Original Research Paper

Volume - 11 | Issue - 10 | October - 2021 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Orthopaedics

OUTCOMES OF CLOSED UNSTABLE DISTAL RADIUS FRACTURES OPERATED AND FIXED WITH VARIABLE ANGLE LOCKING PLATE

Dr. Rajesh Kapila	Prof and I/C Orthopaedics, GMC, Amritsar.
Dr. Kamal kumar arora	Asst. Prof Orthopaedics, GMC, Amritsar.
Dr. Utkarsha	MBBS intern, MMU, Solan.
Dr. Lokesh Chugh*	Senior Resident Orthopaedics, GMC, Amritsar. *Corresponding Author
Dr Shweta Makker	Medical officer, civil hospital, Ajnala, Amritsar.
Dr. Jatinder Singh	Senior resident Orthopaedics, GMC, Amritsar.

ABSTRACT **INTRODUCTION AND AIM:** This study aims to evaluate the functional and radiological outcomes in unstable distal end radius fractures treated with variable angle locking plates.

MATERIAL AND METHODS: We reviewed 20 unstable distal end radius fractures that were operated and fixed with variable-angle locking plate.

RESULTS: According to Green and O'Brien Score (Cooney's modification) , excellent results were reported in 70 %,while good results were present in 20% cases, fair results were seen in 10% cases.

CONCLUSION: The use of variable angle locking plates (VALP) in treating unstable distal end radius fractures is associated with excellent to good functional outcomes with minimal complications. VALP allows subchondral purchase in the articular fragments due to the flexibility in the implant as far as plate positioning (that can be placed even beyond watershed line for very distal radius fractures) and as far as screw positioning in different directions (that can hold various distal fracture fragments as well as styloid process fracture). By this way, VALP helps in maintaining the reduction and predictably yields better functional outcome especially in unstable distal end radius fractures with early return to pre-injury occupation.

KEYWORDS : Unstable fractures, distal radius, variable angle locking plate(VALP).

1. INTRODUCTION :

Fractures of the distal end of radius represent approximately 16% of all fractures treated by orthopaedic surgeons[1]. It is a common injury of upper extremity. Such fractures mainly affect the elderly population and involve low energy trauma[2]. Restoration of volar angulation, radial length, and radial inclination are essential for good functional outcomes at the wrist joint. Maintenance of articular congruity and stable fixation reduce the incidence of osteoarthritis and also help in earlier rehabilitation[3]. Management of distal end radius fracture has undergone extraordinary evolution over the preceding few years. Various treatment modalities, including plaster cast application, Kirschner wire fixation, dorsal and volar plates (locking and non-locking),and external fixation, have been described for the management of these fractures[4,5]. Osteoporosis is one of the major factors in deciding on the treatment modality, and locking plates are favoured in the treatment of these complex fractures[6]. Locking volar plates mechanically bridge the bone and share the load through the locking construct, thus result in lower failure rate. The subchondral placement of distal screws is essential to prevent a loss of reduction and to achieve good functional results[5].

Comminuted distal end radius fractures may require the use of additional fixation methods such as Kirschner wire and dorsal plate in addition to volar fixed-angle plates. This is because the volar fixed-angle locking plates allow the screws to be inserted in a predefined direction, and they do not take into account the personality of the fracture and any variability in the positioning of the plate. This type of fracture can be better managed with the use of a variable-angle plate[7]. Distal placement of plate in case of small distal fragment beyond watershed line and placement of screw in different direction holding various fragment in comminuted fracture is possible by variable angle locking plate[7].

2. OBJECTIVE:

a. Evaluate functional outcome. b. Evaluate radiological outcome. c. Evaluate complications if any.

3. PATIENTS AND METHODS:

This was a prospective study of 20 cases of unstable fracture of distal end radius treated with variable angle locking plate, admitted in Department of Orthopaedics, Govt medical college, Amritsar. An informed consent was taken.

