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A Comparative Study of Volar Plate Fixation versus Percutaneous Kirschner Wire Fixation in the Management of Distal Radius Fractures in Adults

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Abstract: *Introduction: Fracture distal radius is the most common fracture treated; more than one sixth of all fractures that we treat are fracture of distal radius, that means 10% to 25% of all fractures seen at an emergency department and constitutes 17% of all the fractures and 75% of all forearm fractures. The distal ends of radius fractures continue to pose a therapeutic challenge.Aims and Objects: to compare the efficacy, functional and anatomical outcome of the volar locking compression plate and percutaneous k wire in the management of distal radius fracture in adults and various complications related to it.Methods: Hospital based study in the department of Orthopaedics, RIMS , Imphal, Manipur, Randomised controlled trial,conducted for a period of 2 years from August 2016 to August 2018.Results:Out of 62 patients, the study showed mean age of incidence to be 44.5 ±11.94 years in age group ranging from 30-65 years. In our study we found that the injuries were result of accidental fall constituting the commonest mode of injury (50%) followed by RTA (45.2%) and others injuries (4.8%). Females constituted the majority of the study population (64.52%). Age, sex, mode of injury, type of fracture, interval to surgery duration and associated co-morbidities were equally distributed between the two groups showing success of randomization. There was a highly significant diference in the operative time and blood loss between two groups, illustating that percutaneous fixation is much shorter procedure with mean operative time of 30 mins compared to 60mins of ORIF with volar locking plate and has less blood loss being 15-20ml to 155-200ml of ORIF with volar plating.Conclusion: ORIF with volar locking plate provide better radiological outcomes with more stable fixation thus lesser degree of loss of reduction in comparison to percutaneous pinning. However, K wiring remains a simple and inexpensive option for simple fracture patterns.*

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I. Introduction

Fracture distal radius is the most common fracture treated; more than one sixth of all fractures that we treat are fracture of distal radius, that means 10% to 25% of all fractures seen at an emergency department[1] and constitutes 17% of all the fractures and 75% of all forearm fractures. The distal ends of radius fractures continue to pose a therapeutic challenge.[2] A bimodal peak in incidence is described first peak is seen in young men related to high energy trauma and second much more important peak is recorded in postmenopausal females and is related to low energy trauma, typically the middle aged female patients who being less debilitated than more elderly tries to stop her fall and lands on out stretched hand.[3] Specially in the middle age group postural instability is much more common in females explaining gender difference in prevalence to some account. Evidence says that a distal radius fracture in this age can be a signal that postural instability and osteoporotic changes should be investigated and if possible should be corrected.[4] The most common cause is fall onto an outstretched hand especially in osteoporotic patients, but high velocity trauma such as fall from a height, motor vehicle accidents and contact sports are other aetiological factors. Management of these fractures has remained a controversial issue.[5] They are often treated with closed reduction and immobilisation but the difficulty here is the possibility that displacement may persist even in the least complex fractures. Other problem with this method is immobilisation of wrist and forearm for at least 6 weeks and the further time required to regain the functions of forearm wrist and hand by physiotherapy. During this entire time duration, patient's ability to carry out day to day activities are hampered. The need of the hour is treatment modality that restores and maintains anatomy and allows early functional mobility which allows patient to carry out his activities of day to day life with minimal discomfort. Numerous other methods of treating injuries of this nature like closed percutaneous pinning, external fixation, buttress plating have enjoyed recognition from time to time.[7].[8]The two most common forms of surgical fixation are Kirschner wire fixation and locking plate fixation.

Kirschner wire fixation is a longstanding technique in which smooth metal wires with a sharp point are passed across the fracture site through the skin. This technique is rapidly being superseded by locking plate fixation, in which a plate is attached to the bone with fixed angle screws.[9] Locking plates are widely considered to provide stronger fixation, which facilitates earlier return to normal activities. This potential benefit is said to justify the greater cost of the plates.[11] To date, studies comparing the two methods have indicated that locking plates provide improved radiological and/or functional outcomes, particularly in the early stages of rehabilitation; though these studies were smaller single centre trials[10-14]. Aim of this study is to compare the efficacy, functional and anatomical outcome of the volar locking compression plate and percutaneous k wire in the management of distal radius fracture in adults and various complications related to it.

