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ORIGINAL RESEARCH

A comparative analysis of functional outcome of different modalities of treatment for distal end of radius fracture in tertiary care centre

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ABSTRACT

Background: Fractures of the distal end of radius are the most frequently occurring upper extremity skeletal injuries managed by orthopaedic surgeons. Despite continuous refinement in treatment modalities, there is no consensus regarding the same, however, the ideal technique for surgical management is still a point of debate. We did analysis to compare the results of three treatments methods-volar locking plate (VLP), external fixation (EF), Kirschner wire (K-wire), Closed reduction and plaster cast application:in patients with distal radius fractures, and compared the clinical, functional, and radiological results. **Methods:** 20 patients with distal radius fractures who underwent fixation with VLP, K-wire, EF and cast application were included in the study. All fractures were classified according to the Müller**'**s Arbeitsgemeinschaft für Osteosynthesefragen (AO) and Frykman's classifications. Routine radiographs were taken at the postoperative,3 weeks, 6 weeks, 3 months and 6 months. Radial height, Radial inclination, volar tilt, Dorsiflexion,Volar flexion, ulnar deviation, radial deviation, and ulnar variance were assessed on the follow-up visits and additionally at the follow-up for the study. The patient-based Disabilities of the Arm, Shoulder and Hand (DASH) score system and visual analogue score (VAS) were used to evaluate functional outcomes, grip strength was accessed, Radiological and functional outcomes between of these above mentioned modalities were compared and statistically analyzed.**Results:** The average age at the time of surgery was 47.58 years (range = 21 to 72 years).Of a total of 20 patients,15,were operated with VLP, 5 were with K-wire 4.With EF, 7 with cast application.Satisfactory reduction was achieved in all fractures, DASH, VAS and MAYO scores were almost similar in all groups. Regarding radiographic parameters, there was no significant difference in Radial height, Radial inclination, volar tilt, Dorsiflexion,Volar flexion, Ulnar deviation, radial deviation-between the treatment modality groups. When evaluated based on fracture geometry, the DASH score was significantly higher in the patients with AO23A type fracture compared to the patients with AO23B and AO23C type fractures. As for MAYO score, all AO23 groups had similar outcomes.**Conclusion:**Treatment options VLP, EF, K-wire, cast application provide adequate fixation, satisfactory radiological, and functional results for the management of distal radius fractures of various severities. The optimal treatment approach depends on individual features, and the choice for an internal fixation or closed reduction method for the restoration of wrist function should be evaluated thoroughly by the operating surgeon considering the patient-related variations.

Key words: Distal radial fracture, percutaneous pinning, external fixation, volar plating, cast application

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INTRODUCTION

Distal end radius fracture is a common fracture type and has an approximate incidence of 1:10 000 people and represents 17% of all skeletal fractures and 75% of forearm fracturein 1814, Abraham Colles first described the distal end radius fracture with characteristic deformities well before the advent of radiographs. Varying patterns of extra-articular and intra-articular radius fractures are common in adults. They are commonly referred to as Colles, Barton's or Smith's depending upon the pattern of involvement of the distal radioulnar and radiocarpal joint surface and displacement. Treatment of such injuries is often difficult and demanding, particularly when the fracture is severely comminuted or displaced as there is still a debate although high-energy distal radius fractures are more frequent in younger people, low energy fractures in the elderly may still require reduction [1]. Restoration of wrist function and maintaining the radiocarpal and radioulnar joint mechanics at the maximum obtainable level are of utmost concern; deciding between non-operative or operative management is an essential task for orthopaedic surgeons. Articular malalignment, loss of reduction, and inadequate fixation can result in posttraumatic osteoarthrosis, shortening at the fracture site, and impaired wrist and hand function guidelines of American Academy of Orthopaedic Surgeons recommend with moderate strength that, fractures with post-reduction radial shortening >3 mm, dorsal tilt >10 degrees, or intra-articular displacement or step-off >2 mm should be treated surgically rather than cast fixation.

Percutaneous pinning with Kirschner wire (K-wire), volar locking plate (VLP) and external fixation (EF) are among the fixation techniques used in the clinical practice for the treatment of distal radial fractures. Although there are various reports claiming the superiority of one method over another, the decision on the treatment modality is multifactorial. The patient's age, occupation, familiarity of the procedure to the surgeon, the comorbidities such as tendon and median nerve injuries should be taken into account, as well as the fracture configuration,Internal fixation with VLP is the most commonly used treatment for unstable distal radius fractures despite its relatively higher complication rate due to deep dissection of soft tissue around the fracture region, and the need for a removal surgery for intra-articular fracture cases, On the other hand, closed reduction techniques EF and K-wire have the advantages of being less invasive with easy application and lower costs,Hence, basic principles of management are:

i) Stable reduction of displaced fractures.
ii) Maintenance of reducti.

