European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 09, Issue 04, 2022

ORIGINAL RESEARCH

A STUDY OF MANAGEMENT OF DISTAL END RADIUS FRACTURES USING PLATE OSTEOSYNTHESIS

Sudheer Kumar Dachepally[1], J. Rajesh[1], B. M. Chndrashekar[1], Uma Durga Vinod[1]

[1]Assistant Professors, Department of Orthopedics, Govt Medical College/General Hospital, Suryapet, Telangana, India,

Corresponding Author:
Dr. B. M. Chndrashekar, Assistant Professors, Department of Orthopedics, Govt Medical College/General Hospital, Suryapet, Telangana, India.

ABSTRACT

Background: To Study the surgical, Functional outcome and complications of Intra articular fracture (Frykmann Classification) of distal end of radius treated with open reduction and internal fixation by plating.

Materials and Methods: The study will be conducted on patients of distal end radius fractures treated by plate osteosynthesis in Department of Orthopedics, Govt Medical College/General Hospital, Suryapet during the study period January 2021 to March 2022 Sample size –cases of Distal end radius fractures treated with Plate osteosynthesis during 18 month period in our hospital.

Results: The mean age of the patients taken up for the study was 45.9 years with the youngest patient being 21years and the oldest being 79 years. There were 11 female patients (55%) and 9 male patients (45%). Mode of trauma due to fall 12 patients(60%) is more as compare to RTA(road traffic accident) 08 patients (40%). Left side 11 patients (55%) is involved more as compare to right 09 patients (45%). Present study documents 90% functional excellent to good results, suggests that stabilizing the fracture fragments with volar plate and screws in the management of the fractures of distal radius, is an effective method to maintain the reduction till union and prevent collapse of the fracture fragments, even when the fracture is grossly comminuted/intraarticular/unstable and/or the bone is osteoporotic.

Conclusion: The technique emphasizes that open reduction and internal fixation with volar plating has excellent functional outcome with minimal complications thus proving that it is the prime modality of treatment for distal radius fractures.

Keywords: Distal end radius fractures, volar plate, Plate osteosynthesis, RTA.

INTRODUCTION

Fractures of the distal radius continue to be the most common skeletal injuries treated by the orthopedic surgeon. In fact, these injuries are the most common fractures of the upper extremity and account for approximately 1/6th (16%) of all fractures seen and treated in emergency rooms.[1-3] Distal radius fractures impair the mechanical foundation of the man's most important tool, the hand. No other fracture of metaphysis has a greater potential to destroy hand function and more soft tissues damage. The same ligaments, retinaculae, tendons and the periosteum that cover the fracture which are the surgical barrier for open reduction of the fracture fragments, help to achieve reduction of the fracture by ligamentotaxis.[4]

In most of the cases prompt detection of displacement of articular fragments, stability, and reducibility provides a rational basis of optimal management of these complex distal end radius fractures. Many distal radius fractures are relatively uncomplicatedand are effectively treated by closed reduction and immobilization in cast. However unstable / intra-articular fractures can damage the integrity of the articular congruence and /or kinematics of these articulations.[5]

A consensus prevails that vast majority (nearly 90%) of distal radius fractures are articular injuries resulting in disruption of both the radiocarpal and radioulnar joints.[6,7] About 50% of the metphyseal fractures have intra articular extension to radiocarpal or distal radioulnar joint.[5] Intra-articular fractures are inherently unstable, difficult to reduce anatomically and immobilize in closed POP support and are associated with high rate of complications.[8]

With the changing mode of injury, fracture of the distal end radius occurring in younger patients, increasing functional demands of the patients, better understanding of the fracture pattern, advances in biomechanics of the wrist and availability of treatment oriented classification system, it seemswe have to look beyond the conventional teaching that they all do well ultimately. Distal radius fractures especially the high energy fractures are often associated with poor results and high complication rates.[5] Preservation of the articular congruity is the principle prerequisite for successful recovery.[7] The best method of obtaining and maintaining an accurate restoration of articular anatomy however, remains a topic of considerable controversy.[7]

As open reduction and volar plating ensures more consistent correction of displacement and maintenance of reduction, this study evaluates the functional outcome of open reduction and plate fixation in the management of fracture distal end radius.

Aims and objectives

1. To Study the surgical outcome of Intra articular fracture (Frykmann Classification) of distal end of radius treated with open reduction and internal fixation by plating.
2. To assess the functional outcome of distal radius fractures treated with plate osteosynthesis
3. To study the complications associated with the procedure.

