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Percutaneous pinning vs volar plating in unstable distal end radius fracture: A comparative study

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Abstract
A fall on outstretched hand is most common mechanism for causing fracture of distal radius. The majority of factures in the elderly are extra-articular, whereas there is much higher incidence of intra-articular fracture in younger patients. In the present study 50 patients were included with unstable distal end radius fractures, in which 25 cases were managed with percutaneous pinning and 25 cases were managed by open reduction and internal fixation with volar plating. Patients were evaluated clinically and radiologically. The results were graded according to Green and O'brain score and comparison was done according to the union and functional outcome in individual cases. In our study we found that fracture of distal radius managed either with volar locking plate or by percutaneous pinning with k-wire fixation had empowering results.

Keywords: distal radius, fracture, percutaneous pinning, volar palting

Introduction
In 1814, Abraham Colles' described distal radius fracture prior to the advent of radiography; he probably did not know that the best treatment of distal radius fractures would still be discussed today. Distal radius fractures are those which occur about 1 inch from distal articular surface. Fractures of the distal radius usually are classified as extra-articular or intra-articular [1]. Factures of the distal radius are a common injury, constituting 8% to 17% of all extremity fractures and as much as 72% of all forearm fractures [2].
There are three main peaks of fracture distribution: one in children age 5-14, the second in males under age 50, and the third in females over the age of 40 years [3].
A fall on an outstretched hand is the most common mechanism for causing injury to the distal radius [4].
The distal radius fractures can be managed conservatively or operatively. If it is undisplaced or minimally displaced it can be managed conservatively. Displaced fractures need reduction with direct manipulation or traction through finger traps. The surgical options for treatment of distal radius fractures can be categorized into three main tools that may be used individually or in combination to obtain optimal stability: percutaneous pinning, external fixation, and internal fixation [5].
The distal radius fracture is the most common fracture [6]. Today, the vast majority achieve a good subjective result [7], but as many as 21% still have remaining disability one year after the injury [8]. Due to the high incidence of the fracture, an improved outcome in just a small percentage of patients would result in improved quality of life for a substantial number. With this in mind, the intriguing challenge today is how to measure and interpret the outcome of current treatment and analyzing whether these lead to an acceptable outcome. The objective in the present study was to compare between percutaneous pinning and volar plating in unstable distal end radius fractures with special reference to: Achieving adequate and maintaining stable reduction, Union of fracture and to contribute to an improved functional outcome.

Material and Methods
50 Cases of either sex with unstable distal end radius fracture, admitted in the department of orthopaedics of Government Medical College, Amritsar were taken for the study.

Patients were included after approval from the Institutional Ethical Committee, Government Medical College, Amritsar. An informed and written consent was taken from the patient before inclusion in the study. Total of 50 cases were selected, 25 cases were selected for percutaneous pinning (PP) and 25 cases were selected for volar locking plate (VLP), randomly.
Cases were classified according to Fernandez classification.