We performed cross-sectional data analysis to compare the results of these treatments methods-VLP, EF, K-wire-,cast application in patients with distal radius fractures and compared the clinical, functional, and radiological results in an attempt to determine which modality provides better outcome and satisfactory restoration of the wrist function.

MATERIALS AND METHODS

STUDY PERIOD: March2024 to January2025.
PLACE OF STUDY: Karnataka Medical College and Research Institute, Hubli.
SAMPLE SIZE:20 cases.

INCLUSION CRITERIA

1) Age less than 18 years.
2) Patients with displaced intra articular and extra articular fractures of distal radius.

EXCLUSION CRITERIA

1) Age less than 18 years.
2) Patients with compound fracture.
3) Patients with associated ipsilateral upper limb trauma.

SURGICAL TECHNIQUES

An initial reduction maneuver was attempted before each treatment method. Procedures were performed under general anesthesia with patient in supine position under fluoroscopic guidance.

1) VLP FIXATION

The fracture was fixed using the volar approach through the interval between the flexor carpi radialis and radial artery. MISS distal radius plates (TST Tıbbi Aletler San ve Tic Ltd. Şti., Istanbul) with locking screws were used.

2) EXTERNAL FIXATION

An external fixator (Dynamic Angled Clamp Wrist Fixator, TST Tıbbi Aletler San ve Tic Ltd. Şti., Istanbul) was fixed on the radius with 3 or 4-mm Schanz pins according to the surgeons 'preference. Initially, two Schanz screws were placed onto the radius diaphysis under fluoroscopic guidance, followed by two Schanz screws onto the 2nd metacarp. The wrist was kept on flexed position during the placement of the screws to prevent contracture due to blockade of the tendons by screws. The fracture was reduced and the system secured. Additional percutaneous 2 mm K-wires were inserted under fluoroscopy in order to secure the wrist integrity when necessary.

3) PERCUTANEOUS PINNING (K-wire)

After the reduction of the fracture under fluoroscopic guidance, two or more-according to the necessity-2 mm or 1.5 mm K-wires were placed medially and laterally. Stability was checked and a short arm splint was applied.

Active and passive exercise of the digits and the elbow were initiated on the first postoperative day.

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Wound dressing was changed once daily, and when necessary in the early postoperative time. In groups of VLP and external fixation no splint was applied. Splints were only applied in percutaneous pinning group for 4 weeks. The external fixator and K-wires were removed in (6-8) weeks after surgery.

METHODOLOGY-(ASSESSMENT TOOL)

The Post operatively the patients will be assessed based on the functional outcome and radiological outcome. Functional outcome will be done using the quick DASH scoring system.The quick DASH scoring system is a 9 item self-report questionnaire which is the shortened and modified version of the Disability of the Arm, Shoulder and Hand (DASH) scoring system. The radiological outcome will be done using the Sarmiento's modification of the Lindstorm criteria.18 The assessment will be based on the residual radial angulation, radial shortening and the loss of radial inclination.

All the patients were subjected to clinical and radiographic examination. Anteroposterior (AP) and lateral views of the wrist joint on both sides was obtained at the time of presentation. The radiographs were assessed in terms of loss of palmar tilt or presence of dorsal tilt, radial shortening and loss of radial inclination. Fractures were classifed according to the AO classifcation into type A (extra-articular), type B (partial articular) and type C (complete articular). After pre-anaesthetic evaluation, patients were taken up for either POP cast or surgical treatment. The patients were followed up for two years. Clinical, radiological and functional reviews were performed, Radiological assessment was done in terms of residual dorsal angulation, radial shortening and loss of radial inclination. The results were graded according to the Sarmiento's modification of Lindstrom Criteria.4 Clinical and functional evaluation of the patients was done at the last follow-up according to the demerit point system of Gartland and Werley5 with Sarmiento *et al*'*s* modifcation4.

The Patient-Rated Wrist Evaluation (PRWE)is a 15-item questionnaire that assesses wrist pain and impairment in daily activities. Using the PRWE, patients are able to score their amount of wrist pain and disability from zero to ten.