MATERIALS & METHODS

Source of Data: The study will be conducted on patients of distal end radius fractures treated by plate osteosynthesis in Department of Orthopedics, Govt Medical College/General Hospital during the study period January 2021 to March 2022.

Sample size: Cases of distal end radius fractures treated with Plate osteosynthesis during 18-month period in our hospital.

Method of Collection of Data: We will prospectively follow up cases of distal end radius fractures treated with Plate osteosynthesis during 18 month period in our hospital. Patients with distal end radius fracture are admitted and examined according to protocol both clinically and radiologically. Fracture care will be provided by trained Traumatologist at our hospital. They will be followed up regularly by clinical examination, Neers' scoring and X rays taken immediately after operation, at 6 weeks, 12 weeks and 24 weeks after surgery.

Study Design: Observational prospective study

Inclusion Criteria:

1. Patients who are medically fit and willing for surgery.
2. Age group of 20-70 years of both sexes
3. All patients with distal end radius fractures treated with Plate osteosynthesis.
4. Patients willing to give consent

Exclusion Criteria:

1. Patients below the age of 20 years.
2. Patients who are unfit for surgery due to associated medical problems.

Statistical Analysis: Patients will be evaluated by Demerit point system of Gartland and Werley and results will be analyzed by Proportions.
The investigations done in the cases selected for the study are:

1. Routine Blood investigations
2. X ray wrist – Postero-anterior view and lateral view
3. X-ray forearm with wrist – Anteroposterior and lateral view
4. Immediate Post-operative X ray and at 6 weeks, 12 weeks and 24 weeks after surgery.

Follow Up Protocol: Patients will be followed up regularly at 4 wks, 6wks, 12 wks and 6 months post operatively and each time will be assessed radiologically for reduction and union, and clinically for range of motion.
Objective evaluation is based on range of motion. The minimum required for normal function: dorsiflexion 45 degrees, palmar flexion 30 degrees, radial deviation 15 degrees, ulnar deviation 15 degrees, pronation 50 degrees, supination 50 degrees.

Surgical Technique: Surgery was performed under appropriate anesthesia i.e. either general anesthesia or axillary or supra clavicular block under tourniquet control. Open reduction and internal fixation was done using modified Henry approach between the flexor carpi radialis and radial artery. The pronator quadratus was sharply taken off the radial aspect of the radius and reflected ulnar side to facilitate exposure of the fracture. Under direct visualization and the aid of fluoroscopy, the fracture was then reduced. Depending on the difficulty in achieving the reduction, provisional fixation with k-wires can be occasionally utilized. The plate and screws were placed and the provisional fixation (in use) was removed. The plate was initially secured proximally with a 3.5-mm cortical screw. Upon confirming adequate placement of the plate, a second screw proximal to the fracture was used to firmly secure the hardware. Distal fixation with locking screws was then performed while maintaining the fracture reduced. The remaining proximal fixation was then completed.[9]

