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**Dr. Suneel Hirekodi**  
Post-Graduate, Department of  
Orthopaedics, Karnataka  
Institute of Medical Sciences,  
Hubballi, Karnataka, India

**Dr. Venkatesh Mulimani**  
Professor and Unit Chief,  
Department of Orthopaedics,  
Karnataka Institute of Medical  
Sciences, Hubballi, Karnataka,  
India

**Dr. Manikya R**  
Assistant Professor, Department  
of Orthopaedics, Karnataka  
Institute of Medical Sciences,  
Hubballi, Karnataka, India

**Corresponding Author:**  
**Dr. Suneel Hirekodi**  
Post-Graduate, Department of  
Orthopaedics, Karnataka  
Institute of Medical Sciences,  
Hubballi, Karnataka, India

## A clinical study to determine the functional outcome of distal end radius fracture managed with volar locking plate and screws

**Dr. Suneel Hirekodi, Dr. Venkatesh Mulimani and Dr. Manikya R**

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### Abstract

**Background and Objective:** Fracture of the distal radius is one of the most common skeletal injuries treated by orthopaedic surgeons. For a favourable functional outcome, radial length, radial tilt angle, and articular surface congruity must all be restored. Recognition of fracture patterns and fixation of fracture to maintain reduction is the key for successful management of complex fractures of distal radius. Volar locking plates allow improved fracture fixation without leading to soft tissue and vascular complications. They have been shown to provide excellent stability for an unstable fracture with volar Metaphyseal comminution. The objective of the study was to evaluate the clinical and functional outcome of fracture of distal end of the radius treated by ORIF by Volar locking plate and screws using Criteria of Gartland and Werley Point System.

**Methods:** Thirty patients with fracture of distal end radius were treated by ORIF by Volar locking plate and screws in Karnataka institute of medical sciences, hubballi. Between from November 2020 to September 2022.

**Results:** The study included 30 patients, 27 male and 3 females aged from 21 to 69 years with mean of 33.53 years. The average duration of follow-up was 12 months. Using the Demerit scoring system of Gartland and Werley score, we had 20% excellent results, 50% good results, 16.67% fair results and 13.3% poor result. As per our results, excellent to good results were found in 70% of patients.

**Interpretation & Conclusion:** ORIF by Volar locking plate and screws can be an alternative to other procedures in treating the extra-articular fracture with volar displacement and volar Barton's fracture radius. Excellent to good results are produced by using volar locking plate for fixation of distal radius fractures.

**Keywords:** Distal radius fracture, open reduction internal fixation (ORIF), volar locking plate

### Introduction

Fracture of the distal radius is one of the most common skeletal injury treated by orthopaedic surgeons. These injuries account for approximately one sixth of all fractures treated in emergency room <sup>[1]</sup>. Fractures of the distal end of the radius continue to pose a therapeutic challenge. Some of these fractures are caused by high energy trauma, resulting in intra-articular involvement and comminution. Treatment of such injuries is difficult. These fractures often are unstable, are difficult to reduce anatomically and are associated with complications of post-traumatic osteoarthritis after intra-articular fracture of the distal end of the radius.

Fractures of the distal radius have been associated with colourful history since its first description by Pouteau in 1783 and later by Abraham Colle's in 1814 <sup>[2]</sup>. Restoration of radial length, radial tilt angle and congruity of articular surface is important for good functional results <sup>[3]</sup>. Failure to achieve and maintain near anatomic reduction can lead to degenerative arthritis, distal radio-ulnar and metacarpal instability and ulnar impaction syndrome with resultant pain, decreased mobility, strength and function <sup>[4]</sup>. Two important changes since the days of colle's are increase in incidence of high energy vehicular trauma and greater demand for perfection by the patient, these factor change the mode of treatment.

Recognition of fracture patterns and fixation of fracture securely and to maintain reduction is the key for successful management of more complex fractures of distal radius <sup>[5]</sup>. Number of classification system has evolved taking into consideration the fracture patterns, degree of

comminution, radial shortening and displacement, dorso-palmar displacement, angulations and soft tissue involvement. This places burden on the surgeon to evaluate each fracture individually.

