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Volar Locking Plate in the Management of Distal Radius Fractures- A Prospective Study

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Abstract

Introduction*: Fractures of lower end of radius constitute 17% of all fractures and 75% of all forearm fractures. It occurs in the middle aged and elderly women commonly. It also occurs in the young men with high velocity injury. Distal radial fractures are treated with a variety of techniques. ORIF is indicated to address the unstable distal radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through other techniques. ORIF with a volar locking compression plate system is currently followed for treating Distal radius fractures resulting in good reduction and also provide immediate stability. The patients can be mobilized early and potentially reducing wrist stiffness.**Aim** : To assess the clinical and functional outcome of fracture distal radius treated with volar locking plate and to observe the complications associated with volar locking plate of distal radius.**Methods***: In this study 60 patients with distal radius fractures and were operated with a volar locking compression plate using a volar Modified Henry's approach.The patients were regularly followed up at six weeks, three months and six months, one year following the surgery and were evaluated clinically and radiologically. Final outcome was evaluated by QUICK DASH evaluation questionnaire **Results**: There are 24 males and 36 females with an average age of 41.2 years . At the end of one year the functional outcome based on Quick DASH score was excellent in 80% of the patients and while good outcomes were noted among 20% of patients, no Poor results. A total of four complications, 2 cases of stiffness and 2 cases of extensor pollicis longus tendon irritation occurred.**Conclusion***:A satisfactory functional and radiological outcome can be obtained for a great majority of patients with most of the distal radius fractures including complex intra-articular fractures by using a volar locking plate fixation and the overall complication rate was low.*

Keywords*: Distal radius fractures ,Unstable fractures ,Open Reduction and Internal Fixation ,LCP,Volar approach.*

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I. Introduction

Fractures of lower end of radius are the most common fractures of the upper extremity, constituting about 17% of all fractures and 75% of all forearm fractures[1]. It occurs in the middle aged and elderly women commonly. It also occurs in the young men with high velocity injury. Patients with fracture distal end of radius have many complications more frequently and failure in the management may cause permanent disability. Therefore treatment methods are continually improving and best suitable method of management has to be followed in each case. Distal radial fractures are treated by wide variety of techniques like closed manipulation, POP cast reduction and percutaneous pins, ligamentotaxis external fixation & internal fixation etc. ORIF is indicated to address the unstable distal radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through closed manipulation and ligamentotaxis and percutaneous pinning

Various surgical techniques has been reported in literature but ORIF with a volar locking compression plate is currently followed for the treatment of distal radius fracture which results in good reduction and providing immediate stability.The patients are mobilized early and potentially reducing stiffness .

Difficulties with dorsal fixed-angle plates prompted the use of volar fixed-angle plates for dorsal fractures. It has been long recognized that there is a correlation between the functional outcome following a distal radial fracture and the restoration of the radio-carpal and the radio-ulnar relationship[2]. What has been less predictable has been the maintenance of the reduction of fractures in osteopenic bone or fractures considered to be unstable.

There are several theoretical advantages to approaching and fixing the radius through a volar approach;
1) more space is available, the flexor tendons are farther from the bone and pronator quadratus is interposed.
2) The volar cortex is typically less comminuted than the dorsal cortex, which makes reduction of the fracture easier.
3) Volar scars are better tolerated as they are less obvious and the blood supply to the radius is less likely to be disturbed.
4) Potential earlier return to self-care, work and sport
5) Diminished frequency and duration of formal occupational therapy,
6) potentially less overall pain,
7) Decreased risk of displacement,
8) potential cost savings secondary to a diminished need for radiographs

In view of high frequency of distal end radius fractures and less data available regarding the optimal treatment, present study was taken to assess functional evaluation of fractures of lower end radius treated with volar locking plate fixation followed by early mobilization of wrist joint.

II. Methods

In this study 60 patients from November 2017 to October 2019 , treated for unstable distal radius fractures using volar locking plate in our institution who fulfilled inclusion criteria are taken .

Inclusion criteria*:* 1. Adults with more than 18years of age. 2. Patients presenting with Frykman's classification. 3. Patients anaesthetically fit for surgery.

Exclusion criteria*:* 1. Skeletally immature patients. 2. Stable extra articular fractures. 3. Compound fractures. 4. Patients with associated injuries in the same fore arm.

