

A Prospective Study Of Functional And Radiological Outcome Of Intraarticular Distal End Radius Fractures Treated With Volar Locking Compression Plate

Suresh Kripalani¹, Manojit Basak¹, Vidisha Sunil Kulkarni¹, Tejas Patil¹, Krishan Kabra¹

Abstract

Introduction: The distal radial fracture is the most common fracture in the human skeleton. Till this date many methods like closed reduction and casting, percutaneous pinning, external fixation with ligamentotaxis, internal fixation with locking plate and arthroscopically assisted reduction have come up over the period of time but the best treatment of distal end radius fractures is still a matter of debate. This study aims to evaluate the functional and radiological outcome of intraarticular distal end radius fractures treated with volar locking compression plate.

Material and methods: A prospective interventional study was conducted on in-patients at a tertiary care centre from July 2017 to January 2019. Thirty five patients with intraarticular distal end radius fracture underwent volar locking plate fixation and followed up at 4th week, 8th week, 12th week, 6th month, 1 year, 18 months.

Results: we found that 23 (65.7%) patients had very good functional outcome, 10 patients (28.6%) had good functional outcome, 2 patients (5.7%) had satisfactory outcome, there is no patient with poor outcome in this study and 97.1% patients had excellent to good results and 1 patient (2.85%) had fair radiological outcome. Out of 35 patients 3 patients (8.6%) had superficial infection which was treated with antibiotics for adequate period of time with daily dressing. 1 patient (2.9%) had stiffness at the wrist joint which was treated with regular physiotherapy, wax bath.

Conclusion: Use of Volar locked compression plates in distal radius fractures provided excellent to good results with correction and maintenance of distal radius anatomy with early rehabilitation.

Keywords: volar locking compression plate, Fracture distal end radius, functional, radiological, outcome.

Introduction

The distal radial fracture is the most common fracture in the human skeleton with an incidence of about 17% of all fractures.⁽¹⁾ The classic fracture was described by Sir Abraham Colles in 1814. Over the last 200 years the treatment of distal end radius fracture has improved to a great extent.

Low energy, extraarticular, distal radius fracture often does well with closed reduction and cast immobilization. High velocity injuries results in severely comminuted and unstable fractures with intra articular components. 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 over the period of time.⁽³⁾

The goal of distal radius fracture treatment is to restore hand, wrist and forearm function with a high quality of motion and stability. Due to increased rate of complications such as malunion, subluxation or dislocation of distal radio-ulnar joint or late collapse of fracture with procedures such as closed reduction and cast immobilization, ligamentotaxis with external fixator and percutaneous pin fixation are not very much preferred in intraarticular fractures. Furthermore, these procedures often result in poor functional and cosmetic outcome. The residual deformity of wrist adversely affects the hand function causing pain, limitation of supination and pronation, and decreased grip strength as a result of

radiocarpal and distal radioulnar joint arthritis.⁽⁴⁾

Many studies have associated as little as 1mm of incongruity of the articular surface with worse outcomes, where as other reports have found no association between radiographic arthrosis and clinical outcomes. Hence, anatomical articular reduction and stable fixation with or without bone grafting, greatly reduces the incidence of post-traumatic osteoarthritis and stiffness. The accuracy of fracture reduction correlates directly to the final outcome. With the advent of Locking Compression Plate (LCP), the bone fragments can be held together in place even after union to prevent secondary displacement of unstable fractures and post operative collapse especially in elderly osteoporotic bone.⁽⁵⁾⁽⁶⁾

In cases with good bone stock, open reduction and internal fixation is indicated to address the unstable distal end radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through external manipulation and ligamentotaxis.

This study evaluated the functional and radiological outcome of internal fixation with volar locking plate osteosynthesis in the management of unstable, intraarticular fractures of distal end radius.

Method

This prospective study was conducted on in-patients at a tertiary care centre i.e. Post Graduate Institute Of Swasthiyog Pratishtan in the department of orthopaedics for Eighteen months from July 2017 to January 2019 after approval from the ethical committee. A total of 35 patients were selected for the study based on inclusion/exclusion criteria.