Recent studies have emphasized that better methods of identifying and classifying distal radial fracture may direct the treating surgeon to alter the treatment and to adopt open reduction of these fractures in the proper circumstances [6]. In order to treat unstable distal Radius fractures and articular incongruities that cannot be anatomically reduced and maintained through external manipulation and ligamentotaxis, open reduction and internal fixation is indicated, provided that there is enough bone stock to allow for early range of motion [7].

A tiny buttress plate, like the one Ellis described, is routinely utilised as a fixation for volar marginal fractures since loss of reduction with displacement of the carpus is so common [8]. Many things are subject to trend and fashion, and the treatment of distal radial fractures is no exception. Pins and plasters gave way to external fixation, and now internal fixation has begun to surpass all other treatment modalities [9]. The purpose of this study was to evaluate the functional and clinical outcome of surgical management of distal radial fractures in adults using Open Reduction and Internal fixation with volar plate and screws.

### Materials and Methods

Source of data: All Patients of volar Barton fractures seen as out-patients and in patients in Karnataka Institute of medical science, hubballi. This is a prospective study from November 2020 to September 2022 Sample size of 30 patients were operated.

### Methods of collection of data

**Patient selection:** After initial resuscitation in the emergency, closed fractures were splinted & operated at the earliest. In our series cases were selected from patient with fracture distal end of radius classifiable on the Frykman's classification system.

**Radiographic assessment of wrist:** Antero-posterior and lateral view were taken, analysis of the articular involvement was done. All the patients selected for the study were admitted, examined according to the protocol, associated injuries if any were noted and clinical and laboratory investigations were done in order to get fitness for surgery. Open reduction and internal fixation by Buttress, plate and screws, was done. Follow up and assessment at 2 weeks, 1 months, 3 months, 6 months, final evaluation was performed at 1 year using demerit point system of Garland and Werley.

**Inclusion criteria:** Adults over 18years of age, both male and female with volar Barton fracture, volar displaced distal end radius, smith's fracture and with or without other associated injuries. Patients medically fit for surgery. Patients willing for surgical treatment and have given informed written consent.

**Exclusion criteria:** Patients below 18 years of age. Patients medically unfit for surgery. Compound fracture associated with vascular injuries. Patients not willing for surgery. Management of patient- As soon as the patient with suspected

distal radius fracture was seen, necessary clinical & radiological evaluation was done. Patients were evaluated & managed either conservatively or by surgical methods. Most patients in the conservative group were treated on out patient basis, some were admitted. All patients planned for surgical management were admitted & Routine laboratory investigation like Hb, BT, CT, and urine complete examination was done. CT of distal Radius with wrist was done for cases which required better appreciation of the fracture pattern. The patients were operated on elective basis after overcoming the avoidable anaesthetic risks.

**Surgical approaches and technique:** In our series all patients underwent open reduction and internal fixation by volar locking plate and screws. The aim was to restore the radio carpal, radio ulnar joint congruity and to regain radial length. The surgery was carried out under general anaesthesia or brachial block after thorough preparation of the parts.

### Surgical exposure

**Modified henry's approach:** A longitudinal incision about 7.5 cm long taken on the radio-volar aspect. The plane between the Flexor carpi radialis and the Palmaris longus was developed. The Flexor Pollicis longus tendon was retracted radially and the median nerve and the other tendons were retracted towards ulna.

The fibers of the pronator quadratus were severed from their origin on the radius and the fracture was exposed. Fracture was reduced and a volar locking plate was contoured so that when it is applied and fixed to the proximal fragment, the distal transverse part will act as a buttress and hold the fracture reduced. The reduction of the fracture and restoration of the articular surface was confirmed by direct observation and by antero-posterior and lateral views in C arm. Pronator quadratus was placed over the plate to its origin on the radius and wound was closed.