Inclusion criteria
All type I unstable, all type II and type III

Exclusion criteria
All type I stable fractures and badly comminuted fractures i.e. type IV and type V fractures.
Patients were admitted in the Emergency and OPD Department. After that patients were examined with respect to the injuries and special attention was given to circulation and neurological status of the limb. Primary treatment in the form of antibiotics, analgesics, immunization against tetanus, intravenous fluid, and splinting was done. It was followed by radiological examination of the limb in posterior-anterior, lateral and any other special view as indicated. Routine investigations of blood and urine were carried out.
As soon as the patient was fit for surgery, the patient was operated under appropriate anaesthesia, taking aseptic precautions with proper cleaning and draping. The implant used for osseous fixation was either kirschner wire or volar plate depending on the type of fracture, according to fernandez' classification.
If there were impacted fragments then the first step in reduction was to disimpact these fragments.in some cases it was necessary to release the traction and exaggerate the deformity in order to achieve this. Once reduction was achieved and confirmed under image intensification, then three k wires were inserted, two were inserted from the tip of the radial styloid and one from the dorso-ulnar aspect. First the radial styloid was palpated and great care was taken not to injure the superficial branch of the radial nerve or the tendons of the first and the third extensor compartment. After checking reduction and anticipated direction of the k-wire using image intensification, the K-wire was introduced carefully using power drill. The K-wire was just penetrating the opposite cortex. Then a second K-wire wire was introduced through the radial styloid in the same manner, but in a divergent direction. Under image intensifier control, the third K-wire was introduced from the dorso-ulnar rim of the radius into the anterior cortex of the radial shaft. The fourth compartment was displaced radially by the pressure of the thumb, which enabled precise k-wire positioning into the dorso-ulnar corner of the lunate facet. Then, the k-wires were cut and bent. The ends were left outside or under the skin, to reduce the possibility of pin-track infection. Special care was taken to avoid any crossing of the K-wires at one point at the fracture level. Then, casts were applied and windows were created in the cast directly over the pin sites. Because the reduction is stabilised with K-wires, a below elbow cast was preferred.
Volar plating was done using standard volar approach. Incision started at thenar crease of palm, curve toward middle of forearm, then through FCR tendon sheath and then the FCR was retracted ulnarly and the incision was continued through dorsal sheath, down to FCR and radial artery (radial artery need not be exposed) and it was simply retracted radially and protected by the surrounding soft tissues. The pronator quadratus muscle was taken down from its radial origin to expose underlying fracture and this was repaired at the end of the case, since repair of the pronator was difficult, it was tied down to the radial edge of the buttress plate and excessive retraction of the median nerve was avoided. It was best to achieve reduction prior to plate application. Reduction was achieved with supination and dorsiflexion over rolled towel, and was confirmed with image intensifier. Reduction was held temporarily with K wires inserted from volar to dorsal, which was oriented to allow holes of the T plate to slide down wire. Articular reconstruction was supported by auto genous cancellous-bone graft, as well as a small buttress plate in some cases, with initial fixation of the distal plate screws, the proximal end of the plate was placed over the cortex, with opposition of the this end of the plate over the cortex, there was increase volar tilt, which improved the reduction. Distal end of plate was placed far enough proximally to avoid insertion of screws into articular surface and insertion of ulnar screws was considered first to ensure that there was no joint trespass (lateral screws will obstruct view of medial screws). The plate was bent to conform to the normal configuration of the radius (contour plate around the radial styloid), esp. in smaller patients. The screws placed in diaphyseal bone acted as a buttress for distal fragment. K wires were then removed.
Post-operatively patients were advised active movement of the adjacent joints as early as possible. Wounds were dressed regularly. Antibiotics therapy was given. The final position and alignment was checked on post-op x-ray. Discharge if any was sent for culture sensitivity every week and antibiotics therapy changed accordingly. This was continued till the wound heels.
Patients were discharged from hospital depending upon the local condition and were called for follow up in Out-patient department every 3 weeks till the fracture unites. Wires/pins were removed once the sign of radiological union was present.

Patient assessment
Patients were followed up at 3 weeks, 6 weeks, 3 months and 6 months after surgery and radiographs were taken. Functional evaluation was assessed with the clinical rating as devised by Cooney Green and O'Brien Score (Cooney modification) as follows: pain, functional status, range of motion, and grip strength measured as percentage of normal (range, 0-25 points) Points were added for the four categories and a final rating were obtained as follows: excellent, 90-100 points, good, 80-90 points; fair, 65-80 points, and poor, less than 65 points.

Results

Table 1: Fernandez's classification

Fernandez Classification	No. of Patients		Percentage
	Percutaneous pinning	Volar Locking Plate	
Type 1	4	6	20%
Type 2	10	12	44%
Type 3	11	7	36%
Total	50		100%

Table 2: Mean Flexion at Follow UP

Mean Flexion	PP	VLP	p-value	
3 weeks	16.11±2.98	19.6±3.78	0.000	significant
6 weeks	30.67±2.76	34.77±1.11	0.000	significant
3 month	50.96±6.12	73.1±6.56	0.000	significant
6 month	82.00±2.89	82.7±2.11	0.101	non significant

P-value: 0.101

Table 3: Mean extension at follow up

Mean Extension	PP	VLP	p –value	
3 weeks	25.77±3.14	30.67±8.036	0.000	Significant
6 weeks	43.55±7.13	50.23±6.78	0.000	Significant
3 month	62.34±7.13	77.87±8.13	0.000	Significant
6 month	83.16±2.88	83.77±4.12	0.171	not significant