II. Materials And Methods

Study setting: Hospital based study in the department of Orthopaedics, RIMS , Imphal, Manipur.
Study design: Randomised controlled trial.
Study period: Study conducted for a period of 2 years from August 2016 to August 2018.
Study population: Patient with distal radius fractures who attended OPD and emergency, department of Orthopaedic, RIMS during study period after initial manipulation in the casualty if deemed to be unstable were included if following inclusion criteria were fulfilled.

Inclusion criteria: Those who has given consent for the operation and the study aftyer proper explanation regarding the study and at least 18 years of age with unstable distal radius fractures were included in our study.Fractures were deemed unstable if they had displaced after initial treatment with closed reduction and splinting , or if three of the following criteria as described by Lafontaine et al[44] were met - dorsal angulation of $>20^0$,dorsal comminution, an intra articular fracture,an associated ulnar styloid fracture, an age of more than sixty years.

Exclusion criteria: Fractures with neurovascular injury,non displaced fracture, pathological fracture**,**open fracture with sever soft tissue loss**,**fractures with immature skeleton**,**pre existing impairment of function of the same limb**,**distal radius fracture extending to the shaft of the radius,fractures with incomplete follow up.

Sample size: The disabilities of the arm , shoulder , and Hand (DASH) score (Hudak et al.1996)[23] at 12 months was the primary outcome variable used to determine statistical power . The level of significance was set at $P<0.05$.Power analysis showed that 90% power to discover a difference of 10 points (SD 12) in DASH score would require 62 patients . The standard deviation of 12 points was based on data from a group of similar patients in a previous study (Wilcke et al .2007)[24] **.**

Sampling design: Patients are choosen from the group who has given consent for the study and fulfilled inclusion criteria. Randomization was done for to divide them into 2 groups. Group A. k wire group,Group B. volar plate group. First case was chosen for k wire group by tossing a coin and subsequently alternate cases done with volar plate fixation. K wire was applied in 31 patients and volar locking plate was used for 31 cases out of total 62 cases.

Operative technique: The patients was operated under regional or general anesthesia and antibiotic prophylaxis was given 1 hour before induction of anesthesia. Patient was placed in the supine position with hand supported on hand table and affected limb was prepared with 10% betadine solution & draped .A tourniquet was applied to the upper arm as proximal as possible.

Surgical approach for percutaneous inter focal k wire fixation: The entire upper extremity was prepared and draped free, as for an open operation, and the surgeon and assistant are gowned and gloved.The reduction was easily accomplished by using a so called handshake grip to distract the fracture while counter traction is applied proximal to the elbow by the assistant. The surgeons contralateral thumb was used to restore the normal volar tilt once distraction of the fracture is adequate. The reduction was then evaluated in the AP and lateral planes with the image intensifier. Once the length, radial inclination and volar tilt, and the joint surface of the radius have been restored, the fracture was fixed by two crossed 1.5mm smooth K wires, inserted percutaneously with a power drill. The first K wire was inserted at the tip of the radial styloid process.This requires about a 45^0 angle with the long axis of the radius on the postero anterior view and aiming the wire 10^0 dorsally on the lateral view. The second K –wire was inserted into the dorsal ulner corner of the distal part of the radius between the 4^{th} and 5^{th} extensor canals.

Surgical approach for volar plate fixation: The incision was by modified Henry volar approach.The skin incision was centred over the FCR tendon and of approximately 8 cm length,longitudinally along the course of flexor carpi radialis (FCR) tendon. The FCR sheath was opened and tendon was retracted to the radial side. Underneath the FCR sheath lies the flexor pollicis longus (FPL) tendon.This was retracted towards ulna revealing the Pronator Quadratus (PQ) muscle. The pronator quadratus muscle was elevated from its radial origin and reflected towards ulna to expose the distal radius. Each fragment was identified, disimpacted and reduced K wires was used for provisional fixation depending upon fracture pattern. Plate was applied to the volar surface. Drill guide was placed into a distal hole and a K-wire drilled through the guide and its placement

was checked with fluororoscopy. The fracture reduction, plate position, and the location of the K-wire relative to the joint was assessed under fluoroscopy. One of the four distal holes was first targated. Depending on the fracture pattern, number and position of screws will be decided. One by one the remaining proximal holes was selected and locking head screws was applied. Finally proper joint reconstruction, screw placement and screw length was ensured using multiple radiographic views.