Inclusion criteria-

- Adults aged over 18 years both male and female with -

¹Department of Orthopaedics, P.G.I. Swasthiyog Prathishthan Miraj, India – 416410

Address for correspondence:

Dr. Manojit Basak,

Department of Orthopaedics, P.G.I. Swasthiyog Prathishthan Miraj, India – 416410

E-mail: basakmanojit89@gmail.com

closed unstable, comminuted, intra articular fractures of distal end radius –partial articular and complete articular fractures With or without displacement as per AO classification, AO Types-2R3B With subtypes 2R3B1.3,2R3B1.3,2R3B3.1,2R3B3.3 and all subtypes of 2R3C were included in the study.

- Those who gave their consent for the study

Exclusion Criteria-

- Skeletally immature patient,
- Patients with compound fractures,
- patients with dorsal rim(burton)fractures i.e.AO TYPE 2R3B2.1,2R3B2.2,2R3B2.3,0
- Fractures in pregnant female,
- patients with old neglected fractures (more than 3 weeks old).

All the patients were induced in operation theatre under brachial plexus block, with or without general anesthesia under prophylactic antibiotic coverage 30 minutes before. Pneumatic tourniquet was applied and time noted. The distal end of the radius was approached via modified henry's approach. Each fragment was identified, disimpacted and reduced under direct vision. Kirschner wire was used for provisional fixation depending upon fracture pattern. Locking plate was applied to the volar surface. Plate(2.7mm volar locking plate) was placed as distally as possible and fixed with locking screws, to engage the strong subchondral bone but still proximal enough to be out of the joint by not projecting beyond or above the watershed line which was confirmed under image intensifier. Check X-ray in anteroposterior and lateral views were obtained. Physiotherapy protocol was started from the next day itself under observation of skilled physiotherapist. The patients were followed up at 4th week,8th week,12th week,6th month,1 year,18 months and evaluated with DASH questionnaire for functional outcome. For radiological outcome Sarmentio's modification of Lind Strom Criteria was used.

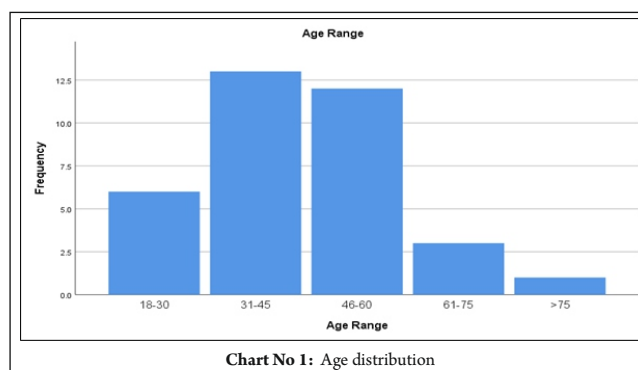
Statistical analysis

The data collected was by using SPSS software by using appropriate statistical tests(based on type and distribution of data). The groups were compared by the chi square test for age, sex, side of involvement, mode of injury, duration for union, functional and radiological outcome and others. Wilcoxon rank sum test is used for DASH scores. P-value of <0.05 was taken for level of significance.

Results

The present study consists of 35 cases of fracture distal end of radius. All the cases were openly reduced and internally fixed with 2.7mm volar locking compression plate. The study period was from July 2017 to January 2019.

1.Age distribution



The age of these patients ranged from 25 -79 years with fracture being most common in 3rd and 4th decade and an average age of 44.60 ± 13.66 years.

2.Sex distribution

Table 1: Sex distribution

SEX					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	3	8.6	8.6	8.6
	M	32	91.4	91.4	100
	Total	35	100	100	

Out of 35 patients, 32 patients (91.4%) were males and 3 patients (8.5%) were females showing male preponderance mostly because of outdoor activities in factories, fields, travelling and sports etc.