Having concluded the diagnosis, preanaesthetic checkup was done and once the patient was declared fit, operative intervention was contemplated after explaining the details of surgery and written informed consent with cast for undisplaced extra-articular fractures, percutaneous fixation with K-wires for minimally displaced extra-articular andundisplaced stable intra-articular fractures, external fixation used for ligamentotaxis for unstable grossly comminuted intra-articular fractures and volar plating for displaced non-comminuted intra-articular fractures.

STATISTICAL ANALYSIS

Table 1: Demographic profile wise distribution of patients

Profile	No of patients	% of patients
Age groups		
<=40yrs	7	36.84
41-60yrs	7	36.84
>=61yrs	5	26.32
Gender		
Male	12	63.16
Female	7	36.84
BMI		
Underweight	9	47.37
Normal	6	31.58
Overweight	4	21.05
Total	19	100.00

Table 2: Summery of age and BMI

Parameters	Minimum	Maximum	Range	Mean	Median	SD
Age	21.00	72.00	51.00	47.58	47.00	15.42
BMI	15.80	34.00	18.20	24.54	25.00	5.22

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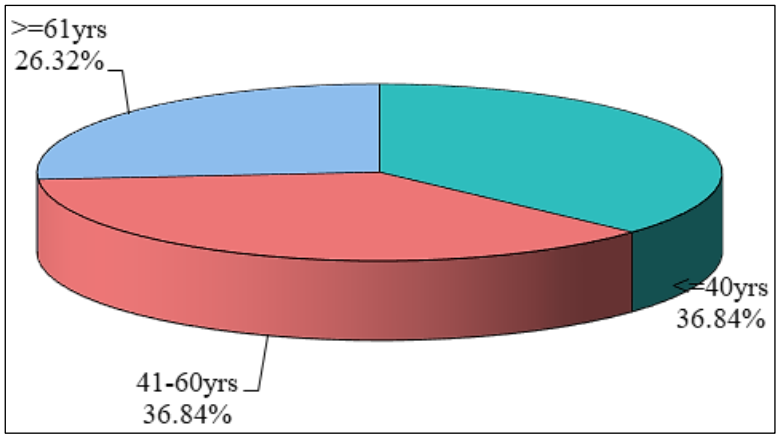

Figure 1: Age wise distribution of patients

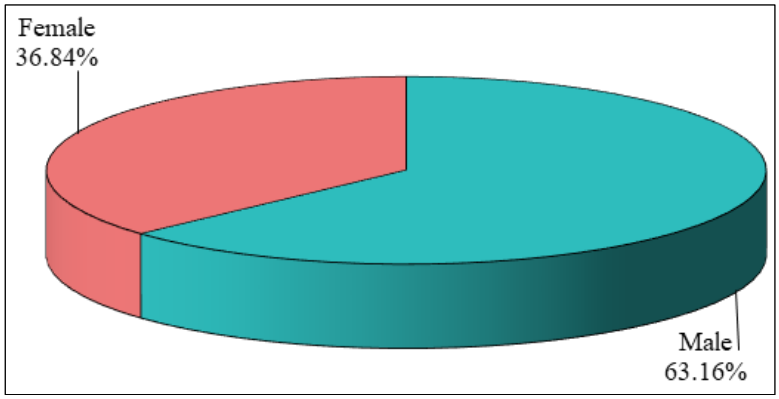

Figure 2: Gender wise distribution of patients

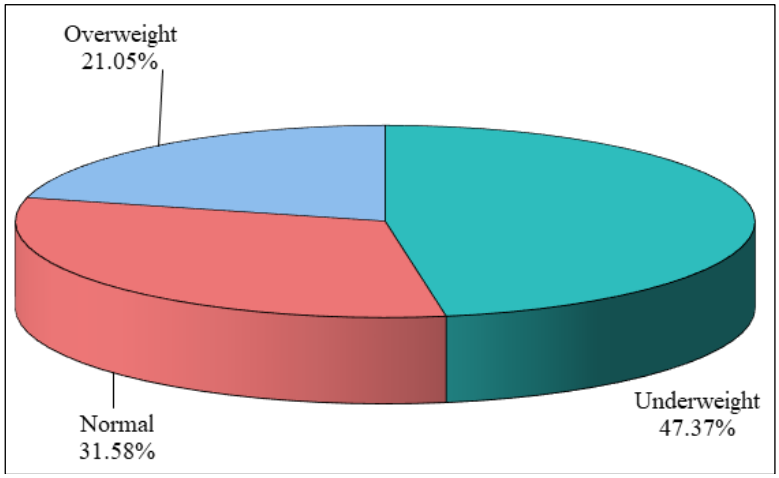

Figure 3: BMI wise distribution of patients

Table 3: Pre-operative displacement and DRUJ wise distribution of patients

	No of patients	% of patients
Pre-operative displacement		
3	13	68.42
4	6	31.58
Druj		
No	10	52.63
Yes	9	47.37
Total	19	100.00