P-value 0.171

Table 4: Mean pronation at follow up

Mean Pronation	PP	VLP	p –value	
3 weeks	24.01±6.18	27.77±3.33	0.000	significant
6 weeks	39.89±5.12	50.12±5.89	0.000	significant
3 month	60.34±7.22	77.65±4.78	0.000	significant
6 month	82.02±7.34	82.89±8.45	0.238	not significant

Table 5: Mean supination at follow up

Mean Supination	PP	VLP	p –value	
3 weeks	25.76±4.18	30.01±3.98	0.000	Significant
6 weeks	37.88±4.48	48.12±6.33	0.00	Significant
3 month	65.34±3.78	80.13±5.12	0.000	Significant
6 month	81.77±3.98	82.16±3.33	0.302	not significant

Green and O'brien score (Cooney modification)

Table 6: AT 3 weeks

Green and O' brien Score	PP		VLP		Total
	No. Of Patients	Percentage	No. Of patients	Percentage	
Excellent	0	0%	0	0%	0
Good	0	0%	18	72%	18
Fair	25	100%	7	28%	32
Poor	0	0%	0	0%	0
Total	25	100%	25	100%	50

Table 7: At 6 weeks

Green and O'Brien Score	PP		VLP		Total
	No. Of Patients	Percentage	No. Of patients	percentage	
Excellent	0	0%	0	0%	0
Good	2	8%	20	80%	22
Fair	22	88%	5	20%	27
Poor	1	4%	0	0%	1
Total	25	100%	25	100%	50

Table 8: 3 Months

Green and O' brien Score	PP		VLP		Total
	No. of Patients	Percentage	No. of Patients	Percentage	
Excellent	0	0%	4	16%	4
Good	4	16%	17	68%	21
Fair	20	80%	3	12%	23
Poor	1	4%	1	4%	2
Total	25	100%	25	100%	50

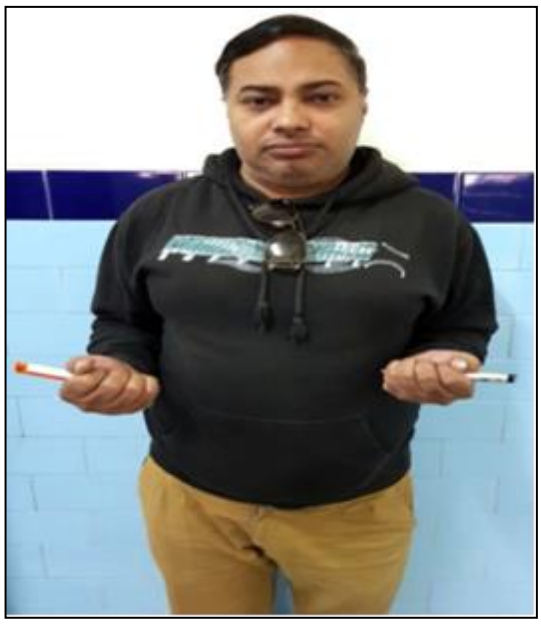
Table 9: At 6 month

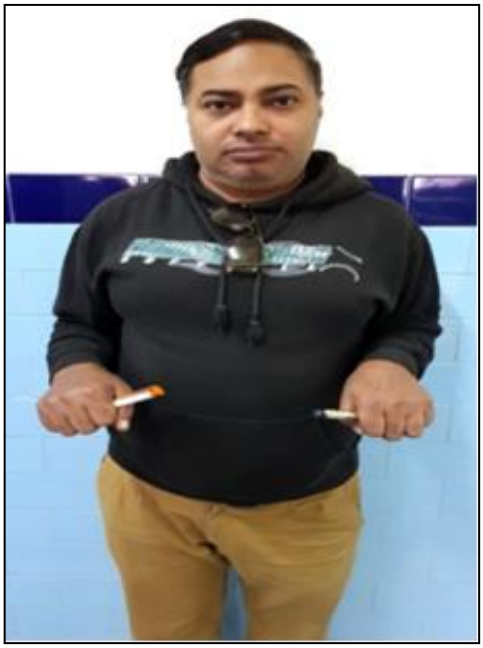
Green and O' Brien Score	PP		VLP		Total
	No. of Patients	Percentage	No. of patients	Percentage	
Excellent	7	28%	15	60%	22
Good	15	60%	9	36%	24
Fair	2	8%	0	0%	2
Poor	1	4%	1	4%	2
Total	25	100%	25	100%	50