3.Side affected:

Table 2: Side affected

SIDE					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	LT	17	48.6	48.6	48.6
	RT	18	51.4	51.4	100
	Total	35	100	100	

4.Mode of injury:

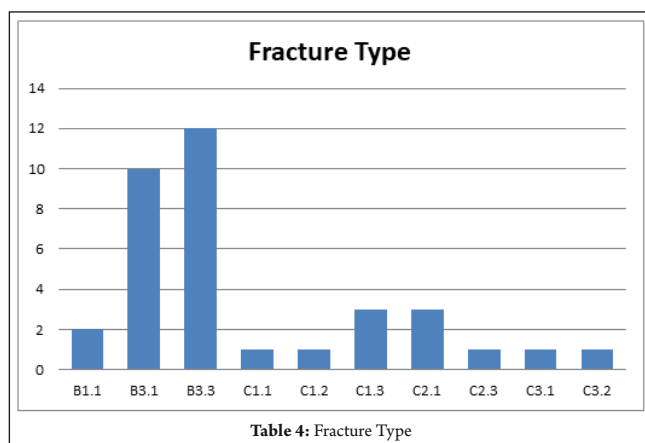
Table 3: Mode of Injury

Mode of Injury(MOI)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ASSUALT	1	2.9	2.9	2.9
	FALL	9	25.7	25.7	28.6
	FALL FROM HT.	2	5.7	5.7	34.3
	FALL OF HEAVY OBJECT	1	2.9	2.9	37.1
	RTA	22	62.9	62.9	100
	Total	35	100	100	

There were 22(62.85%) patients with history of road traffic accidents, 9(25.71%) patients with history of fall and

1(2.8%) patients with history of assault.

6. Fracture characteristics



The fractures were classified according to latest AO OTA classification. Type 2R3B are partial articular fractures amongst which the fractures involving the dorsal rim (Barton's fracture) are not included in the study, Fractures involving the scaphoid fossa i.e. 2R3B1.1 and involving lunate fossa 2R3B1.3 and fractures involving volar rim (volar barton) i.e. 2R3B3.1 and 2R3B3.3 are included in this study.

All complete articular fractures i.e. 2R3C with or without multifragmentary metaphyseal component are also included.

Percentage of 2R3B1.1 (Involving scaphoid fossa) is 5.7%, Percentage of 2R3B3.1 is 28.6% and 2R3B3.3 is 34.3% i.e. volar barton fractures are the majority by 62.9%.

Rest all together intraarticular fractures with or without metaphyseal comminution i.e. 2R3C Type of fractures is 31.7%.

6. Associated injuries

9 (25.7%) patients had other associated injuries

Table 5: Associated Injuries					
ASSOCIATED INJURIES					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	CLW OVER SCALP	1	2.9	2.9	2.9
	L1#, LT ULNAR STYLOID# VOLAR	1	2.9	2.9	5.7
	LEFT DER# (OPPOSITE DER#)	1	2.9	2.9	8.6
	LT GT #	1	2.9	2.9	11.4
	LT SHAFT TIBIA#	1	2.9	2.9	14.3
	LT ULNAR STYLOID#	1	2.9	2.9	17.1
	NIL	26	74.3	74.3	91.4
	RT DER# (OPPOSITE DER#)	1	2.9	2.9	94.3
	RT ELBOW DISLOCATION	1	2.9	2.9	97.1
	RT PILONS#, RT MM#	1	2.9	2.9	100
	Total	35	100	100	

7. Duration of fracture union

Mean union time in our study was 8.25 ± 2.62 weeks, with a range of 6-14 weeks. There was no delayed union or non

union in our study

Table 6: Duration of Fracture Union					
Union time(wks)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6	14	40	40	40
	7	1	2.9	2.9	42.9
	8	11	31.4	31.4	74.3
	10	2	5.7	5.7	80
	12	4	11.4	11.4	91.4
	14	3	8.6	8.6	100
	Total	35	100	100	

motion at wrist at final follow up:

Table 7: Range Of Motion					
Range Of Motion (ROM)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	FULL	23	65.7	65.7	65.7
	GOOD	12	34.3	34.3	100
	Total	35	100	100	

9. Outcome

Table 8: FUNCTIONAL OUTCOME				
FUNCTIONAL				
		Frequency	Percent	Valid Percent
Valid	VERY GOOD	23	65.7	65.7
	GOOD	10	28.6	28.6
	SATISFACTORY	2	5.7	5.7
	Total	35	100	100