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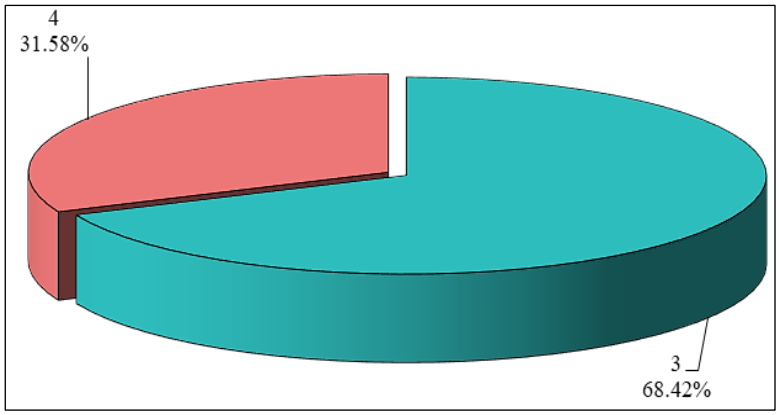

Figure 4: Pre-operative displacement wise distribution of patients

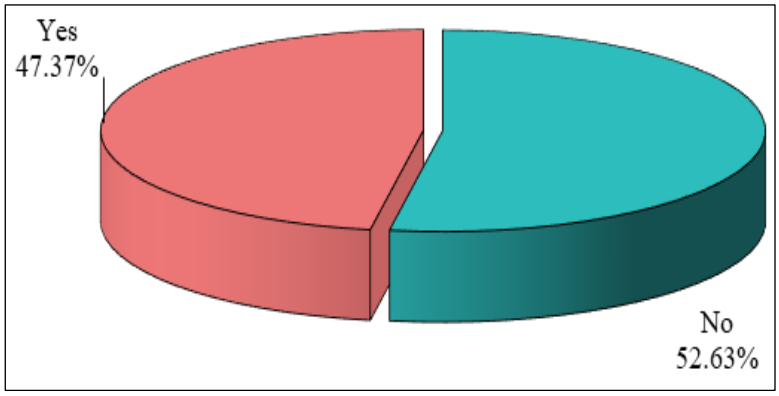

Figure 5: DRUJ wise distribution of patients

Table 4: Post-operative reduction wise distribution of patients

Post-operative reduction	No of patients	% of patients
No	7	36.84
Good	12	63.16
Total	19	100.00

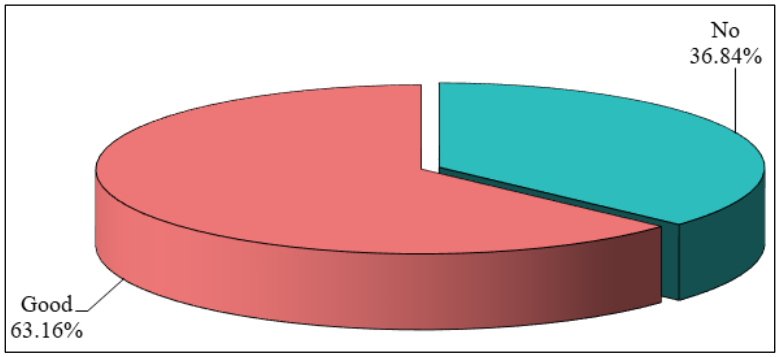

Figure 6: Post-operative reduction wise distribution of patients

Table 5: Summery of outcomes at the final follow-up

Parameters	Minimum	Maximum	Range	Mean	Median	SD
Radial height	7.00	12.00	5.00	9.31	9.10	1.56
Radial inclination	18.00	29.00	11.00	24.12	25.00	3.45
Volar tilt	5.40	11.60	6.20	8.08	8.00	1.75
Dorsiflexion	60.00	90.00	30.00	75.37	75.00	9.00
Volar flexion	53.00	72.00	19.00	63.32	63.00	5.42
Ulnar deviation	14.00	26.00	12.00	20.16	20.00	3.52
Radial deviation	12.00	26.00	14.00	19.68	20.00	3.59
Dash score	11.00	20.00	9.00	16.21	16.00	2.74

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Grip strength	8.00	11.00	3.00	9.00	8.80	0.79

Table 6: Correlations among all parameters by Karl Pearsons correlation coefficient

