was supported with an anterior below elbow POP slab with the wrist in neutral position. All the patients were followed up for a period of 6 months.

### Results:

The age and gender wise distribution of the study subjects shows that majority of the patients (50%) were in the age group between 30 and 50 years and the mean age was 37.8 years and the males outnumbered females with a male: female ratio of 2:1 approximately. Among all these fractures, 47 were closed fractures and only 3 were open fractures and 72% were intra-articular fractures and 28% were extra-articular fractures. Around 58% of the study subjects acquired the fracture through road traffic accident and only 42% had a fall on out-stretched hand.

**Table 1: Demographic and fracture details**

Variables		Number	%
Gender	Male	32	64
	Female	18	36
Age (in year)	20-30	9	18
	31-40	13	26
	41-50	12	24
	51-60	9	18
	>60	7	14
Mode of injury	RTA	29	58
	Fall	21	42
Type of fracture (Frykman's classification)	I	9	18
	II	6	12
	III	14	28
	IV	8	16
	V	4	8
	VI	2	4
	VII	0	0
	VIII	7	14
Type of fracture (AO classification)	A1	0	00
	A2	5	10
	A3	11	22
	B1	4	08
	B2	7	14

	B3	8	16
	C1	10	20
	C2	5	10
	C3	0	00

The distal end radius fractures were classified based on Frykman’s classification which has types and among them type III found to be more common (28%) in our patients which is intra-articular fractures involving the radio carpal joint followed by type I which is a transverse metaphyseal fracture. Fracture was also further classified based on AO classification and among them A3 (Extra-articular radius, multi fragmentary), B3 (partial articular radius, frontal, volar rim) and C1 (complete articular simple metaphyseal) were found to be the more common types.

All the patients were investigated, and anaesthetist opinion was obtained and was operated. The mean duration between the time of fracture and surgery was 3.3 days. After the surgery the patients were followed for a period of 6 months and none of the patients had immediate post-

operative complications and for 78% of the subjects the fracture reunion had occurred in 2 – 3 months and for only 3 patients it took more than 4 months for the union. According to the range of motion which was assessed 16 weeks post-operatively we found dorsiflexion, palmar flexion, pronation and supination was almost in the normal range for all the patients and only 3 patients had pain in the radio-ulnar joint and for one patient the grip strength was 60% and less. Only 3 patients had complications in our entire study subjects, all the 3 patients had developed arthritis. The outcome evaluation was measured based on demerit score system of Gartland and Werley and for 94% of the patients the results was in the range of good and excellent and for only 3 patients, it was fair and none of the patient had a poor result.

**Table 2: Fracture union duration and outcome evaluation of the patients**

Variables		Number	%
Duration of fracture union	2-3 months	39	78
	3-4 months	8	16
	>4 months	3	06
Outcome evaluation	Excellent	25	50
	Good	22	44
	Fair	3	06
	Poor	0	00

**Discussion:**

The main objective of its treatment is the re-establishment of anatomic integrity and functioning. In unstable intra-articular

fractures, re-establishment of interarticular integrity of the wrist and maintaining the radial length are often not possible with closed methods. A better understanding of

wrist anatomy and functioning through the studies conducted in the recent years, as well as the increasing expectations of patients have expanded the borders of surgical treatment and improvements in fixation materials have provided new opportunities. Over the last one decade most of the studies were conducted towards clarifying the best surgical treatment for fracture of the distal extremity of the radius. In this context a recent study by Osada et al had documented the increasing popularity of open reduction and internal fixation, especially since the introduction of locked volar plates in 2001 [22]. The study had demonstrated that locked volar plates were well tolerated, and it had allowed early mobilization and it had provided good support for deforming muscle forces after the surgical reduction, even among patients with intra-articular fractures. The majority of the studies have used subjective tools for measuring quality of life, such as the Gartland and Werley calculation and the DASH calculation while others have given greater emphasis to the radiographic parameters obtained after surgical reduction of fractures of the distal extremity of the radius [23-25]. In our study, 58% of the subjects had RTA and 42% had a history of fall with outstretched hand and similar studies in the past had also shown similar results. The present study shows only 5 patients had some associated injuries like ipsilateral lower third ulnar fracture, superior pubic rami fracture whereas the study done by Jacob et al and Agarwal K et al had shown the percentage of associated injuries as 28.8% and 62.5% respectively [26, 27]. Proposed advantages of locked volar plating include improved pull-out strength even in osteoporotic bone [28]. Internal fixation using a dorsal plate, which is greatly advocated, achieves anatomical reduction with good stability. However, a variety of complication has been documented, including irritation of

subcutaneous tissue, tenosynovitis of extensor muscle, rupture of extensor tendon and even chronic pain [29]. The present study demonstrates good to excellent results in the majority of patients based on G&W functional outcome evaluation after locking plate fixation of the lower end distal radius with lower rate of complications. [30] For 94% of the patients, the results were in the range of good and excellent and for only 3 patients, it was fair and none of the patient had a poor result. Hence locking plate fixation may be recommended for distal radius fractures. Requiring operative intervention with early mobilization of wrist joint

### **Conclusion:**

Volar application of a locking compression plate for dorsally displaced distal radial fracture is a safe alternative. It provides stable fixation to dorsally displaced fractures of the distal radius with excellent radiographic and functional results and minimal complications.

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