### Post Operative Protocol

After the surgery, the operated limb was supported with an anterior or posterior splint and was kept elevated for 3 days till the edema subsided. All the patients received antibiotics, analgesics and anti-inflammatory drugs to prevent infection and to relieve pain and swelling. Active movements of the fingers, elbow and shoulder were started on the first postoperative day. On the 3rd postoperative day, the operated wound was inspected and active movements of fingers and wrist were encouraged and the range of movements depending upon the tolerance of pain by the patients. As the patient's tolerance to pain increased they were motivated for more vigorous physiotherapy regime. Sutures were removed on 10-12<sup>th</sup> postoperative day. The splints were discarded and were replaced by a crepe bandage and patients were advised to carryout normal activity within the crepe bandage and resistant major activities. Non-compliant patients were advised to wear the splints till the first follow-up. Clinical assessment of pain, Range of motion, Clinical & radiological assessment of union and any complications was done on regular follow up. The final evaluation was done on the 12<sup>th</sup> month. The patients were evaluated according to standard objective and subjective criteria using demerit-point system of Gartland and Werley.

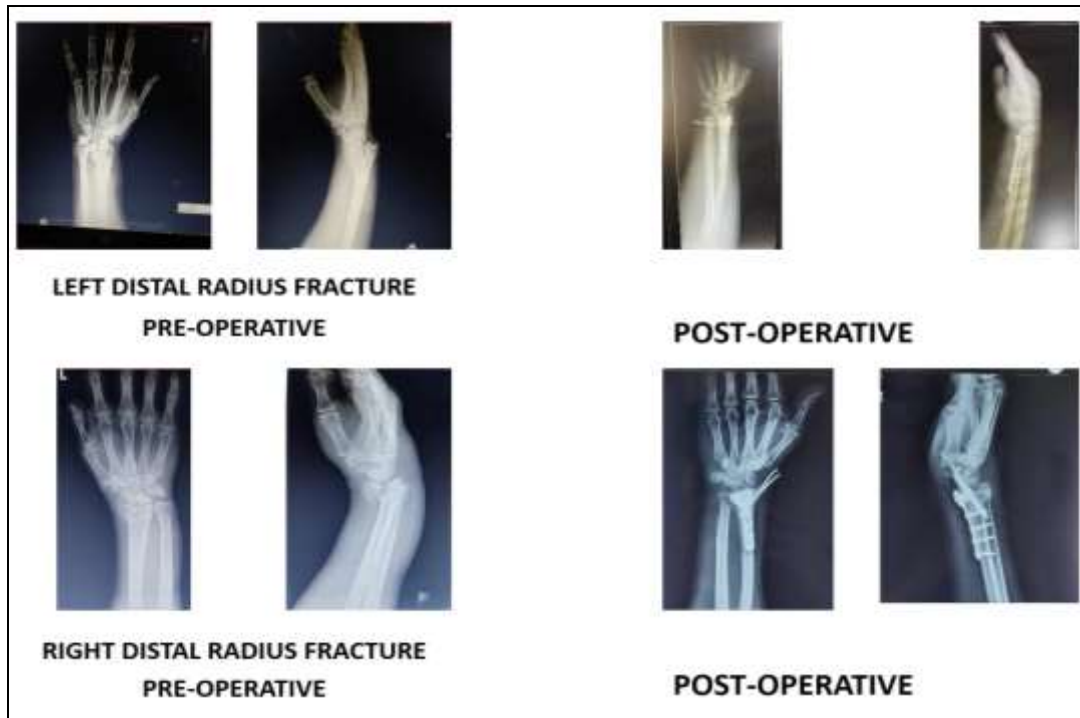
**Table 1:** Demerit-point system of gartland and werley.

Element	Result	Points
<b>Residual deformity</b>	None	0
	Prominent ulnar styloid	1
	Residual dorsal tilt	2
	Radial deviation of hand, mild to moderate	2
	Radial deviation of hand, severe	3
<b>Subjective evaluation</b>	No pain, disability, or limitation of motion (excellent)	0
	Occasional pain, slight limitation of motion, no disability (good)	2
	Occasional pain, some limitation of motion, feeling of weakness in wrist, no particular disability if careful, activities slightly restricted (fair)	4
	Pain, limitations of motion, disability, activities more or less markedly restricted	6
<b>Objective evaluation</b>	No loss or pain	0
	Loss of dorsiflexion	5
	Loss of ulnar deviation	3
	Loss of supination	2
	Loss of palmar flexion	1
	Loss of radial deviation	1
	Loss of circumduction	1
	Pain in distal radio-ulnar joint	1
<b>Arthritic complications</b>	None	0
	Minimal	1
	Minimal with pain	3
	Moderate	2
	Moderate with pain	4
	Severe	3
	Severe with pain	5
<b>Nerve complications</b>	None	0
	Mild	1
	Moderate	2
	Severe	3
<b>Poor finger function due to cast</b>	None	0
	Minimal to mild	1
	Moderate to severe	2