There were 36 males and 24 females between the age group of 18-70 years. 42 patients had right side involvement and 18 had left side involvement. Of the 60 cases injury occurred due to road traffic accident in 36 patients and fall on out stretched hand in 24 patients . All patients selected for the study were admitted and examined according to protocol. The selected patients were briefed about the nature of the study and a written informed consent was obtained .

The information such as sex, age, details of injury, duration and progression were obtained through an interview. Patients are subjected to clinical as well as local examination. These findings were recorded on predesigned and pretested proforma .

Any emergency management if required was done and the patients were evaluated with respect to the pre operative investigations. Standard radiographs in AP and lateral views are taken for the diagnosis and to know the type of fracture. The fracture fragments were analysed.The involvement of radio-carpal and distal radioulnar joints were assessed and classified according to the Frykman's classification. The fractured forearm was immobilized in a below elbow POP slab and kept elevated till the oedema subsided. Pain and inflammation were managed using analgesics and anti-inflammatory medications.

Patients were operated under anesthesia as per the fitness of patient. Prophylactic IV (intravenous) antibiotic usually, a third generation cephalosporin was given 15 minutes before surgery. The operations were performed under brachial block and general anesthesia. Position and tourniquet: 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. Forearm and hand were thoroughly scrubbed, painted with betadine and spirit and draped.

Surgical procedure*:* The duration from the date of injury to date of operation ranged from 2-5 days.

Procedure: All cases are managed with a volar locking compression plate using a volar Modified Henry's approach.

The incision for volar plating of the distal radius fractures is performed through the distal extent of the modified Henry's approach. An incision was made between the flexor carpi radialis (FCR) tendon and the radial artery. This interval is developed, exposing the flexor pollicis longus (FPL) muscle at the proximal end of the wound and the pronator quadratus muscle distally. The radial artery is carefully retracted radially and the tendons of the flexor carpi radialis (FCR) radially and flexor pollicis longus (FPL) ulnar side.(figure 1- A ,B)

The pronator quadratus muscle is divided at its most radial aspect. Any elevation of the muscle of the Flexor Polices Longus should be done at its radial aspect, as it receives its innervation from anterior interosseous nerve from its ulnar side. Pronator quadratus is divided and elevated, the fracture is visualized, and reduction maneuvers can be accomplished under direct vision. After exposure and freshening of the fracture site, the fracture is reduced and provisionally fixed under fluoroscopy with temporary K-wires, reduction forceps . Reduction aids should be placed so that they do not interfere with the placement of the plate. The plate is selected following fracture reduction and a cortical screw is inserted to the distal oval hole of the vertical part

of the plate to temporarily secure the plate to the proximal fragment. After fixing the distal fragment of the frcature with subchondral locking screws, radial length was acheived , by pushing the plate distally. The first screw can be left as it is or changed with another locking screw.

The screws must be inserted at the radial styloid, beneath the lunate facet, and near the sigmoid notch. volar tilt can be achieved more during distal screw placement when the wrist is volarly flexed as much as possible by an assistant. Radial length can be increased by pushing the whole plate distally while using the oval plate hole and screw as a glide. The final position of the plate was confirmed using fluoroscopy. Pronator quadratus was used at the time of closure, to cover, the implants that were applied to the anterior surface of the radius. Once stable fixation was achieved and hemostasis secured, the wound was closed in layers and sterile dressing was applied. The tourniquet was removed and capillary refilling was checked in the fingers. The operated limb was supported with an below elbow POP slab with the wrist in neutral position.