Figure 1: Instruments

Figure 2: Skin Incision **Figure 3: Superficial Dissection**

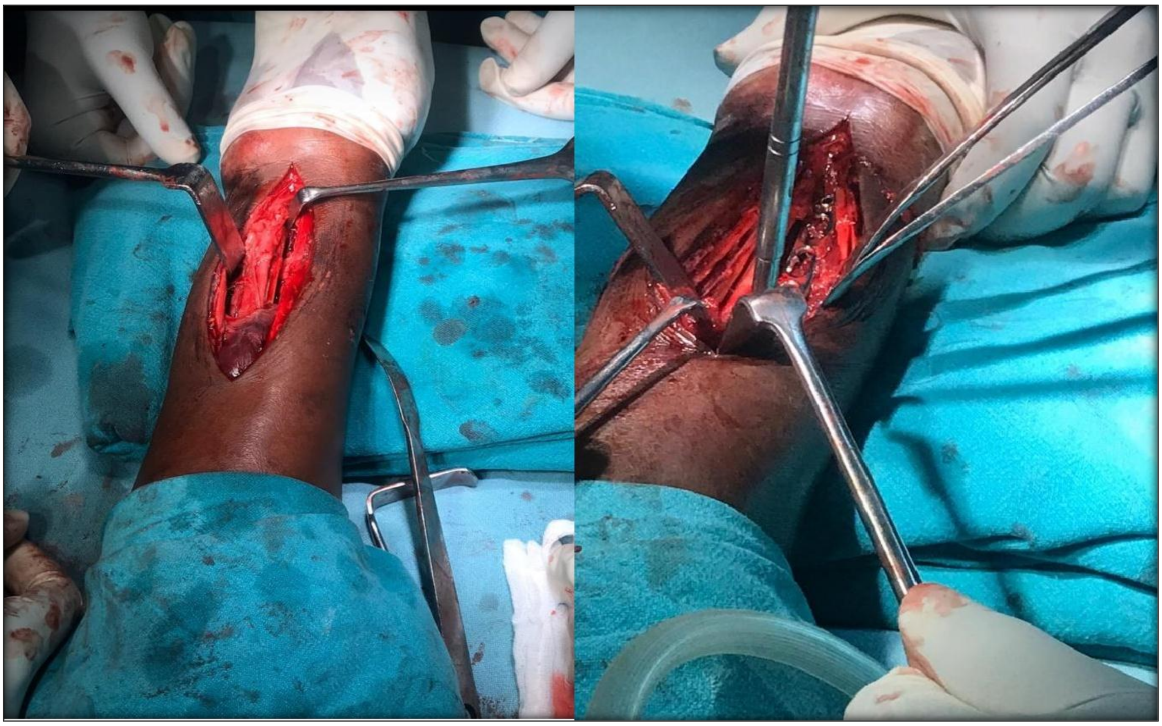

Figure 4: Deep Dissection

Figure 5: Fracture Reduction under C Arm Guidance

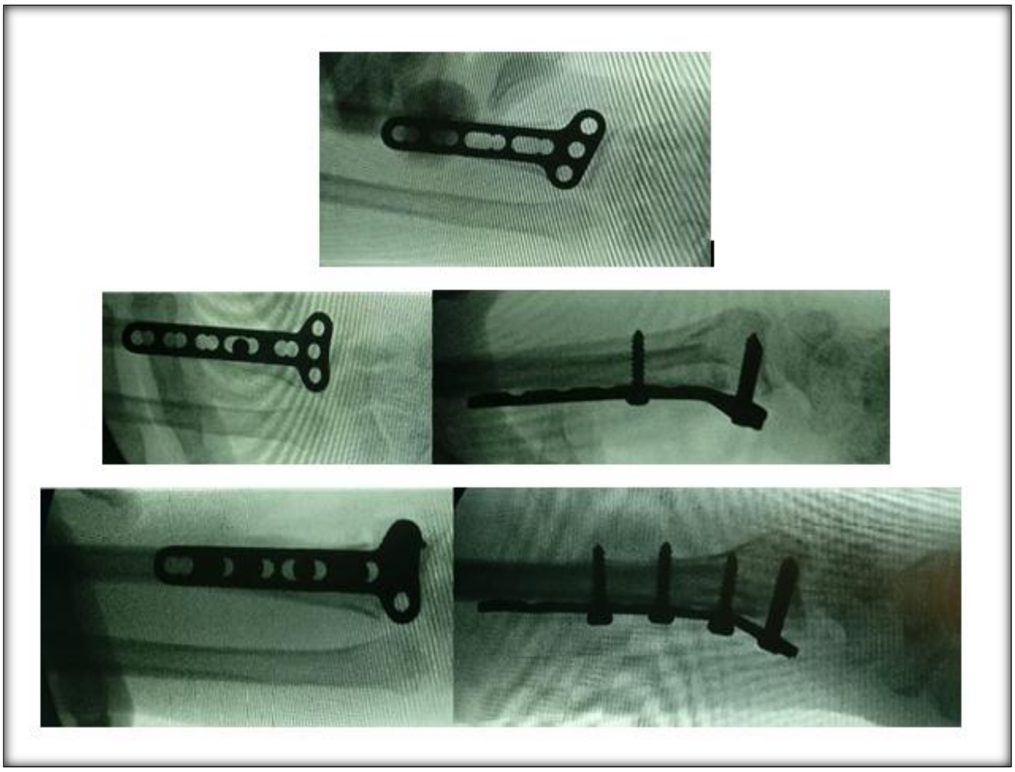

Figure 6: Locking Plate and Screws Fixation

RESULTS

The mean age of the patients taken up for the study was 45.9 years with the youngest patient being 21years and the oldest being 79 years. There were 11 female patients (55%) and 9 male patients (45%).