Score (max 24)	Outcome
0 to 2	Excellent
3 to 8	Good
9 to 20	Fair
21 to 24	Poor



**Fig 1:** Implants and instruments



**Fig 2:** Radiographs

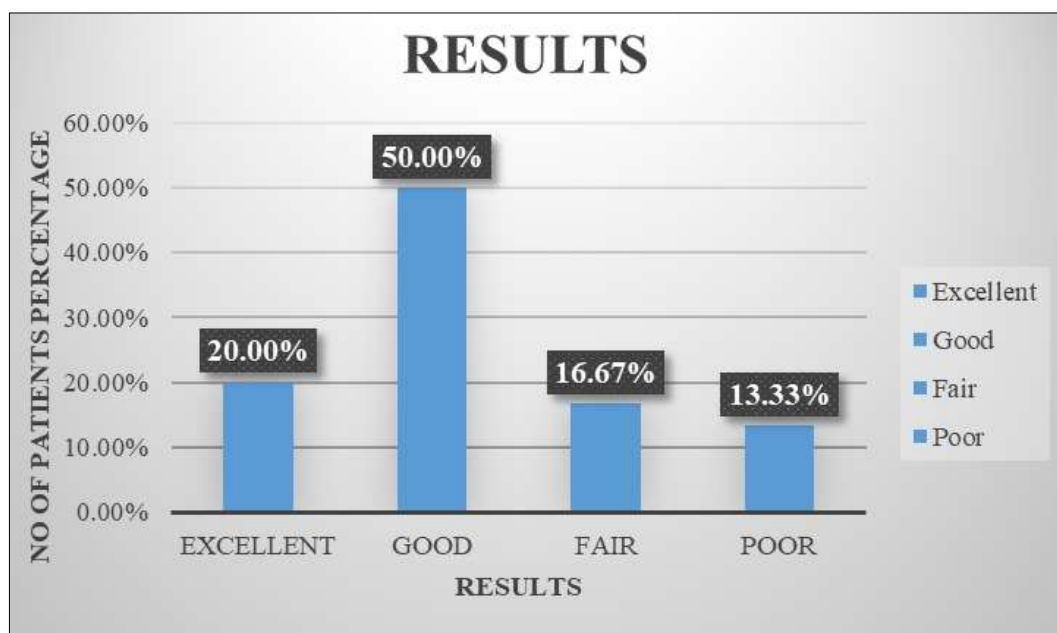
**Results**

Final evaluation in our series was done at 1 Year follow up on the basis of demerit point system of Gartland and Werley. The minimum duration of follow-up for final evaluation in our series was one year. In our series 6 patients had excellent