Parameters	Radial height	Radial inclination	Volar tilt	Dorsiflexion	Volar flexion	Ulnar deviation	Radial deviation	Dash score	Grip strength
Radial height	-								
Radial inclination	0.4123	-							
Volar tilt	0.1435	-0.0806	-						
Dorsiflexion	-0.2637	0.3224	-0.1944	-					
Volar flexion	-0.1879	0.2754	0.1458	0.5961*	-				
Ulnar deviation	-0.3065	0.0241	-0.0709	0.1386	-0.0786	-			
Radial deviation	0.0696	0.1498	-0.2722	-0.3367	-0.4030	0.2682	-		
Dash score	-0.3259	-0.5865*	0.0184	0.1364	0.1113	0.1232	-0.2413	-	
Grip strength	0.1331	0.1406	-0.0299	0.2069	0.0937	0.0301	0.0707	0.0746	-

*$p<0.05$

Table 7: VAS score wise distribution of patients

VAS score	No of patients	% of patients
Score 1	9	47.37
Score 2	8	42.11
Score 3	2	10.53
Total	19	100.00

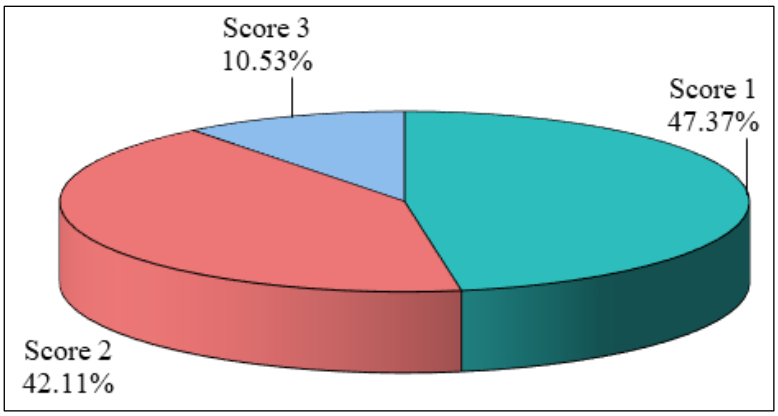

Figure 7: VAS score wise distribution of patients

Dedmerit score	Plate[%]	Cast[%]	K wire[%]	External fixator[%]
Excellent	15[75]	7[23.3]	5[25]	4[40]
good	3[15]	12[40]	9[45]	4[40]
fair	2[10]	9[30]	5[25]	1[10]
poor	0[0]	2[6.6]	1[5]	1[10]
total	20[100]	30[100]	20[100]	10[100]

Table is based on distribution of study subjects on basis of demerit point score system of gartland and werley.

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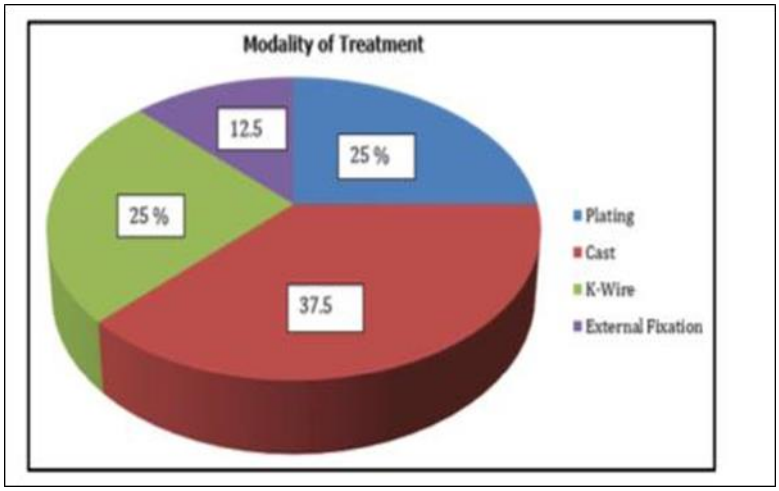