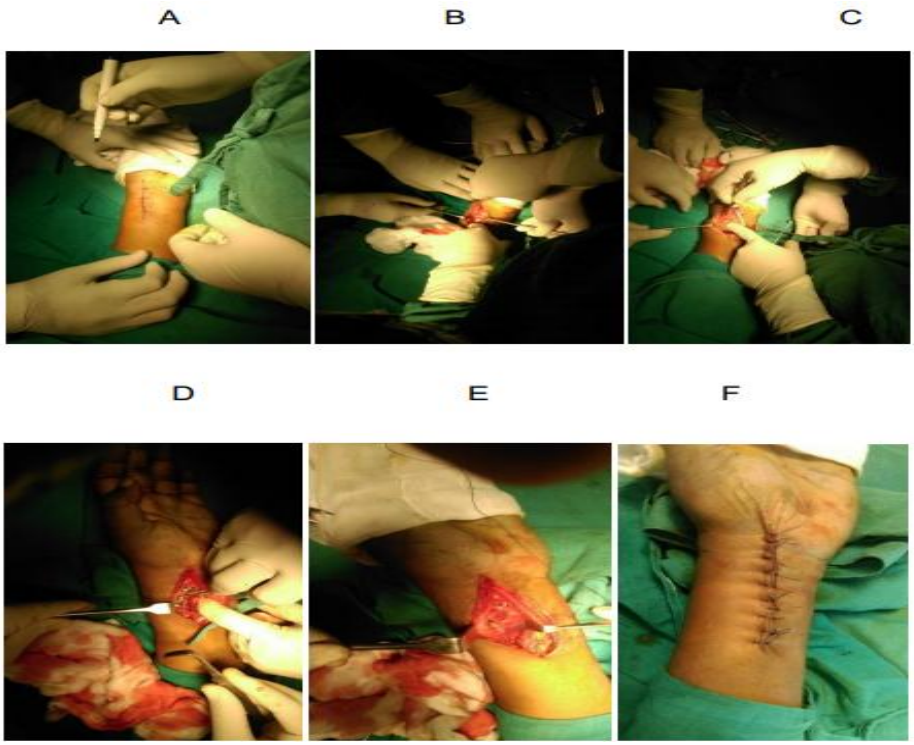

Figure 1: Steps in surgical procedure

A) Skin Incision Site, B) Plain Between FCR And Radial Artery, C) Fracture Reduction, D)Post Reduction Plate Fixation, E) Pronator Quadratus Re Sutured F) Skin Closure

Figure 2: pre & post op x-rays

***Post operative care, Follow up*:** Follow-up of patients was done at six weeks, three months and six months, one year following the surgery. Assessment: For all subjects, radiographs were performed at the end of six weeks, three months and six months, one year follow-up. Patients are evaluated based on the following parameters at the time of discharge and all the four follow ups;

Range of motion: Wrist - Flexion, extension, supination, pronation, ulnar deviation and radialdeviation
Elbow - Flexion, extension, supination and pronation.

Figure 3: Range Of Movements

Final outcome was evaluated by QUICK DASH[3]evaluation questionnaire which consists of 11 items to measure physical function and symptoms in Upper limb musculoskeletal disorders

III. Results

This study is a prospective study which was conducted in the Department of Orthopaedics, ANDHRA MEDICAL COLLEGE, GOVERNMENT GENERAL HOSPITAL, VISAKHAPATNAM. From November 2017 to October 2019. A total of 60 cases who sustained fractures of lower end of radius were included in the study

Table1:Incidence Of Distal Radius Fractures In Different Age Groups

AGE IN YEARS	NO OF CASES	PERCENTAGE
18 – 30	12	20
31 – 40	20	33.3
41 – 50	14	23.3
51 – 60	12	20
61 – 70	2	3.3

Table 2: Sex Incidence

SEX	NO OF CASES	PERCENTAGE
MALE	36	60
FEMALE	24	40

Table 3: ***Side Of Involvement***

SIDE	NO OF CASES	PERCENTAGE
RIGHT	42	70
LEFT	18	30

Table 4: ***Mode Of Injury***

MECHANISM OF INJURY	NO OF CASES	PERCENTAGE
ROAD TRAFFIC ACCIDENT	36	60
FALL ON OUT STRETCHED HAND	24	40

Table 5: Type Of Fracture According To Frykman's Classification

TYPE	NO OF CASES	PERCENTAGE
I	6	10
II	1	1.66
III	16	26.66
IV	9	15
V	13	21.6
VI	2	3.33
VII	10	16.6
VIII	3	5

Table 6: Extra Articular And Intra Articular Fracture

TYPE OF FRACTURE	NO OF CASES	PERCENTAGE
EXTRA ARTICULAR	22	36.66
INTRA ARTICULAR	38	63.33

Table 7:Time Since Injury To Date Of Operation

DURATION	NO OF CASES	PERCENTAGE
1 – 5 DAYS	56	93
6 – 10 DAYS	4	7

Table 8: Duration Of Fracture Union

TIME OF UNION	NO OF CASES	PERCENTAGE
2 – 3 MONTHS	44	73
3 – 4 MONTHS	12	20
4 – 6 MONTHS	04	7

Table 9: Quick Dash Score

SCORE	NO OF CASES	PERCENTAGE
≤25	48	80
26 TO 50	12	20
51 TO 75	-	-
TOTAL	60	100

IV. Discussion

Distal radius fractures are most frequently seen upper extremity fractures. The main aim of its treatment is the re-establishment of anatomic integrity and to maintain inter-articular integrity and the radial length. The primary goal in treatment of this injury is to provide good reduction and immediate stability to achieve anatomic fracture union, allow the quick return of hand function, and avoid complications.