Post operative management: Postoperatively, the limb was placed into a bulky dressing ,postsurgery active finger movements were encouraged. Suture removal was done on the 10 day and then they are discharge. Ulnar deviation, palmer deviation and active rotational exercises were started two weeks post operatively. Patients were followed up post-operative visits at 2 and 6 weeks, and 3, 6, 12 and 24 months postsurgery .All relevant findings recorded in every visit, functional assessment system and radiological assessment of fracture progression was done. Implant was removed after the maturation of callus which is assess by standard AP and lateral radiographs and clinical sign of union usually after 1 year and for K-wire group K wires were removed after 3 week in the OPD.

Data management and statistical analysis: Data was checked for completeness and consistency. Data were entered and analysed using SPSS V.23 for window (IBM Inc.).DASH score was used for functional treatment. Unpaired student t-test is used for physical and radiographic measurement. p value of < 0.05 was considered statistically significant.

III. Results

62 patients with fracture distal end of radius who met the inclusion criteria were included in the study, out of which 31 were randomized into group A, treated by closed reduction and percutaneous fixation supplemented by cast and 31 in group B, treated by volar locking plate.

1.Age distribution:

Table 1: showing age distribution of the patients in different groups.

Age in years	No of patients		percentages
20-30	1	7	12.90
31-40 years	8	5	20.97
41-50 years	13	10	37.09
51-60 years	6	5	17.75
61-70	3	4	11.29
Total	31	31	100.00

2. Sex distribution:

Table 2: Sex distribution of the patients

Sex of the patients	No of patients		Percentages
Male	9	13	35.48
Female	22	18	64.52
Total	31	31	100

3. Side of involvement

Table 3: Showing Side of involvement:

Gender	K wire	Volar plate	Percentage
Right	23	17	64.5
Left	8	14	35.5
Total	31	31	100

4. Mode of injury:

Table no 4: showing Mode of injury:

Mode of injury	K wire	Volar plate	Percentage
RTA	13	15	45.2
Accidental Fall	16	15	50
Others	2	1	4.8
Total	31	31	100

5.Type of fracture according to Frykmans classification: Fracture classified according to Frykman classification showed 28 cases (45.2%) were extra articular (Type I and II) followed by 20 cases (32.3%) were intra articular involving radiocarpal and radioulnar joint (Type VII and VIII).

6. AO classification :

Table no 5: Showing distribution of fracture according to AO classification.

Type	K wire	Volar plate	Percentage
A (Extra articular)	14	14	45.2

B (Partial articular)	6	5	17.7
C (Complete articular)	11	12	37.1
Total	31	31	100

7.Time interval between injury and surgery: P value is 0.059 .

Table no 6: Showing distribution of surgical lag time

Surgical lag time	Timing of operations in days	Mean time to operations in days
K wire group	2-12	4.41±2.4
Volar plate group	2-12	5.77±3.06

8. Duration of surgery: P value is 0.001

Table no 7: Showing duration of surgery among different groups

Duration	K wire	Volar plate
Minutes (Mean)	20.19±4.88 (15-30)	49.83±7.0 (40-60)

9. Average blood loss:

Table no 8: Showing amount of blood loss during sugery among different groups

Blood loss	K wire	Volar plate
Amount (ml)	8.09±3.59 (5-10)	155.48±18.76 (120-200)

10. Duration of fracture union (Radiological): p value is 0.004.

Table no 09: Showing mean time for union among different groups

Time of union	K wire	Volar plate
In weeks	7.38±1.02 (5-8)	6.67±0.83(5-10)

11. Complications: There was no intra-operative or immediate post opearative complication. Late complication encountered in 11 cases of k wire group and 4 cases of volar plate group. In k wire group 3 patient developed complex regional pain syndrome, which was managed with active physiotherapy,1 case developed carpal tunnel syndrome which was managed with steroid injection.3 cases developed superficial pin track infection which was managed with antibiotic and local wound dressing. 4 cases developed malunion (13%) in comparison to volar plate group 1 case (4%) because of loss of reduction post operatively.In volar plate group 3 cases developed hypertrophic scar which was excised at the time of implant removal.

