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Original Research Article

Prospective Functional Outcome Assessment after Surgical Management of Fractures of Distal end Radius

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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 Orthopaedics, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar during the period of 12 months (May 2019 - April 2020). 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. The involved forearm was immobilized with a below elbow POP and kept elevated. 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 analyzed 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. All the patients were followed up for a period of 6 months to 1 year.

Results: majority of the patients (51.7%) were in the age group between 30 and 50 years and the mean age was 36.4 years and the males outnumbered females with a male: female ratio of 3:2. Around 58.3% of the study subjects acquired the fracture through road traffic accident and only 41.7% had a fall on out-stretched hand. 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 (26.7%) in our patients which is intra-articular fractures involving the radio carpal joint followed by type I which is a transverse metaphyseal fracture. Fracture were also further classified based on AO classification and among them A3 (Extra-articular radius, multi fragmentary) and C1 (complete articular simple metaphyseal) were found to be the more common types. In 71.7% of the subjects, the fracture reunion had occurred in 2 – 3 months and for 11.6% patients it took more than 4 months for the union. 91.7% of the patients the results was in the range of good and excellent and for only 8.3% patients, it was fair and none of the patient had a poor result.

Conclusion: The present study demonstrates good to excellent results in the majority of patients after locking plate fixation of the lower end distal radius with lower rate of complications. Hence locking plate fixation may be recommended for distal radius fractures.

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

Introduction

Fractures of distal end of radius continue to pose a therapeutic challenge. Intra articular and extra articular malalignment can lead to various complications like post-traumatic osteoarthrosis, decreased grip strength and endurance, as well as limited motion and carpal instability [1]. Open reduction and internal fixation is indicated to address the unstable distal radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through external manipulation and ligamentotaxis, provided sufficient bone stock is present to permit early range of motion [2]. Internal fixation of metaphyseal bending fractures has become increasingly popular due primarily to directly control and maintain physiologic palmar tilt, prevent collapse with external fixation, and avoid bridging the radiocarpal joint. 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 preferred, as the screws directly buttress against collapse and 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 [3].

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. 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. 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 [4, 5].

There are two types of plates for fractures of distal radius one is conventional plates and the other is fixed angle locking compression plates. When using conventional plate's communition must be less, they poorly hold the cancellous bone fragments, toggle of screws in the distal holes of the plate leads to settling and loss of reduction. With conventional plates and screws stability is achieved by compression of plate to bone by bicortical screws. With fixed angle locking plates the locking screws support subchondral bone and resist axial forces. Compression of locking compression plate to bone is unnecessary and preserves periosteal blood supply [6]. Fixed angle construct provides additional strength to fixation by constructing a scaffold under the distal radial articular surface [7]. Volar fixed angle locking plates are an effective treatment for unstable extra articular distal radius fractures allowing early post-operative rehabilitation [8]. Because of angular stability of locking compression plates reduction can be maintained over times so that secondary displacement is no longer a problem [9]. 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 [10]. 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 Orthopaedics, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar during the period of 12 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 presented with elbow flexed and the wrist supported by the other hand. Careful inspection of the deformity, swelling and ecchymosis were done. 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 finger tips. The involved forearm was immobilized with a below elbow POP and kept elevated. 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 analyzed 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.

Surgical procedure: 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 in situ 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 to 1 year.

Results:

The age and gender wise distribution of the study subjects shows that majority of the patients (51.7%) were in the age group between 30 and 50 years and the mean age was 36.4 years and the males outnumbered females with a male: female ratio of 3:2. Around 58.3% of the study subjects acquired the fracture through road traffic accident and only 41.7% had a fall on out-stretched hand.

Table 1: demographic and fracture details

Variables		Number (n=60)	%
Gender	Male	36	60
	Female	24	40
Age (in years)	20-30	12	20
	31-40	16	26.7
	41-50	15	25
	51-60	10	16.7
	>60	8	13.3
Mode of injury	RTA	35	58.3
	Fall	25	41.7
Type of fracture (Frykman's classification)	I	10	16.7
	II	7	11.7
	III	16	26.7
	IV	9	15
	V	6	10
	VI	2	3.3
	VII	0	0
	VIII	10	16.7
Type of fracture (AO classification)	A1	0	00
	A2	8	13.3
	A3	13	21.7
	B1	6	10
	B2	6	10
	B3	9	15
	C1	11	18.3
	C2	7	11.7
	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 (26.7%) in our patients which is intra-articular fractures involving the radio carpal joint followed by type I which is a transverse metaphyseal fracture. Fracture were also further classified based on AO classification and among them A3 (Extra-articular radius, multi fragmentary) and C1 (complete articular simple metaphyseal) were found to be the more common types.

In 71.7% of the subjects, the fracture reunion had occurred in 2 – 3 months and for 11.6% patients it took more than 4 months for the union. The outcome evaluation was measured based on demerit

score system of Gartland and Werley and for 91.7% of the patients the results was in the range of good and excellent and for only 8.3% 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	43	71.7
	3-4 months	10	16.7
	>4 months	7	11.6
Outcome evaluation	Excellent	32	53.4
	Good	23	38.3
	Fair	5	8.3
	Poor	0	00

Discussion:

Distal radius fractures are one of the most common injuries encountered in orthopedic practice. They make up 8%−15% of all bony injuries in adults [11]. Abraham Colles is credited with description of the most common fracture pattern affecting distal end radius in 1814, and is classically named after him [12]. The radius initially fails in tension on the volar aspect, with the fracture progressing dorsally where bending forces induce compressive stresses, resulting in dorsal comminution. Cancellous impaction of the metaphysis further compromises dorsal stability. Additional shearing forces influence the injury pattern, resulting in articular surface involvement [13].

All fractures characterized by minor comminution, without or with minimal displacements can be considered for closed reduction and cast immobilization. The fracture should be kept under closed observation to look for any re-displacement. Despite the widespread acceptance of immobilization in a plaster cast, questions remain regarding the optimum position, the duration of immobilization and the need to extend the cast proximal to elbow. No clear consensus exists as to the best position for immobilizing the wrist in plaster.

Sarmiento *et al* [14] advocated immobilization in a position of supination to decrease the deforming force of the brachioradialis, which may cause loss of reduction. In contrast, Wahlstrom recommended immobilization in pronation because he claimed that the pronator quadratus causes the deforming force most responsible for the loss of reduction [15]. Most surgeons immobilize distal radius fractures in some amount of palmar flexion on the principle that dorsal periosteal hinge provides stability. However, the optimal position of hand function is with the wrist in dorsiflexion. Immobilization of the wrist in palmar flexion has a detrimental effect on hand function because dorsiflexion at the wrist is needed for proper rehabilitation of fingers [16, 17].

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 [18-20].

In our study, 58.3% of the subjects had RTA and 41.7% had a history of fall with outstretched hand and similar studies in

the past had also shown similar results. Proposed advantages of locked volar plating include improved pull out strength even in osteoporotic bone [21]. 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 [22].

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. [23] For 91.7% 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. Hence locking plate fixation may be recommended for distal radius fractures. Requiring operative intervention with early mobilization of wrist joint.

Conclusion:

The present study demonstrates good to excellent results in the majority of patients after locking plate fixation of the lower end distal radius with lower rate of complications. Hence locking plate fixation may be recommended for distal radius fractures.

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