Table 1: Sex Incidence Ratio

Sex	**No. of cases**	**Percentage**
Male	9	45
Females	11	55

Mode of trauma due to fall 12 patients (60%) is more as compare to RTA (road traffic accident) 08 patients (40%).

Table 2: Mechanism of Injury

Mechanism of injury	**No. of cases**	**Percentage**
FALL	12	60
RTA	8	40

Category 1: trauma due to fall
Category 2: trauma due to RTA (road traffic accident)
Left side 11 patients (55%) is involved more as compare to right 09 patients (45%).

Table 3: Comparisions

Side	No. of cases	Percentage
Right	9	45
Left	11	55

2 patients had associated injuries (multiple rib fractures & tibia fracture) According to Modified AO classification:

- Type A – 9 patients (45%)
- Type B – 10 patients (50%)
- Type C – 1 patient (5%).

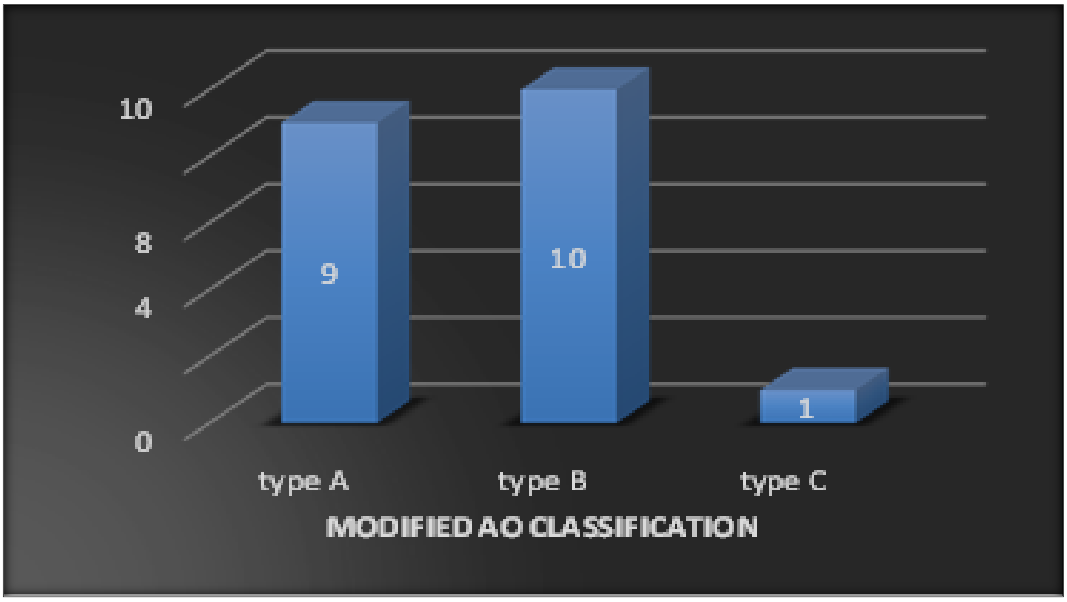

Figure 7: Modified AO Classification

Table 4: Modified AO classification

Type of classification	No. of patients	Percentage
Type A	9	45
Type B	10	50
Type C	1	5