Functional outcome was evaluated by DASH scoring system According to DASH score 23 (65.7%) patients had very good functional outcome, 10 patients (28.6%) had good functional outcome, 2 patients (5.7%) had satisfactory outcome, there is no patient with poor outcome in this study. Radiological outcome was evaluated on the basis of SERMENTIO'S modification of LINDSTROM criteria. Out of 35 patients 23 (65.7%) patients had excellent

Table 9: Radiological Outcome		
RESULTS	NO. OF PATIENTS	PERCENTAGE
EXCELLENT	23	65.71
GOOD	11	31.42
FAIR	1	2.857
TOTAL	35	100

radiological outcome whereas 11 (31.42%) patients had good results and 1 patient (2.85%) had fair radiological outcome.

Table 10: Functional Vs Radiological Crosstabulation					
		Count			
		RADIOLOGICAL			Total
		EXCELLENT	FAIR	GOOD	
FUNCTIONAL	GOOD	0	0	10	10
	SATISFACTORY	0	1	1	2
	VERY GOOD	23	0	0	23
Total		23	1	11	35

Table 11: Chi-Square Test			
Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	50.909 ^a	4	0
Likelihood Ratio	49.115	4	0
N of Valid Cases	35		
a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .06.			

As per chi-square test, $\chi^2(4) = 50.909$; $p = 0.000$. As the p-value is coming out to be 0.000, which is less than the critical alpha value of 0.05, it shows there is statistically significant interaction between functional and radiological outcome, which means radiologically excellent and good outcome correlates to functionally very good to good outcome.

10. Complications

Table 12: Associated Complications.					
ASSOCIATED COMPLICATIONS(ASO COMP)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NIL	31	88.6	88.6	88.6
	STIFFNESS	1	2.9	2.9	91.4
	SUPERFICIAL INFECTION	3	8.6	8.6	100
	Total	35	100	100	

Discussion

Over the last decade, several studies have been directed towards clarifying which surgical treatment method would be best for fracture of the distal extremity of the radius. Due to increased rate of complications such as malunion, subluxation/dislocation of distal radio-ulnar joint or late collapse of fracture with procedures such as closed reduction and cast immobilization, ligamentotaxis with external fixator and percutaneous pin fixation are not very much preferred.

Furthermore, these procedures often result in poor functional and cosmetic outcome. The residual deformity of wrist adversely affects the hand function causing pain, limitation of supination and pronation, and decreased grip strength as a result of radio-carpal and distal radio-ulnar joint arthritis(4). Hence to provide the early and effective functional rehabilitation of the distal end radius fractures, open anatomic reduction and internal fixation with locking compression plates(LCP) is mandatory.

This study is undertaken to determine the efficacy, long term results and complications of distal end radius fractures treated with open reduction and internal fixation with 2.7mm volar locking compression plate(Volar LCP) system. We evaluated our results and compared them with those obtained by various other studies utilizing different modalities of treatment. Our analysis is as follows

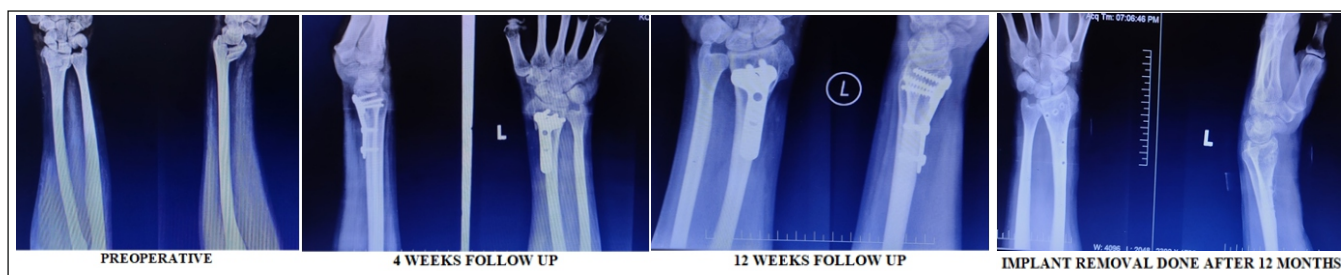
Age distribution: In our study the minimum age of the patient is 25 maximum age is 79 years with an average age of 44.60 as compared with other studies like Kevin C, Chung et al had average age of the patients was 48.9 years with minimum age 18 years and maximum years 83 years.(7) In Rohit A et al average age of the patients was 57 years with minimum age 17 years and maximum years 79(8).