Percutaneous pinning

Fig 1: pre-operative radiograph

Fig 2: post-operative radiograph





Volar plate fixation

Fig 3: preoperative radiograph

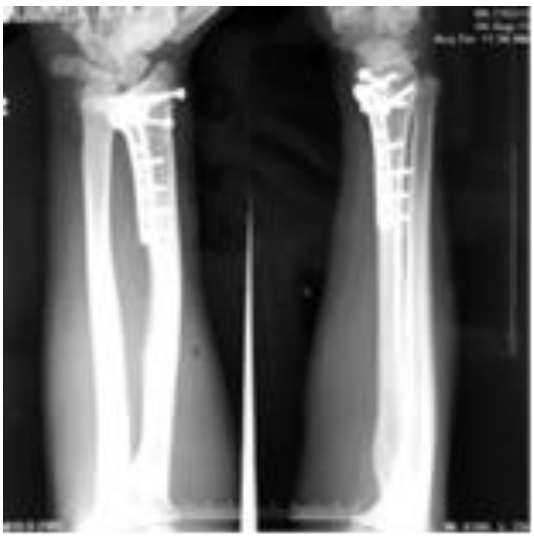
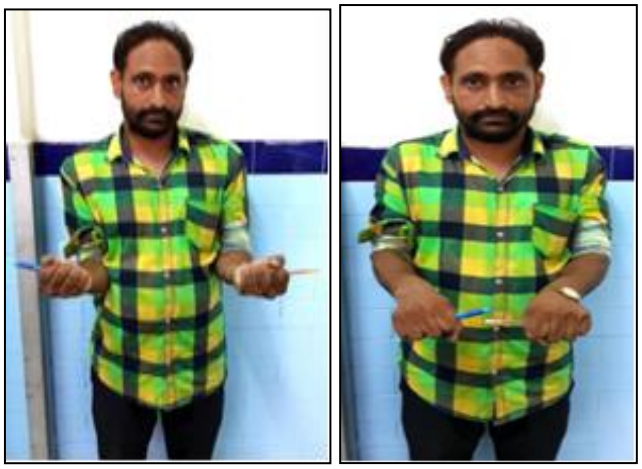


Fig 4: preoperative radiograph



Discussion

In this study the mean age of the patients was 39.92 ± 16.16 with the youngest patient being 17 years and the eldest was 78 years. It was observed that comminuted intra articular fractures are more common in young adults. In present study, males were predominantly affected with distal radius fractures 28 (56%) while 22 (44%) were female. Higher involvement of males in our society can be because of their greater association in outdoor activities.

Road side accidents were found to be the main cause of distal radius fractures involving 56% (n=28) patients, the second being trivial domestic fall with 36% (n=18) cases and third was fall from height with 8% (n=4) cases.

The fixed-angle nature of volar locking plates achieves adequate stability for unstable distal radius fractures and allows good wrist mobilization, leading to improved strength [9]. It has been reported by Kamei S *et al.* and Mac Dermid JC *et al.* that functional results are considered to be stabilized 6 months after operation, even thought here might be some progress in the range of motion and grip strength after this period and we also observed similar outcomes [10, 11].

Although volar locking plate has certain advantages over the percutaneous pinning with K wire in the earlier post-operative period, this decreases as time passes. Both fixation techniques seem to apply sufficient stabilization to restore and retain anatomy after fracture of distal part of the radius and should be individually chosen accordingly. The method of fixation should be chosen according to the activity of the patient and the fracture morphology. Volar locking plate has the advantage of mobilizing the limb earlier and return to work while percutaneous pinning with K wire can be equally effective in communited unstable fractures where the fracture is too distal for plate application and screw purchase.

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