INCLUSION CRITERIA:

1. All unilateral unstable fractures of distal end radius, more than 18 years of age (in skeletally mature patients).
2. All fresh fractures or presentation less than 2 weeks,
3. Closed fractures.

EXCLUSION CRITERIA:

1. Simple, stable, extra articular distal end radius fractures
2. Patient less than 18 years of age.
3. Compound fractures.
4. Pathological fracture.
5. Patient with severe co- morbidities.
6. Patients who refused to participate in study

Emergency management: Patients were given first aid in the form of splintage of the wrist joint, anti-inflammatory drugs and analgesics were administered as and when required. General physical and local examination was done and noted.

Imaging of the Wrist Posteroanterior and lateral views of the wrist were obtained, with oblique view for further fracture definition, contralateral wrist views may help to assess the patient's normal distal radius radiological parameters.

Pre-operative preparation: Pre-operative counselling of patient and his relatives regarding the method of treatment and prognosis was done and consent was taken. Thorough preoperative planning was done to assess the proper procedure. In operative group appropriate parenteral broad spectrum antibiotics was given just pre-operatively and continued for 3-5 days after operation.

Operative technique: Variable angle volar locking plate was to be applied using the Modified Henry's approach between the radial artery and Flexor carpi radialis tendon (Fig.1). Fracture site was exposed; anatomic reduction was done and fixed with the plate (Fig.2) .

(Fig.1) 

(Fig.2) 

Post-Operatively As per protocol the sutures were removed on 12th day. Physiotherapy in form of active assisted exercise were started early. Patients were assessed clinically and radiologically in follow up visits at 4th, 8th, 12th, 16th, 20th, 24th weeks.

The final results were evaluated and correlated according to **Green and O'Brien** criteria.

Criteria	Findings and Score	Findings and Score	Findings and Score	Findings and Score	Findings and Score
Pain	25 No pain	20 Mild pain	15 Moderate	0 Severe	
Functional Status	25 Returned to regular employment	20 Restricted employment	15 Restricted but unemployed	0 Unable to work	
Grip Strength	25 Normal	15 75%-99% of normal	10 50%-74% of normal	5 25%-49% of normal	0 0-24% of normal
Range of movement	25 (normal) Palmar flexion dorsiflexion arc is more than 120°	15 (75%-99% of normal) Palmar flexion dorsiflexion arc is 91°-119°	10 (50%-74% of normal) Palmar flexion dorsiflexion arc is 61°-90°	5 (25%-49% of normal) Palmar flexion dorsiflexion arc is 31°-60°	0 (0-24% of normal) Palmar flexion dorsiflexion arc is less than 30°
Final score	Excellent 90-100	Good 80-89	Satisfactory 65-79	Poor Below 65	

The quality of reduction was measured with a standard radiograph and then classified as satisfactory in cases with a dorsal tilt < 10°, < 2mm of radial shortening, and < 2mm of joint surface step-off [8,9]. The range of motion at the wrist joint was measured with the help of a goniometer. The grip strength was calculated using a digital hand dynamometer. The patient was made to stand with his/her elbow at full extension and with the shoulder adducted and neutrally rotated. The grip strength was measured in kilograms and as a percentage of the normal strength of the other wrist.

4. RESULTS:

In our study:

- The mean age was 43.55±11.076 years (ranged from 18-60 years)
- Females were predominantly affected; M:F::08(40%):12(60%)
- Fall was the leading cause of injury involving 12(60%) followed by roadside accidents 08(40%).
- Right side [14 (70%)] was most commonly involved.
- Associated injuries were seen in three(15%) patients in present study. Ulnar styloid fracture were seen in 07(35%) patients.
- It was observed that the maximum number of patients [10 (50%)] had C1 fracture patients.
- Mean time of radiological union in patients is 8.4 ±1.23 weeks.(Fig. 3)
- The mean volar tilt was 4.65 ± 3.94 degrees. (Fig.4)
- The mean radial shortening 1.7 ± 1.92mm.(Fig.5)
- The mean radial inclination was 16.85 ± 5.102 degrees.(Fig.6)
- Mean range of motion, palmer flexion 77.5 degree, dorsiflexion 69.5degree, supination 76 degree, pronation 75.75 degree, ulnar deviation 27.5 degree and radial deviation of 17.45 degree was seen in patients treated with volar plating.
- 16(80%) patients had no limitation of movements, three(15%) patients had mild limitation of movements and that too was managed conservatively.
- The complication observed was superficial infection in four patients.
- Hypertrophic scar was observed in two patients. All being managed conservatively.
- As per Green O' Brien scoring system (Cooney's modification) we had excellent results in 14(70%) patients, good results in four (20%) patients and fair results in two(10%) patients. No poor results were seen in any patient.(Fig. 8)

5. DISCUSSION:

Management of comminuted distal radius fracture has undergone considerable change with the advent of newer implants, Variable angled Locking Plate (VALP) is the latest in this armamentarium. The flexibility in the placement of both plate as well as screws allow it to be used very distally in case of small distal fragments and fixing different fracture fragments through variable angle screws without using additional implants.

The present study was a prospective study of 20 cases having closed, unstable distal radius fracture . Open reduction and internal fixation with VALP was done.

Patients had mean age of 43±11 yrs (18-60 yrs), with female preponderance (eight males, 12 females), with history of fall as major cause of injury (60%) and right side was most commonly affected side(14 patients ie. 70%) Majority of cases of distal radius fractures were of AO type C1 (50%), followed by type B3 (20%), B2 (15%), C2 (10%) and C3 (5%).

Post operative mean range of motion, palmer flexion 77.5 degree, dorsiflexion 69.5 degree, supination 76 degree, pronation 75.75 degree, ulnar deviation 27.5 degree and radial deviation of 17.45 degree was seen in patients treated with volar plating. Results of present study were comparable to study done previously Kavin k et al (2016)[13]

The mean volar tilt was 4.65 ± 3.94 degrees. (Fig. 4) that was similar with study done by Saraogi Akash Ashok et al (2014)[12] (3.43 degrees) by Kevin k et al (2016)[13] (5.21±5.17º).

The mean radial shortening 1.7 ± 1.92mm.(Fig. 5) and the mean radial inclination was 16.85 ± 5.102 degrees.(Fig.), both were comparable to that of Prem Kotian et al (2017)[14] (4.71±2.31 mm, 15-16º) study group patients.

Mean time of bone union, confirmed on follow up x ray was 8.4±1.23 weeks. Comparing to study conducted by Margaret W. M. Fok et al (2013)[11], similar results were seen.

Radiological parameters were maintained at final follow up and functional results in term of range of motion and grip strength improved from 8 weeks till final follow up.

Patients responded well with minimal complications, four patients (20%) had postoperative superficial infection which was cured with conservative management.

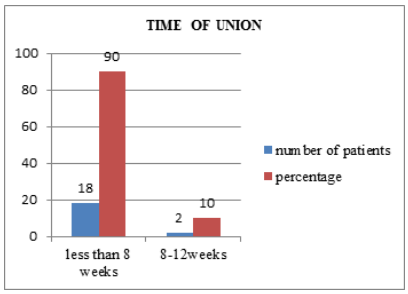
VALP could be placed even beyond watershed line with no risk of flexor tendon rupture. Variability in screw positioning provided better subchondral purchase as well as helped in holding different fracture fragments without using additional implants. Screw malpositioning was not reported with judicial use of fluoroscopy.

In present study by using Green O' Brien scoring system (Cooney's modification) excellent results were observed in 14(70%) patients, good results in four(20%) patients and two(10%) patients had fair results (Fig. 8). Assessing results after distal radius fracture treatment, study done by Kavin k et al (2016)[13], concluded excellent results in 65%, good results in 35% patients Results in our study were comparable with previous study.