Out of 35 patients, 32 patients (91.4%) were males and 3 patients (8.5%) were females showing male preponderance because of outdoor activities in factories, fields, travelling and sports in our study which is comparable to other studies. The study done by Hanae Minegishi et al included most female 12 (80%) and male 3 (20%).(9)

Mode of injury: There were 22(62.85%) patients with history of road traffic accidents which is the commonest cause of injury in our study, 9(25.71%) patients with history of fall and 1(2.8%) patients with history of assault as compared to the previous studies. In the study of Ayhan Kilic et al also found road traffic accident in 13 patients (48.1%) and fall in 14 patients (51.9%) while Chung KC et al found 42 patients (48.3%) had road traffic accident and 45 patients (51.7%) had trauma due to fall.(10)(7).

In our study all the fractures were closed. according to AO OTA classification we have included the partial articular and intra articular fractures(except for dorsal rim fractures)

In total 2R3B type of fractures are 68.6% out of which 2(5.71%) patients had B1.1 and 10(28.6%) patients had B3.1, 12(34.3%) patients had B3.3 type fractures(volar burton). C type of fractures are 31.7% as compared other





studies. In a study by Jose et al there were 9 (16.9%) A3 fractures, 11 (20.7%) B2 fractures, 15 (28.30%) B3 fractures, 10 (18.86%) C2 fractures and 8 (15.09%) C3 fractures. (11) In another study by V. Gauresh there were Twenty-eight fractures (47%) were classified as AO type A, 9 (15%) as type B and 23 (38%) as type C. (12)

In total 9 (25.7%) patients had associated injuries in our study, if we look at other studies such as in Jakob M et al study out of 73 patients 21 (28.8%) had associated injury and In Aggrawal AK et al study out of 16 patients 10 (62.5%) had associated injuries. (13) (14)

The percentage of associated injuries was low in our study because of exclusion criteria, while in other studies considered all the varieties of injuries

As compared to other studies mean union time in our study was 8.25 ± 2.62 weeks, with a range of 6-14 weeks. There was no delayed union or non union in our study. The difference in union rate was due to variable factors, like there was trend towards increasing union time with higher energy fracture type like in type C fracture but this did not prove significant. While in Anakwe RE, et al average time of bony union was 12 weeks. (15)

UMESH et al in their study found 40 (80%) patients had union within 2-3 months and 8 (15%) patients had union in 3-4 months. There were 2 (4%) cases of delayed union. (16) Excessive distraction of the hardware to obtain satisfactory reduction can result in delayed union non-union.

The range of motion during the final follow up found to be FULL in dorsiflexion, palmar flexion, ulnar deviation, radial deviation, supination and pronation in 23 (65.7%) patients and it was good i.e. with mild restriction in terminal range of motion in 12 (34.3%) patients.

Jose et al in their study found the average wrist range of motion at the end of 1 year of follow-up was 61.13 ± 12.88 degrees flexion (range 35 to 85 degrees) and 50.66 ± 18.43 degrees extension (range 35 to 90 degrees). The average forearm range of motion was 77.43 ± 11.40 degrees supination (range 50 to 90 degrees) and 84.37 ± 5.35 degrees pronation (range 70 to 90 degrees) at 1 year of follow-up. Hand grip strength (compared to opposite side), as assessed by a hand held dynamometer improved from $55.45 \pm 21.55\%$ (range 40 to 90%) at 6 weeks follow-up to $89.00 \pm 4.55\%$ (range 75 to 100) at 1 year follow-up,

respectively. (11) In a study by UMESH et al 98% of the total number of patients at final follow up had an excellent range of dorsiflexion as well as palmar flexion. (16)