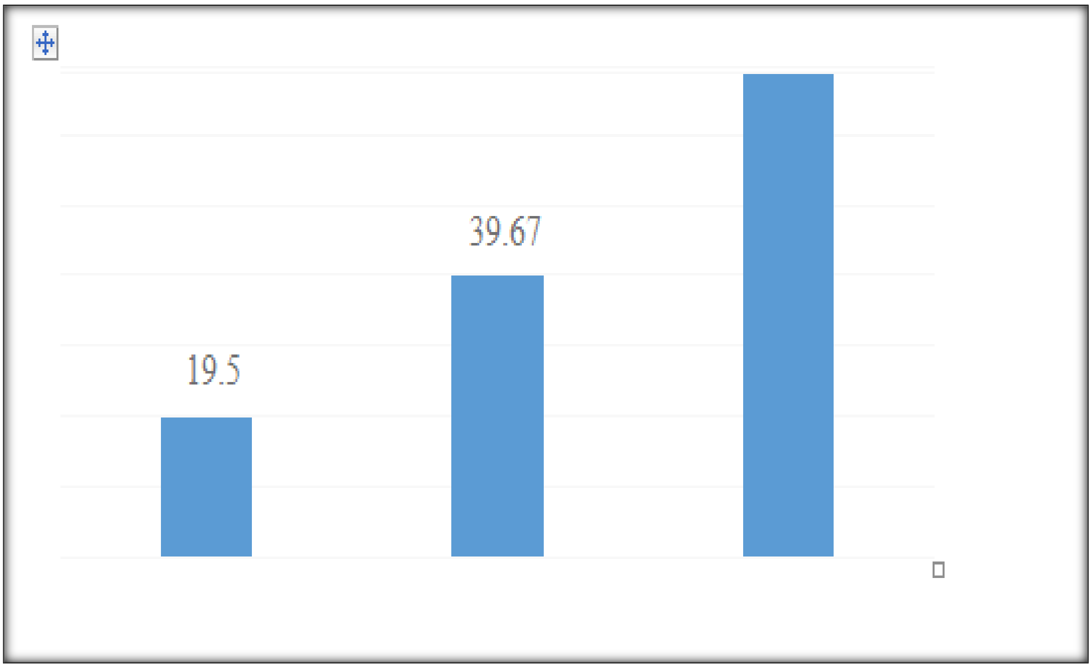

Figure 8: Range of Motion in Wrist after Surgery: Average value in 20 patients

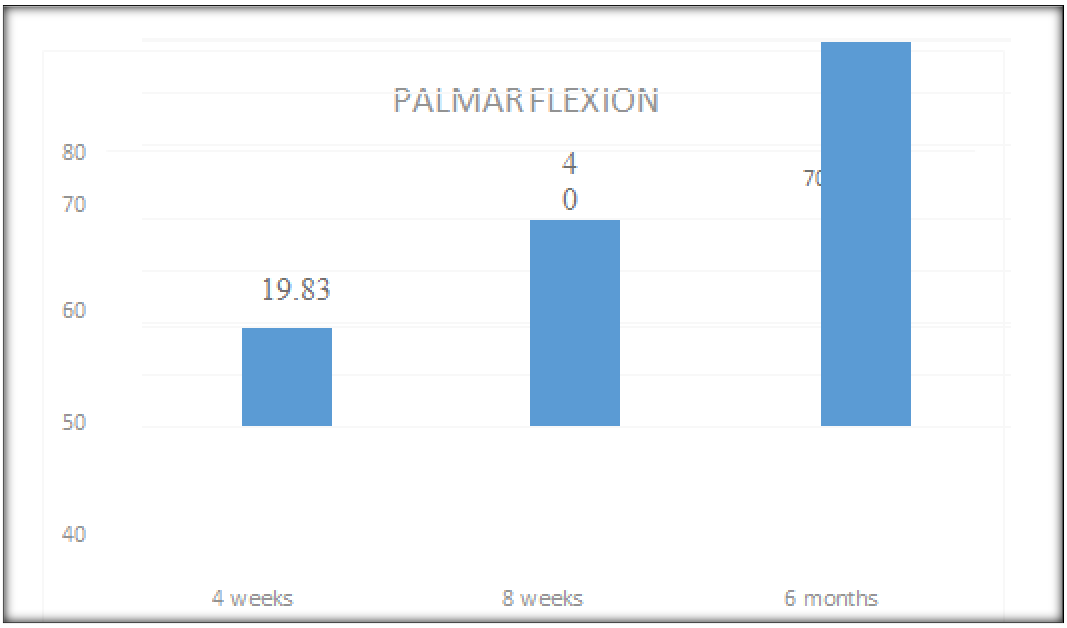

Figure 9: Palmarflexion

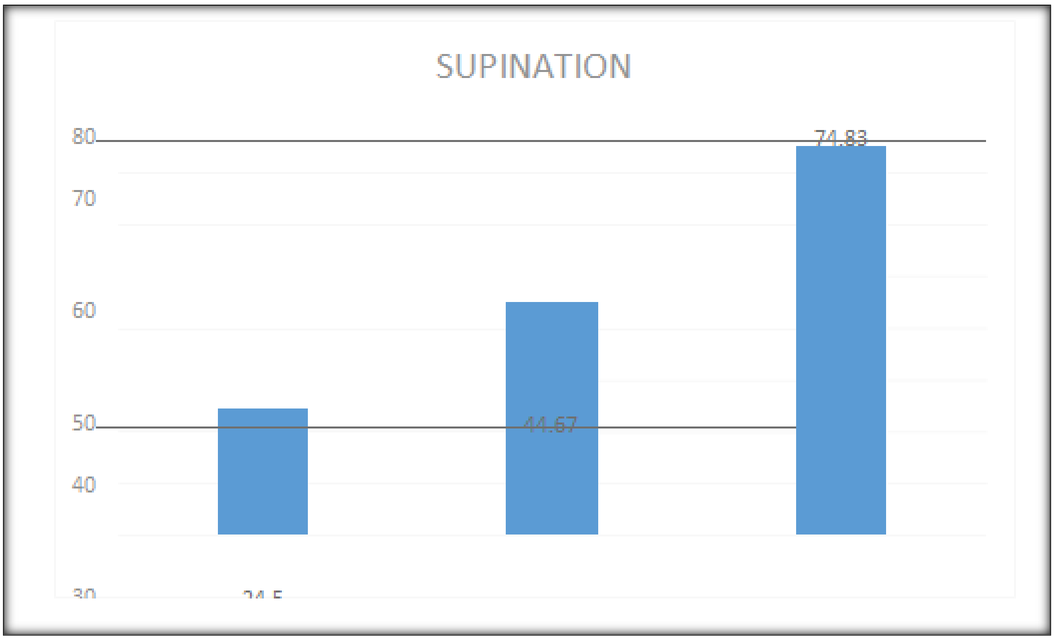

Figure 10: Supination

Table 5: Assessment of Functional Outcome Usin Demerit Point System of Gartland and Werley

Residual Deformity	**Points**	**No of Patients**
Prominent ulnar styloid	1	4
Residual dorsal tilt	2	1
Residual elevation of hand	2-3	0
Point range	0-6	
Subjective Evaluation	**Points**	**No of Patients**
Excellent: no pain, disability, or limitation of motion	0	10
Good: occasional pain, limitation of Motion: no disability	2	8
Fair: occasional pain, limitation of motion, Feeling of weakness, activities slightly restricted	4	2
Poor: pain, limitation of motion, disability, activities more or less restricted	6	0
Objective Evaluation	Points	No Of Patients
Loss of dorsiflexion	5	
Loss of ulnar deviation	3	
Loss of supination	2	1
Loss of pronation	2	
Loss of palmar flexion	1	
Loss of radial deviation	1	
Loss of circumduction	1	
Pain in distal radio-ulnar joint	1	6
Grip strength – 60% or less of opposite side	1	
Complications	**Points**	**No of Patients**
Arthritic change		

	Minimum	1	6
	Minimum with pain	2	2
	Moderate	3	
	Moderate with pain	4	
	Severe	4	
	Sever with pain	5	
Nerve complications		1-3	0
Loss of finger motion		1-3	0
Point range		0-10	
End Result Point Range		**Points**	**No of Patients**
Excellent		0-2	10
Good		3-8	8
Fair		9-20	2
Poor		21 and above	Nil

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. In this context, Osada et al recently documented the increasing popularity of open reduction and internal fixation, especially since the introduction of locked volar plates in 2001. They demonstrated that locked volar plates are well tolerated, allow early mobilization and provide good support for deforming muscle forces after the surgical reduction, even in 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.[10-13] The use of 2 mm plate and screws allows more accurate treatment after reconstruction of joint under direct vision and reestablishment of radial length both intermediate and lateral columns can be buttressed and cancellous bone graft may be added where it is needed. The 2.0 screws usually give good purchase in distal fragments. A 3.5 mm T plate can be used for the intermediate column but not for the lateral column and also this plate is too big for small fragments and it is difficult to obtain a good purchase in comminuted distal fragments.[14] There is extensive work to show that locked volar plates are well tolerated, allow early movement and maintain position even for intraarticular fractures.[9,14] Proposed advantages of locked volar plating include improved pull out strength even in osteoporotic bone.[15] 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.[16] In view of this fixed angle locked volar plate for the distal extremity of radius have gain much space among orthopedic surgeons, since these not only provide stable fixation but also avoids the above mentioned complication.[17,18]