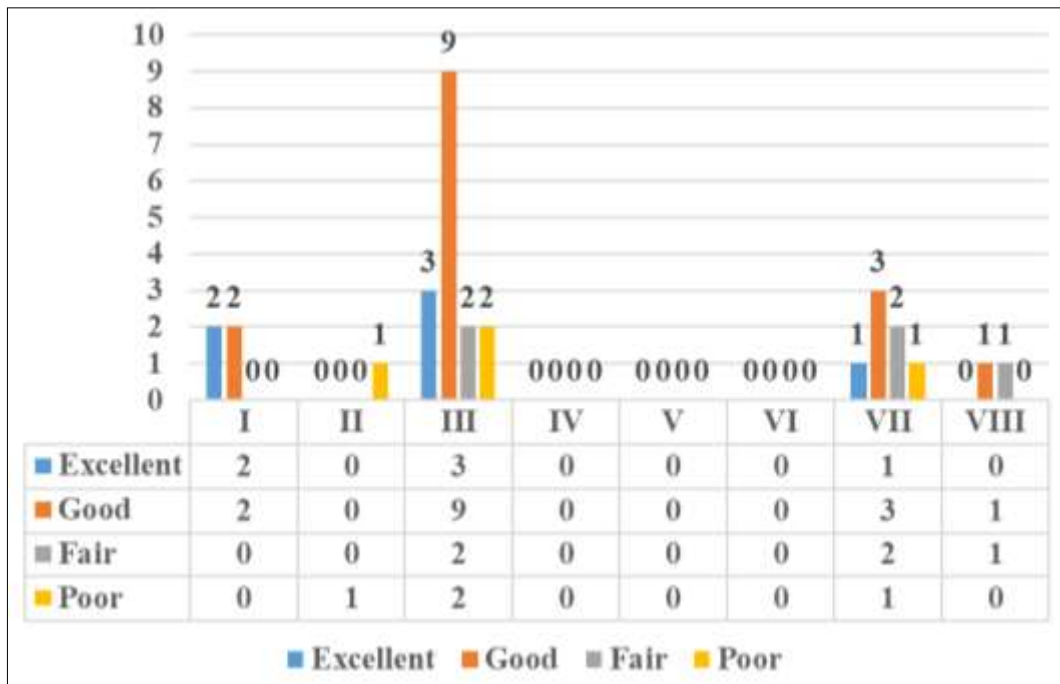
results accounting for 20%, 15 patients had good results accounting for 50%, patients had fair results accounting for 16.67% and 4 patients had poor results accounting for 13.33%.

**Table 2:** Results distribution

Results	No. of Patients	Percentage %
Excellent	06	20
Good	15	50
Fair	05	16.67
Poor	04	13.33