Functional outcome was evaluated by DASH scoring system using DASH score we found that 23 (65.7%) patients had very good functional outcome, 10 patients (28.6%) had good functional outcome, 2 patients (5.7%) had satisfactory outcome, there is no patient with poor outcome in this study. Jose et al At the end of 1 year follow-up concluded 11 (20.75%) patients had excellent outcome, 26 (49.06%) had good outcome, 10 (18.87%) patients had satisfactory outcome and 6 (11.32%) patients had poor outcome as per the modified Mayo wrist scoring system. (11). Umesh et al In their series, had 90% excellent, 6% good, 2% fair and 2% poor results. (16)

Radiological Outcome

Out of 35 patients 23 (65.7%) patients had excellent radiological outcome whereas 11 (31.42%) patients had good results that means 97.1% patients had excellent to good results and 1 patient (2.85%) had fair radiological outcome. If we compare the results with other studies we can find similarities like. Chavan et al in their study found that out of 35 patients 19 (54.3%) had excellent radiological outcome, 13 (37.1%) patients had good outcome and 3 (8.6%) patients had fair outcome and no poor outcome was there. (17) In another study by JOSE et al they found On radiological scoring by Sarmiento's modification of Lindstorm criteria, 36 (67.92%) patients had excellent results, 10 (18.87%) patients had good results and 7 (13.21%) patients had fair results. (18)

Complication- Out of 35 patients 3 patients (8.6%) had superficial infection which was treated with antibiotics for adequate period of time with daily dressing. 1 patient (2.9%) had stiffness at the wrist joint which was treated with regular physiotherapy, wax bath.

Conclusions

We conclude that

- Using 2.7 mm volar locking compression plate with locking screws is an excellent method of fixation of intraarticular distal end radius fracture.
- Pre operative planning with proper implant selection and

intraoperatively anatomical reduction, perfect plate positioning are the key to excellent functional and radiological outcome and also avoids complications. The optimal placement of distal screw is important, they must be inserted at the radius styloid, beneath the lunate facet, and near the sigmoid notch. Therefore the plate is positioned near the volar radius margin. But fixation of implants over or distally to the watershed line can exert pressure on the flexor tendon and cause injury, tendon related complications. In our study there was no tendon related complications found.

- Physiotherapy started on the next day itself after surgery

helps in speedy return to full, painless range of motion.

So, these current results are very much encouraging. We believe that restoration of joints and the articular anatomy with optimum postoperative physiotherapy led to desired results of range of movement, grip strength, pain intensity and functional status. Consequently, it seems pretty rational to use volar LCP for fracture of distal radius with volar approach as an effective treatment method in terms of early rehabilitation and excellent functional and radiological outcome compared to other available methods.