Healing of a fracture depends on a minimal gap, adequate stability, and sufficient blood supply. Most fractures of the distal radius are dorsally-angulated and displaced, the dorsal surface the most appropriate for buttress plating as it counteracts the deforming forces. But the disadvantages of dorsal plating (subcutaneous with hardly any soft-tissue cover, added complexity to the operation due to comminution of the dorsal cortex, the dorsal surface of the distal radius is being convex, the extensor tendons rub against plate leading to tenosynovitis and or their rupture and loss of palmar flexion because of dorsal scarring, and early removal of the metalwork did not necessarily prevent such complications) outweighs the potential benefits (application of plate on the unstable side making it a stable construct, subcutaneous surface making easier surgical access).

The development of locking plates allows the fixation of fractures with any direction of the displacement ,through a volar approach and the implant is placed on the tension side of the fracture .The locking plate reduces the compressive forces that are acting on the bone to achieve stability, which may prevent the periosteal compression and impairment of the blood supply, and it is favoured for fracture healing.

In unstable intra-articular distal radius fractures, re-establishment of inter-articular integrity of the wrist and maintaining the radial length are often not possible by closed methods in such cases, where an open reduction is required.

The present study was taken to observe the functional outcome of operative management of distal radial fractures using volar locking plate fixation.

This present study results were compared with that of those obtained by various other studies utilizing different modalities of treatment. In present study the average age is 41.2 years which is comparable with other studies done by Kilic A et al[8],Chung KC et al[9],Lozano-Calderon sa, et al[7] and Anakwe E et al[10] who reported an average age of 45 years, 48.9 years ,51 years and 48 years respectively.

In present study the reduction achieved in terms of radial inclination ,volar tilt and radial length is as follows: the average radial inclination preoperatively was 7.76±5.8 degrees, the average postoperative radial inclination was 18.2±3.3degrees. The average radial inclination achieved was 10.44 degrees.Mean volar tilt was -17.1±7.82degrees and mean postoperative volar tilt was 6.95±4.54degrees , the total correction achieved was 19.63±7.56degrees .The higher degree of correction achieved was due to the fact that the dorsal tilt was expressed in negative value and hence the correction achieved was greater than the normal range (0-11degrees)

Mean radial length 3.66±1.79mm was observed preoperatively with an immediate postoperative radial length of 9.08±1.65mm , we achieved a mean correction of 6.15±2.66mm during the surgical procedure The results are comparable with the studies done by K . Egol et al[12] , Tamara D et al[5], Marco Rizzo . Brain A. Katt . Joshua T and others[11]

The mean range of motion achieved in our study was as follows palmar flexion of 77±3.10degrees, dorsiflexion of 71.5±3.17degrees, radial deviation of 18.16±5degrees, ulnar deviation of 32.60±4 degrees, supination of 73.75±4.07degrees, pronation of 69.41±3.33degrees. These results were taken at 1 year postoperatively and were compared with the normal side.The results can be compared with studies done by Tamara D et al[5] and Marco Rizzo.et al[11].

In our study stiffness and extensor pollicis longus tendon irritation were the most common complications (6.6 %) seen ,similar when compared to that of studies conducted by Rohit Arora et al[6] and YukichiZenke et al[4].

V. Conclusion

In conclusion, we looked at Functional results of volar locking compression plates and found an improved range of movement and radiological outcome at three , six months and one year follow up. Thus, this study demonstrates that with the execution of good surgical techniques, including proper plate position, proper insertion of screws and avoidance of past pointing, and proper patient selection, a satisfactory functional and radiological outcome can be obtained for a great majority of patients with most of the distal radius fractures(incl. Complex intra-articular by using a volar locking plate fixation.

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