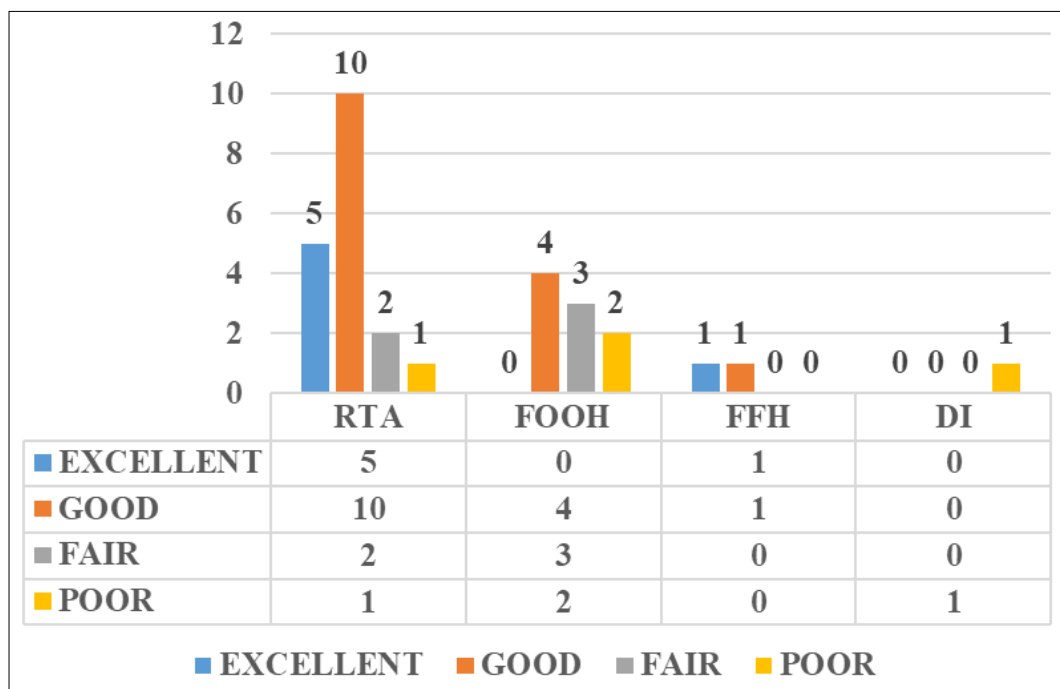


**Fig 3:** Percentage of results pie chart



**Fig 4:** Results in frykman types distribution.

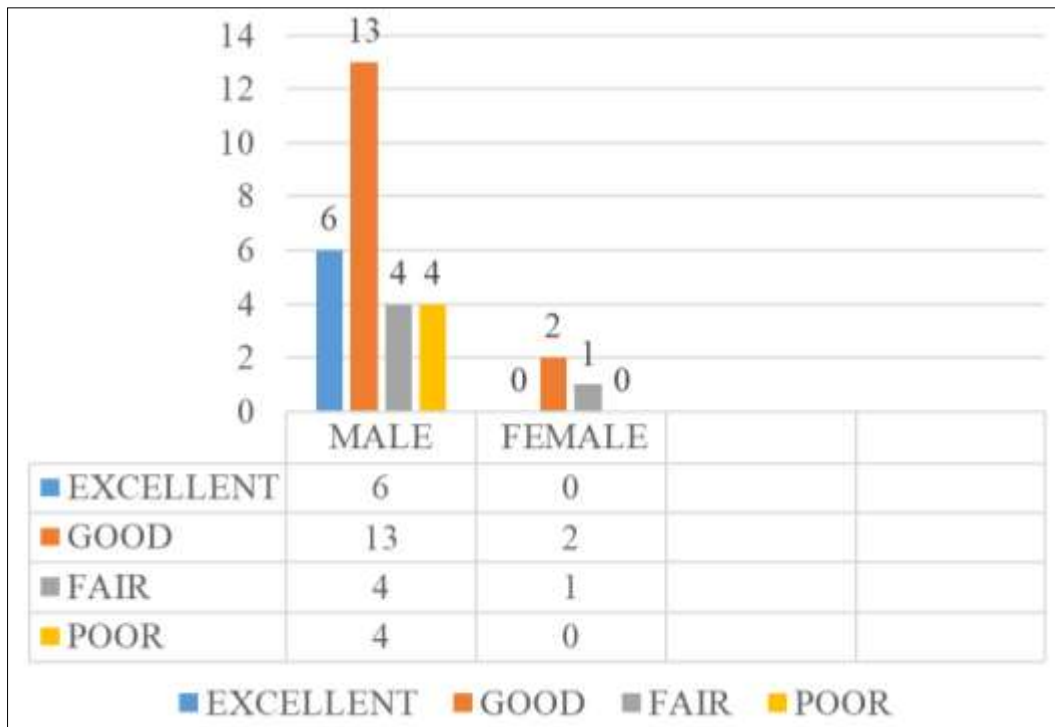
Most of excellent and good results were seen in Frykman type III, Poor results were seen more in Frykman type III injuries.