Volar surgical approach avoids need for an extensive dorsal dissection. The plate is positioned in well-padded area beneath pronator quadrates to avoid flexor tendon irritation and it is thought that patient tolerate volar wrist scar better than dorsal one.[19,20] As they are less obvious and the blood supply to the radius is less likely to be disturbed. Dorsal plate fixation is biomechanically effective in buttressing a dorsally displaced fracture of distal radius. Osada et al compared the biomechanical properties of dorsal and volar fracture fixation plate designs in a cadaver model.[21] They reported that if the volarly placed titanium symmetry plate was used to fix a Colles – type fracture, the distal fragment of radius to develop a dorsal angulations of about 9 degrees if early active mobilization of fingers was initiated during the postoperative period, on the other hand, Leung et al demonstrated no statistical difference between axial loading transmission though the intact radius and a distal radius fracture fix with a volar locking plate.[22] In fact, the volar locking plate showed advantages over dorsal plating in the fixation of dorsally unstable distal radius fracture. In addition, volar plate fixation is a valuable method because of decrease risk of inducing dorsal soft tissue complications. The dorsal approach often needs dissection of the extensor retinaculum and sometime dissection of lister tubercle. Therefore the extensor tendon generally exposed to mechanical attrition by the plates and screw. In the volar approach, the volar anatomy of the wrist presents and advantage over the dorsal aspect because there is more space between the volar cortex and the flexor tendons the pronator quadratus can also sometime act as a hedge to prevent soft tissue complications. The palmer cortex is relatively flat, and the plate I better contoured for application from this aspect rather than on the dorsal cortex of the distal radius.[23] The volar cortex of the distal radius was very often not as severe comminuted when compared with dorsal cortex. Anatomical reduction of palmar cortex may avoid the shortening of the radius, which is important for its restoration. The volar plate system used in our study was a locking plate system and this must be one of the reasons for retaining good anatomical reduction. It is very important to select the proper plate width to provide satisfactory subchondral support across the entire articular surface as well as to capture volar ulnar fragments with at least one threaded peg. Volar prominence of the plate is often associated with an insufficient fracture reduction and residual dorsal tilt of the dorsal fragment as well as with plate application distal to the watershed line.[24]

In present study, most of the fractures were united in the time duration of 6 to 8 weeks. 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 weeks17. Overall mean time to fracture union was 8.4 weeks (6-28 weeks) in the study of Phadnis J etal.[25] Excessive distraction of the hardware to obtain satisfactory reduction can result in delayed union nonunion complex regional pain syndrome or digital stiffness.[26]

Avoidance of malunion is important, since a poor anatomical result adversely affects recovery of function as was reflected in the difficulties patients with malunion had with activities of daily living. In study of Keating malunion with dorsal tilt he also concluded that this could be because of inadequately contouring the plate resulting in excessive dorsal angulation of the distal fragments.[27] They suggested that restoration of the normal volar tilt is the single most important determinant of functional outcome. Despite the high rate of malunion they noticed and acceptable level of function after rehabilitation. Present results

ISSN 2515-8260 Volume 09, Issue 04, 2022

have been encouraging. The operation is technically demanding, we believe that restoration of joints and the articular anatomy led to desired results of range of movement, grip strength, pain intensity and functional status. Consequently, it seems rational to use LCP for fracture radius with volar approach as an effective treatment method in terms of early functional mobilization.

CONCLUSION

Present study documents 90% functional excellent to good results, suggests that stabilizing the fracture fragments with volar plate and screws in the management of the fractures of distal radius, is an effective method to maintain the reduction till union and prevent collapse of the fracture fragments, even when the fracture is grossly comminuted/ intraarticular/ unstable and / or the bone is osteoporotic. The technique emphasizes that open reduction and internal fixation with volar plating has excellent functional outcome with minimal complications thus proving that it is the prime modality of treatment for distal radius fractures. The procedure is applicable for AO types A, B and C fractures of the distal radius, in young patients with a good bone stock as well as in elderly osteoporotic patients.