References

- O'Neill TW, Cooper C, Finn JD, Lunt M, Purdie D, Reid DM, et al. Incidence of distal forearm fracture in British men and women. *Osteoporos Int*. 2001;12(7):555–8.
- Glowacki KA, Weiss APC, Akelman E. DISTAL RADIUS FRACTURES: CONCEPTS AND COMPLICATIONS. *Orthopedics* [Internet]. 1996 Jul 1 [cited 2018 May 10]; 19(7):601–8. Available from: <https://www.healio.com/orthopedics/journals/ortho/1996-7-19-7/%7B2a9e6267-9f0f-4485-bad2-915fee6335bb%7D/distal-radius-fractures-concepts-and-complications>
- Heaney F, Santy-Tomlinson J. ROCKWOOD AND GREEN'S FRACTURES IN ADULTS. *Orthopaedic and Trauma Nursing: An Evidence-based Approach to Musculoskeletal Care*. 2014. 199–220p.
- Chaturvedi B, Irfan Ali S, Krishna S. Modality of Treatment for the Distal End Radius Fracture. *Int J Sci Res Publ* [Internet]. 2014 [cited 2018 Jul 24];4(11). Available from: www.ijsrp.org
- Trumble TE, Culp RW, Hanel DP, Geissler WB, Berger RA. Intra-articular fractures of the distal aspect of the radius. *Instr Course Lect* [Internet]. 1999 [cited 2018 Jul 24];48:465–80. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/10098077>
- Fernandez DL, Geissler WB. Treatment of displaced articular fractures of the radius. *J Hand Surg Am* [Internet]. 1991 May [cited 2018 Jul 24];16(3):375–84. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/1861014>
- Chung K, Spilson S. The frequency and epidemiology of hands and forearm fractures in the United States. *J Hand Surg Am*. 2001;26(5):908–15.
- Arora R, Lutz M, Hennerbichler A, Krappinger D, MD DE, Gabl M. Complications Following Internal Fixation of Unstable Distal Radius Fracture With a Palmar Locking-Plate. *J Orthop Trauma* [Internet]. 2007 May [cited 2019 Jun 29];21(5):316–22. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/17485996>
- Minegishi H, Dohi O, An S, Sato H. Treatment of unstable distal radius fractures with the volar locking plate. *Ups J Med Sci* [Internet]. 2011 Nov [cited 2019 Jun 29];116(4):280–4. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/21702730>
- Kilic A, Kabukcuoglu Y, Ozkaya U, Gul M, Sökücü S, Ozdoğan U. Volar locking plate fixation of unstable distal radius fractures. *Acta Orthop Traumatol Turc* [Internet]. 2009 [cited 2019 Jun 29];43(4):303–8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19809226>
- Jose A, Suranigi SM, Deniese PN, Babu AT, Rengasamy K, Najimudeen S. Unstable Distal Radius Fractures Treated by Volar Locking Anatomical Plates. *J Clin Diagn Res* [Internet]. 2017 Jan [cited 2018 May 22];11(1):RC04–8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28274009>
- Gauresh V. Distal end radius fractures: evaluation of results of various treatments and assessment of treatment choice. *Chinese J Traumatol* [Internet]. 2014 Aug 1 [cited 2018 May 23];17(4):214–9. Available from: <https://www.sciencedirect.com/science/article/pii/S1008127515300535>
- Jakob M, Rikli DA, Regazzoni P. Fractures of the distal radius treated by internal fixation and early function. A prospective study of 73 consecutive patients. *J Bone Joint Surg Br* [Internet]. 2000 Apr [cited 2019 Jun 29];82(3):340–4. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/10813166>
- Aggarwal A, Nagi O. Open Reduction and Internal Fixation of Volar Barton's Fractures: A Prospective Study. *J Orthop Surg* [Internet]. 2004 Dec 4 [cited 2019 Jun 29];12(2):230–4. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/15621913>
- Anakwe R, Khan L, Cook R, McEachan J. Locked volar plating for complex distal radius fractures: Patient reported outcomes and satisfaction. *J Orthop Surg Res* [Internet]. 2010 Aug 5 [cited 2019 Jun 29];5(1):51. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/20687926>
- Nagrle DU, Kadam DS, Bhanushali DR, mujumdar DP, Sarkar DA, Shaikh DI. Outcome of fracture distal radius treated with open reduction internal fixation with volar locking compression plate (A study of 50 cases). *Int J Orthop Sci* [Internet]. 2018 Jan 1 [cited 2018 Jul 22];4(10):1003–11. Available from: <http://www.orthopaper.com/archives/?year=2018&vol=4&issue=1&part=O&ArticleId=823>
- Chavhan AN, Dudhekar UJ, Badole CM, Wandile KN. Functional and radiological outcome in distal radius fractures treated with locking compression plate. *Int J Res Med Sci* [Internet]. 2017;5(2):574. Available from: <http://www.msjonline.org/index.php/ijrms/article/view/2281>
- Jose A, Suranigi SM, Deniese PN, Babu AT, Rengasamy K, Najimudeen S. Unstable distal radius fractures treated by volar locking anatomical plates. *J Clin Diagnostic Res*. 2017;11(1):RC04–8.

Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Kripalani S, Basak M, Kulkarni V S, Patil T, Kabra K. A Prospective Study Of Functional And Radiological Outcome Of Intraarticular Distal End Radius Fractures Treated With Volar Locking Compression Plate. Journal of Trauma and Orthopaedic Surgery Jan-Mar 2020;15(1): 5-11.