**Fig 5:** Mode of injury and results distribution.

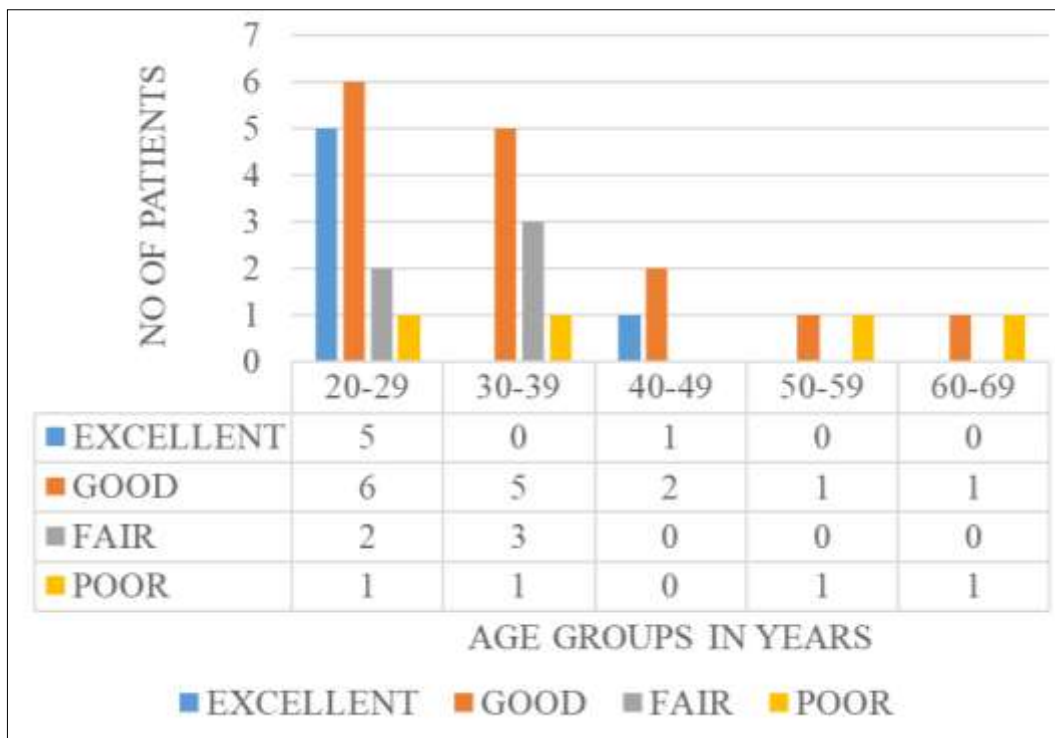
Among RTA and FOOH majority cases given GOOD results 55.56% and 44.44% respectively.





**Fig 6:** Sex and results distribution.

Most of Male (48.14%) and female (66.67%) had shows GOOD results.



**Fig 7:** Age group related results.

These results show that Excellent and Good results were more commonly seen in patients of age group 20 to 40 years.



A) Henry's volar approach,  
 B) Superficial and deep dissection,  
 C) Placement of plate and screws,  
 D) Intra-op C-arm pics.  
 E) Post-op Wound closure

**Fig 8:** Intra-operative photographs of plating



**Fig 9:** Photographs showing excellent results



**Fig 10:** Photographs showing poor results

### Discussion

This study examined the functional results of people with distal radial fractures treated surgically with open reduction and internal fixation using Volar locking plates and screws. Growing interest and fresh ideas on Colle's fracture management have been sparked by an increased understanding of its intricacy. For stable extra articular fractures and mildly displaced articular injuries, closed reduction with cast immobilisation continues to be a solid standard of care, while equivalent management for unstable articular disruption is prone to failure. The most effective way to acquire and maintain an accurate anatomy is still a subject of much debate. However, a recent analysis of fracture pattern and treatment outcomes has shown that surgical intervention is necessary.

In our study, Frykman's classification was used for classification of the fracture type. In this study we have used Volar plates for distal end radius fractures. In our study the number of male patients were more than female patients. They were best handled by open reduction and internal fixation by Volar plate and screws. It should be emphasized that these fractures not only have gross displacement of fragments but also have compressed and crushed juxta-articular fragments which is of no supportive value. A Volar plates purchasing instrument provides a good hold on proximal fragments and lays a very important role by contributing to the stability.

In our study 30 patients were treated with Volar locking plates for intra-articular, unstable extra-articular fractures of distal end of radius, followed up for a minimum of one year, were analysed according to the criteria of demerit point system of Garland and Werley. 6 patients had excellent results (20%), 15 patients had good results (50%), 5 patients had fair results

(16.67%) and 4 patients had poor results (13.3%).

A study was conducted by John K. Bradway and William P Cooney on 16 patients with comminuted intraarticular fractures of distal radius, with a mean follow up of 5.7 years. The evaluation was based on the criteria of Gartland and Werley and also by Green and O'Brien scoring system. They had 56% of their patients rated excellent, 25% good and 19% fair [10]. They had no poor results. This high percentage of excellent and good results compared to our study may be due to fact that the follow up was of longer duration and they had better patient's compliance. Bone grafting was done in more number of patients.