Fig 8

Table 8: PIN infection and migration wise distribution of patients

PIN	No of patients	% of patients
Site infection	3	15.79
Migration	4	21.05

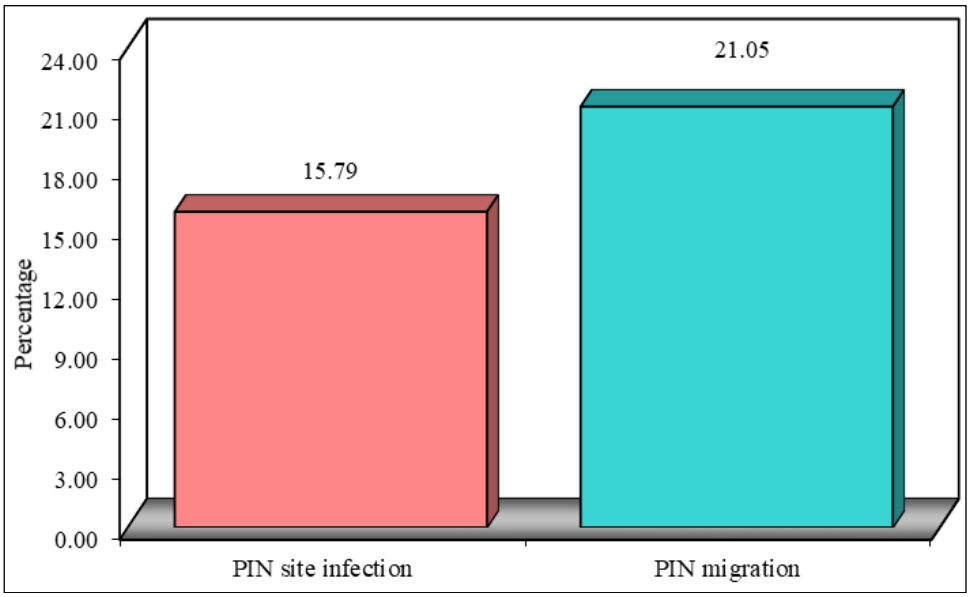

Figure 9: PIN infection and migration wise distribution of patients

Table 9: Co morbidities wise distribution of patients

Co morbidities	No of patients	% of patients
Diabetic mellitus	2	10.53
Hypertension	4	21.05
Seizure	1	5.26

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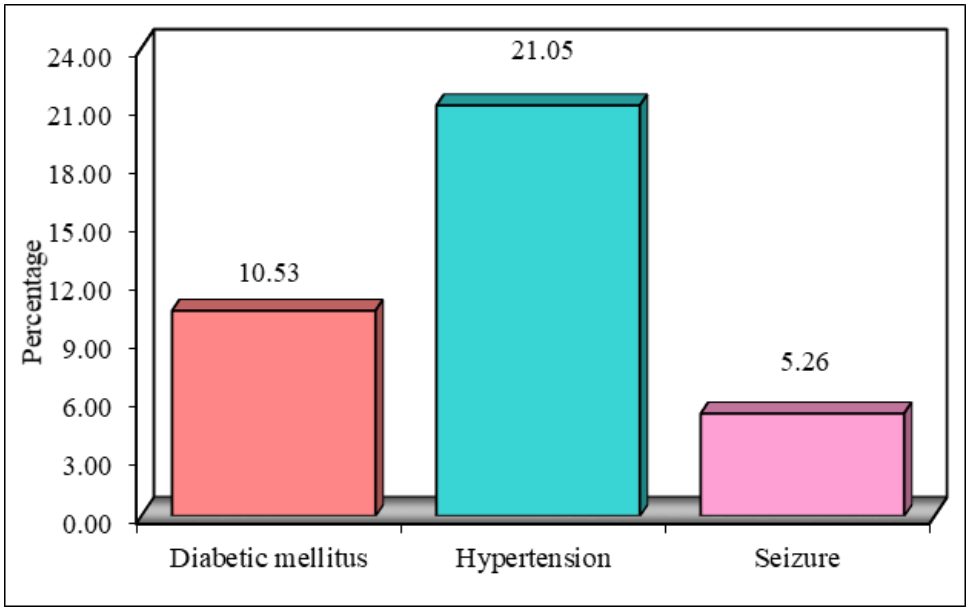

Figure 10: Co morbidities wise distribution of patients

Table 10: Steroid intake wise distribution of patients

Steroid intake	No of patients	% of patients
No	18	94.74
Yes	1	5.26
Total	19	100.00