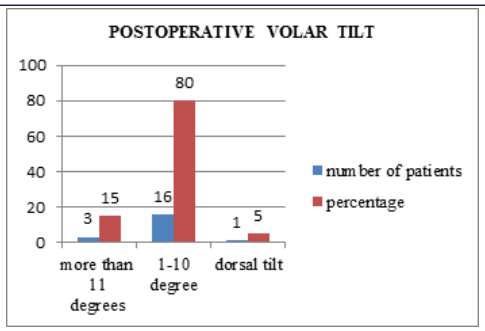
Management of comminuted distal radius fracture requires proper articular restoration, radiological alignment parameter with in normal limits and adequate fixation of various fragments with minimal use of addition implants so as to initiate early rehabilitation. In our study we have observed that all these criteria are well fulfilled by variable angle Locking Plate which not only fixes various fracture fragments but due to variable angle screw placement allows better subchondral purchase and hence affords rigid fixation. This allowed us to have early rehabilitation protocol even in comminuted fractures, so as to have good functional outcome which is clear from our results.

6. CONCLUSION:

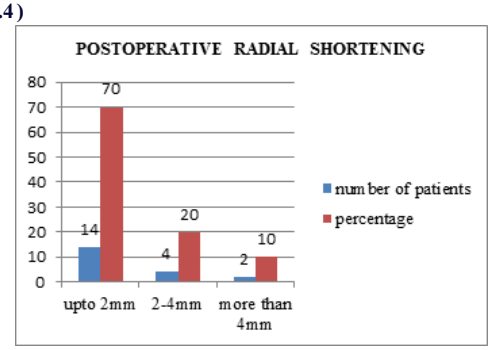
The use of variable angle locking plates (VALP) in treating unstable distal end radius fractures is associated with excellent to good functional outcomes with minimal complications. VALP allows subchondral purchase in the articular fragments due to the flexibility in the implant as far as plate positioning (that can be placed even beyond watershed line for very distal radius fractures) and as far as screw positioning in different directions (that can hold various distal fracture fragments as well as styloid process fracture). By this way, VALP helps in maintaining the reduction and predictably yields better functional outcome especially in unstable distal end radius fractures with early return to pre-injury occupation.



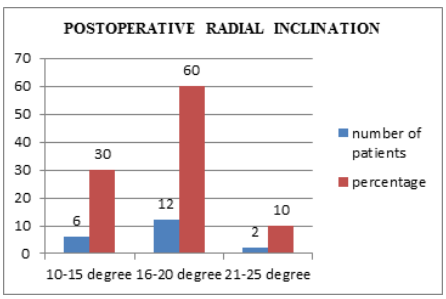
(Fig.3)



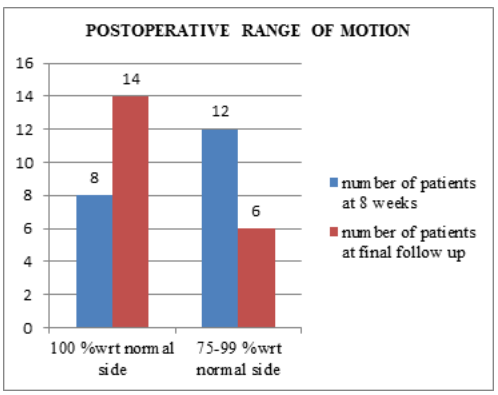
(Fig.4)



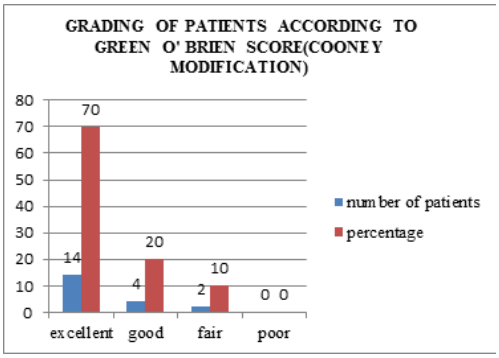
(Fig.5)



(Fig.6)