In our series 23 patients were below the age of 40 years. 3 patients were between 40-49 years and 2 patients were between 50-9 years and 2 patients were above 60 years. The average age of 30 patients was 33.53 years. In the series of Bradway and Cooney [10], the average age of the 16 patients were 40 years. The youngest being 18 years and oldest being 75 years. Thus compared to this series the average age of the patients in our study was almost similar and there were high incidence of male patients in our series.

In our study involvement of right side (56.67%) was more than the left (43.33%). The right side was dominant for all the patients with right side involvement. This may be due to fact that dominant extremity reaches out first to have first impact of trauma.

In our series the mode of injury in 18 patients were due to RTA (60%), 9 patients sustained injury due to fall on outstretched hand (30%), 2 due to fall from height (6.7%) and 1 patient (3.3%) sustained a direct blow.

In the series of Bradway and Cooney, the commonest mechanism was fall on Outstretched hand, seen in 11 patients (69%) and RTA in 4 patients (31%).



The final result in our series after an average follow up after one year showed that 6 patients (20%) had excellent result. Of this 1 patient were above 40 years and 5 were below 40 years. 3 patients had Frykman type III and 2 patients had type I fractures. 5 patients had their trauma due to RTA, 1 patient had sustained injury due to fall from height.

15 patients (50%) in our series had good result. 13 patients were below 50 years of age and 2 patients were above 50 years. Of this 9 patients had Frykman type III injury, 3 had type VII, 2 had type I and 1 had type VIII injury. The mode of injury in 10 patients were due to RTA, 4 patients had fall on outstretched hand and 1 had injury due to fall from height.

5 patients (16.67%) in our series had fair results. 5 patients were over 60 years of age. 3 patient sustained injury due to fall on the outstretched hand, 2 patients sustained injury due to RTA and one due to fall from height.

4 patients had poor results in our series (13.33%). 2 patient due to fall on outstretched hand, 1 patients sustained injury due to RTA and one due to fall from height. 2 out of these patients had Frykman type III injury and one had type VII and one had a type II injury.

Analysing the results as per the age, revealed that 23 patients (76.67%) were below 40 years of age, of these 5 had excellent result (21.73%), 11 had good results (47.82%), 5 had fair (21.73%) and 2 had poor results(8.9%). 7 patients (23.33%) were above 40 years of age of which 1 had excellent results (14.2%), 4 had good results (57.14%) and 2 had poor results(28.57%). This reveals that younger the patients better is the result. This may be due to better quality of the bone, high motivation to get back pre-injury status and better patient compliance.

### Complications

The complications encountered in our study were as follows.

4 patients had deformity due to malunion, which put them into poor category due to restriction of wrist movement and finger stiffness. 3 patients had an infection.

The results in our study show that excellent and good results were achieved in 70% i.e., in 21 patients and fair and poor results were seen in 30% i.e., in 9 patients. This means that the use of volar plates gives relatively better results in intra-articular fractures of distal radius. This does not mean that volar plating is the gold standard in the treatment of intra-articular fractures of distal radius. This is only an alternative method in treating these injuries, so we recommend Volar plating in intra-articular fractures of distal radius gives acceptable results.

### Some of the advantages of volar plating

- Fracture fragments can be reduced under direct vision.
- Joint congruity can be maintained.
- Buttress plate provides stability and prevents collapse at the fracture site.
- Better patient compliance as the fixation is internal.
- Early mobilization can be achieved, thus reducing complication arising from cast immobilization.

### Conclusion

#### From the study, we conclude the following

- Road traffic accidents and fall on outstretched hand were the commonest mode of injury.
- Males were affected more than females.
- Younger the patients better the results.
- Excellent to good results were seen in 70% of patients by using volar locking plate for fixation of fractures of distal

end radius.

- Thus open reduction and internal fixation (ORIF) by Volar locking plate and screws can be an alternative to other procedures in treating the extra-articular fracture with volar displacement and intra-articular fractures of distal end radius.

Therefore, extra-articular fracture with volar displacement and intra-articular fractures of distal end radius managed with Volar locking plate and screws gives better results compared to other modalities of Treatment.

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### Conflict of Interest

Not available

### Financial Support

Not available

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