REFERENCES

1. Ark J, Jupiter JB. The rationale for precise management of distal radius fra ctures. Orthop Clin North Am. 1993 April; 24(2): 205-210.
2. Nagi ON, Dhillon MS, Aggarwal S, Deogaonkar KJ. External fixators for intr aarticular distal radius fractures. Indian Journal of Orthopaedics. 2004; 3:19-22.
3. Jupiter JB. Current concepts review Fractures of the distal end of the radius. J Bone Joint Surg (Am). 1991; 73-A: 461- 469.
4. Agee JM. External fixation: Technical advances based upon multiplanar Lig amentotaxis. Othop Clin North Am. 1993; 24 (2): 265-274.
5. Simic PM., Weiland AJ. Fractures of the distal aspect of the Radius: Changes in T reatment over the past two decades. J Bone Joint Surg (Am). 2003; 85-A: 552-564.
6. Melone CP Jr. Articular fractures of the distal Radius. Orthop Clin North Am. 1984; 15: 217-236.
7. Melone CP Jr. Distal radius fractures: Patterns of articular fragmentation. Ot hop Clin North Am. 1993; 24 (2): 239-253.
8. Knirk, JL, Jupiter JB Intra-Articular Fractures of the Distal End of the Radius in young adults. J Bone Joint Surg. 1986; 68-A: 647–659.
9. Rizzo M, Katt BA, Carothers JT. Comparison of locked volar plating versus pinning and external fixation in the treatment of unstable intraarticular distal radius fractures. HAND. 2008;3:111-7.
10. Osada D, Kamei S, Masuzaki K, Takai M, Kameda M, Tamai K. Prospective study of distal radius fractures treated with a volar locking plate system. J Hand Surg Am. 2008;33(5):691-700.
11. Van Eerten PV, Lindeboom R, Oosterkamp AE, Goslings JC. An X-ray template assessment for distal radial fractures. Arch Orthop Trauma Surg. 2008;128(2):217- 21.

12. Gruber G, Zacherl M, Giessauf C, Glehr M, Fuerst F, Liebmann W. Quality of life after volar plate fixation of articular fractures of the distal part of the radius. J Bone Joint Surg Am. 2010;92(5):1170-8.
13. Lozano-Calderón S, Moore M, Liebman M, Jupiter JB. Distal radius osteotomy.In The elderly patient using angular stable implants and norian bone cement. J Hand Surg Am. 2007;32(7):976-83.
14. Leung F, Tu YF, Chew WY, Chow SP. Comparison of external and percutaneous pin fixation with plate fixation for intra-articular distal radial fractures: A randomized study. J. Bone Joint Surg Am. 2008;90A(1):16-22.
15. Mudgal CS, Jupiter JB. Plate fixation of osteoporotic fractures of the distal radius.J. Orthop Trauma. 2008;22(8):S106-15.
16. Sobky K, Baldini T, Thomas K, Bach J, Williams A, Wolf JM. Biomechanical comparison of different volar fracture fixation plates for distal radius fractures. Hand (N Y). 2008;3(2):96-101.
17. 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. 2010;5:51
18. Krukhaug Y, Gjerdet NR, Lundberg OJ, Lilleng PK, Hove LM. Different osteosynthesis for Colles' fracture: a mechanical study in 42 cadaver bones. Acta Orthop. 2009;80(2):239-44.
19. Fernandez DL. Should anatomic reduction be pursued in distal radial fractures?J Hand Surg. 2000;25:523-7.
20. Baratz ME, Des Jardins JD, Anderson DD, Imbriglia JE. Displaced Intra-articular fractures of the distal radius: Effect of fracture displacement on contact stresses In a cadaver model. J Hand Surg Am. 1996;21:183-8.
21. Osada D, Viegas SF, Shah MA, Morris RP, Patterson RM. Comparison of different distal radius dorsal and volar fracture fixation plates: A biomechanical study. J Hand Surg. 2003;28A:94– 104.
22. Leung F, Zhu L, Ho H, Lu WW, Chow SP. Palmar plate fixation of AO type C2 fracture of distal radius using a locking compression plate: A biomechanical study In a cadaveric model. J Hand Surg. 2003;28B:263-6.
23. Wong KK, Chan KW, Kwok TK, Mak KH. Volar fixation of dorsally displaced distal radial fracture using locking compression plate. J Orthop Surg. 2005;13:153-7.
24. Fok MWM, Klausmeyer MA, Fernandez DL, Orbay JL, Bergada AL. Volar plate fixation of intraarticular distal radius fractures: A retrospective Study J Wrist Surg. 2013;2(3):247-54.
25. Phadnis J, Trompeter A, Gallagher K, Bradshaw L, Elliott DS, Newman K. Midterm fuctional outcome after the internal fixation of distal radius fractures journal of orthopaedic surgery and research. 2012;7:4
26. Kaempfe FA, Wheeler, Peimer CA, Hvisdak KS, Ceravolo J, Senall J. Severe fractures of the distal radius: Effect of amount and duration of external fixator distraction on outcome. J Hand Surg (Am). 1993;18-A:33-41.
27. Keating JF, Court-Brown CM, Mcqueen MM. Internal fixation of volar- displaced distal radial fractures. J Bone Joint Surg. 1994;76:401-40..