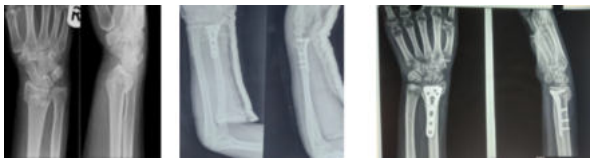
(Fig.7)



(Fig.8)

CASE 1: AO TYPE C1 managed by ORIF with VALP fixation (Fig.9)

a.preop x ray **b. immediate postop** **c. final follow up**



Range of motion at final follow up (left side- normal)

Case 2: Ao Type B3 Managed By Orif With Valp Fixation (fig.10)

a. preop x ray **b. immediate postop** **c.final follow up**

Range of motion at final follow up (right side-normal)

7. REFERENCES:

1. Leung F, Tu YK, Chew WY, Chow SP. Comparison of external and percutaneous pin fixation with plate fixation for intra-articular distal radial fractures: a randomized study. JBJS. 2008 Jan 1;90(1):16-22.
2. Arora R, Gabl M, Gschwentner M, Deml C, Krappinger D, Lutz M. A comparative study of clinical and radiologic outcomes of unstable colles type distal radius fractures in patients older than 70 years: nonoperative treatment versus volar locking plating. Journal of orthopaedic trauma. 2009 Apr 1;23(4):237-42.
3. Wong KK, Chan KW, Kwok TK, Mak KH. Volar fixation of dorsally displaced distal radial fracture using locking compression plate. Journal of Orthopaedic Surgery. 2005 Aug;13(2):153-7.
4. Ring D, Jupiter JB, Brennwald J, Büchler U, Hastings II H. Prospective multicenter trial of a plate for dorsal fixation of distal radius fractures. The Journal of hand surgery. 1997 Sep 1;22(5):777-84.
5. Osada D, Viegas SF, Shah MA, Morris RP, Patterson RM. Comparison of different distal radius dorsal and volar fracture fixation plates: a biomechanical study. The Journal of hand surgery. 2003 Jan 1;28(1):94-104.
6. Rausch S, Klos K, Gras F, Skulev HK, Popp A, Hofmann GO, Mückley T. Utility of the cortical thickness of the distal radius as a predictor of distal-radius bone density. Archives of trauma research. 2013;2(1):11.
7. Ross M, Heiss-Dunlop W. Volar angle stable plating for distal radius fractures.
8. Trumble TE, Schmitt SR, Vedder NB. Factors affecting functional outcome of displaced intra-articular distal radius fractures. The Journal of hand surgery. 1994 Mar 1;19(2):325-40.
9. Nana AD, Joshi A, Lichtman DM. Plating of the distal radius. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2005 May 1;13(3):159-71.
10. Chung KC, Watt AJ, Kotsis SV, Margaliot Z, Haase SC, Kim HM. Treatment of unstable distal radial fractures with the volar locking plating system. JBJS. 2006 Dec 1;88(12):2687-94.
11. Fok MW, Klausmeyer MA, Fernandez DL, Orbay JL, Bergada AL. Volar plate fixation of intra-articular distal radius fractures: a retrospective study. Journal of wrist surgery. 2013 Aug;2(03):247-54.
12. Fok MW, Klausmeyer MA, Fernandez DL, Orbay JL, Bergada AL. Volar plate fixation of intra-articular distal radius fractures: a retrospective study. Journal of wrist surgery. 2013 Aug;2(03):247-54.
13. Khatri K, Sharma V, Farooque K, Tiwari V. Surgical treatment of unstable distal radius fractures with a volar variable-angle locking plate: clinical and radiological outcomes. Archives of trauma research. 2016 Jun;5(2).
14. Kotian P, Mudiganty S, Annappa R, Austine J. Radiological outcomes of distal radius fractures managed with 2.7 mm volar locking plate fixation-A retrospective analysis. Journal of clinical and diagnostic research: JCDR. 2017 Jan;11(1):RC09.