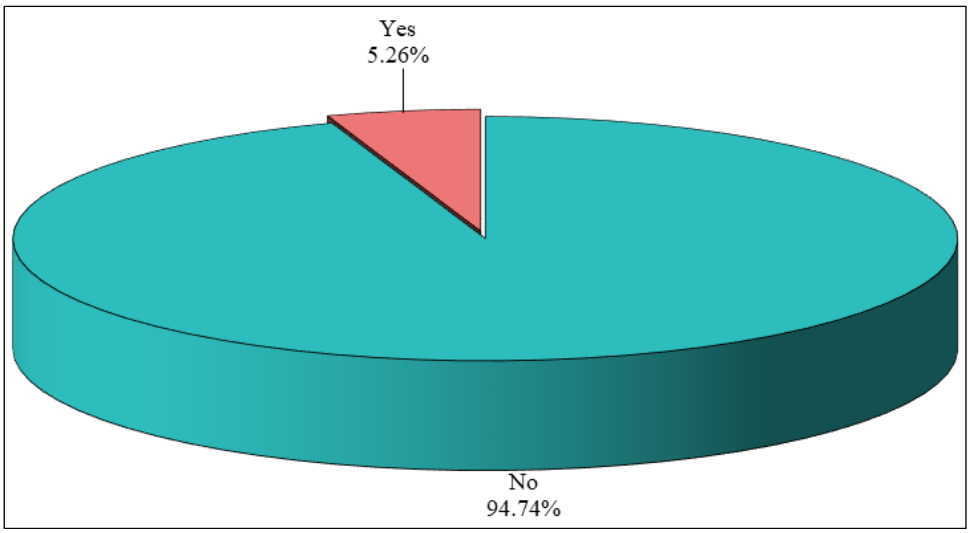

Figure 11: Steroid intake wise distribution of patients

Table 11: Follow up wise distribution of patients

Follow up	No of patients	% of patients
4 months	1	5.26
5 months	9	47.37
6 months	7	36.84
7 months	2	10.53
Total	19	100.00
Mean	5.53	
Median	5.00	
Std.Dev.	0.77	

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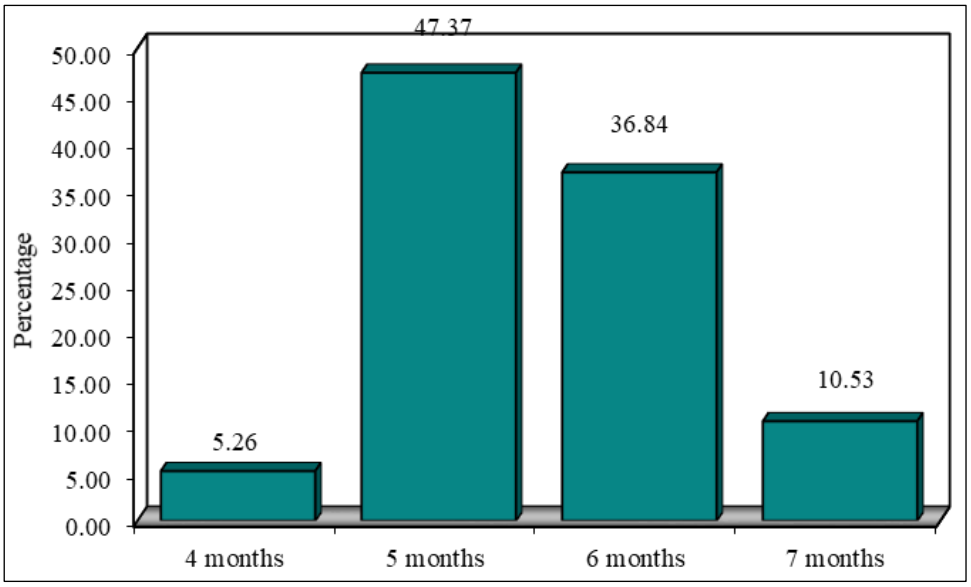

Figure 12: Follow up wise distribution of patients

DISCUSSION

Distal radius fractures are not uncommon. The importance of anatomic reduction has been demonstrated by various clinical studies as well as laboratory assessment of the force and stress loading across the radiocarpal joint. In these fractures with dorsal angulation>9°, loss of radial inclination>3°, loss of radial length>2 mm, and articular surface displacement>2 mm, suboptimal results have been reported. Therefore, every effort should be made to restore the normal length and alignment, as well as articular surface congruence of the distal radius.

After the anatomic reduction has been achieved, many methods are available to maintain the alignment and prevent repeat displacement. Immobilization methods include casting, external fxation, internal fixation with plates, and k wire fixation-depending on the different types of fractures. Every method has its advantages and limitations.

The most common traditional treatment of distal radius fractures is closed reduction and cast immobilization. Three-point fixation with a well fitted cast is essential for adequate immobilization.

Although cast immobilization alone avoids surgery and many complications, it cannot maintain the distraction to correct length or control the rotation of the distal fragment when comminution is present.Loss of reduction usually happens after 2 weeks of casting despite a perfect initial anatomic reduction.Leung *et al*. proposed that Colles 'type of extra-articular fracture be managed conservatively if acceptable reduction can be achieved; otherwise surgery is necessary to obtain a good functional result.

External fixation is popular for the treatment of displaced fractures of the distal radius. With this method, the radial length and dorsal tilt can be improved significantly.For certain intra-articular fractures, percutaneous wires through the radial styloid can be used as a supplement.

Margaliot *et al*.Performed a meta-analysis on outcomes of unstable distal radius fractures managed by external fixators (EF) vs. Plate osteosynthesis. They concluded that there was no evidence to support that the use of ORIF is superior to EF. However, there were signifcantly higher rates of postoperative neuritis, infections, pin loosening and hardware failure in the EF group. Westphal *et al*. performed a retrospective comparative study and found no differences between EF and ORIF outcomes. A randomised controlled trial on displaced intra-articular fractures of the distal radius was conducted by Kapoor *et al*. in 2000. They concluded that ORIF provided the best anatomical restoration with patients least likely to develop arthritis. However ORIF should be avoided in severe comminuted fractures as the fixation may not be stable and would likely result in poor functional outcomes. EF was found to maintain the radial length best due to the sustained countertraction utilising the principle of ligamentotaxis. EF provides the best results in severely comminuted fractures with meticulous pin insertion and pin site care, complications are minimal.

Distractor combined with pinning is also an effective method, especially in the highly comminuted fractures with or without compounding. Complications such as pin tract infection, pin loosening, loss of reduction in osteoporotic bone, suboptimum reduction in intra-articular fractures, wrist stiffness, etc. preclude its use in every case.

Closed reduction together with POP cast gives a better result in the extra-articular type of fracture. It is easy to obtain reduction but difficult to maintain the reduction by simple plaster cast. Union in displaced position leads to poor functional and cosmetic results. Complications such as suboptimum reduction in intra-articular/comminuted fractures, loss of reduction in osteoporotic bone, chances of Sudeck's atrophy on

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repeated manipulation, wrist/finger stiffness, and malunion preclude its use in every case.

Over last decade, there have been numerous clinical trials that have tried to find the best method of management for displaced unstable comminuted distal radial fractures. A Cochrane review of the subject concluded that there is still no robust evidence to support any specific modality of treatment.Treatment is based on fracture type, patient's demand and characteristics, financial status and on treating surgeon's experience and preference. Each method has its own advantages and disadvantages. The modality of treatment has shifted from conservative to surgical management and especially plate osteosynthesis with time. There may be multiple reasons behind this increase mainly due to patient awareness and increased demand for anatomical fracture reduction, early mobilisation and rehabilitation and final important issue,affordability of patient, which has improved overall.Our study has a few limitations. Most of our patients were below 60 years of age and had good bone stock. Hence, it may not be possible to extrapolate our results to an older age group or postmenopausal female patients with poor bone quality. The sample was not homogenous regarding the stages of classification system for comparison by different method of treatment, and therefore, the findings are inconclusive. The sample size of our study is limited to one centre and is very small to conclude very effectively. Many patients who were planned for plate osteosynthesis were managed by cast or K-wire due to financial constraints.

CONCLUSION

Thus,based on this study we conclude that volarplating and external fixation have a relatively better functional outcome for fractures of distal end of radius as compare to percutaneous K wirefixation, and close reduction with cast application, particularly in cases of intra articular fractures, volarplating has excellent, functional results in volar Barton fractures with less chances of loosening of implant, use of volar locking, plate resulted in faster, recovery of function, better, anatomical, reduction and grip strength compare to external fixation, better functional outcome with volar lock plating can be assured as anatomical reduction in Rigid fixation and early mobilization post-operatively and to the absence of pin-site infections and post-operative immobilizations. Similarily, external fixator application proved to be an easy, cost- effective and reliable treatment modality in treating unstable comminuted intra-articular distal end of radius fractures, specially cases having osteoporosis and it functions on the "principle of ligamentotaxis". Recovery of movements was faster in patients who were operated upon than in those managed conservatively with cast or k-wire fixation. Therefore we propose that in the coming future, the modality of treatment of distal radial fractures should shift from conservative to surgical management and especially plate osteosynthesis as evident from its benefits but the vast difference in treatment costs should be taken into consideration when deciding on the treatment option.

CONFLICT OF INTEREST

The author declares no conflict of interest.

ETHICAL APPROVAL

Approved.

CONSENT FORM

Written informed consent was obtained from the patient.

FINANCIAL SUPPORT

Not available.

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