12.Functional assessment:

Table no 10: Patient perceived results measured by the DASH scores

DASH score	K wire	Volar plate	P value
3 month (DASH 1)	27.61±4.27 (20-33)	8.16±2.0 (6-12)	<0.001
6 month (DASH 2)	15.96±2.88 (9-19)	5.48±1.9 (3-9)	0.008
12 month (DASH 3)	7.00±2.38 (6-16)	6.03±1.87 (4-11)	0.08

Values are presented as points (95% CI) corrected for baseline values. P value is calculated by Wilcoxon rank sum test.

IV. Discussion

Fixed-angle volar plating and k wiring represents a valuable treatment modality for the most frequent types of unstable fractures of the distal radius. Conventional method of reduction and cast treatment for distal radius fracture has resulted in unsatisfactory anatomical and functional results, varying degree of deformity and disability with secondary loss of reduction during ongoing treatment .In our study, the overall mean age for all patients was 44.5 ±11.94 years .The age group of 41 to 50 years comprised the highest no of patients (37.09%).The mean age in K wire group was 46.22±9.44 years and in volar plate group was 42.77±13.94. Costa et al[17] reported that the mean age of the patients were 59.7% ±16.4 years in patients undergoing wiring method and 58.3±14.9 years in patients undergoing plating method .4th to 5th decade patients are prone for fracture because they are the main working population of the society and involved in maximum household and outdoor works.In our study, females constituted a majority portion of the patients undergoing plating (58.0%) and wiring (70.0%) while males constituted 41.0% of the study population undergoing plating and 29.0% undergoing wiring. Costa et al [17] reported that 17% of the patients undergoing wiring were males and 83% were females whereas 15% of the patients undergoing plating were males and 85% were females. Hull P et al[21], from his study findings, reported that 25% males underwent plating while 20% underwent wiring.it may be because of increase incidence of osteoporosis in elderly females which makes them vulnerable to fractures. It was observed in our study that 35% patients undergoing plating had injury on the left side while 65% patients had injury on the right side. In patients undergoing wiring, 36% patients had injury on the left side while 74% had injury on the right side. Costa *et* al [17] reported that in patients undergoing wiring, 44% patients had injury on the right side

and 53% patients had injury on the left side. In patients undergoing plating, 44% patients were reported to have injury on the right side and 54% of the patients had injury on the left side.Wong KK et al [18] reported half of the patients (n=15) had dominant limb fractures.In our study accidental fall was main mode of injury(50%) cases followed by road traffic accident (45.2%). Costa et al[17] also reported accidental fall as a main mode of injury followed by road traffic accident. Orbay JL et al[19] reported the causes of the fractures in 24 patients were simple falls on the outstretched hand (n=19), work related accidents(n=2), motor vehicle accident (n=3). In our study we got AO type A fracture constituted highest no of patients (45.2%) followed by type C fractures (37.1%). Costa et al [17] also reported the same 66% cases of Type A fracture in their studies. In Orbay JL et al [19] also found maximum cases in extra reticular group(17 extraarticular out of 24 cases). Regarding the associated injuries head injuries was commonly encountered in 9.67% of patients followed by chest injury in 4 % of cases.The mean time to operation from the date since injury for all fractures was 5.09±2.82 days. With a range of 2-12 days.mean time to date since injury for k wire group was 4.41±2.4 days. And for volar plate group was 5.77±3.06 days. This is almost similar to findings of Wong KK et al[18] where the mean interval between injury and surgical stabilization was 6.6 days. Anakwe R et al[25] and in their studies mean time to surgery was 4 days (range, 1-12). The mean duration taken for surgery for k wire group was 20.19±4.88 days and for volar plate group was 49.83±7.0 days. The average blood loss was higher for volar plating group. For k wire group average blood loss was 8.09±3.59 ml and for volar plate group was 155.48±18.76 ml. In our study duration for fracture union in k wire group and volar plate group was seen by 7.38±1.02 and 6.67±0.83 weeks respectively. This was similar to findings of Orbay JL et al[19] where the average time to radiographic union was 7.1 weeks (range 5-10 weeks).Based on the disability of arm shoulder and hand score (DASH Score) for the present study , the mean DASH Score at 12 months was not significant at all in comparison to both groups. The mean DASH score at the end of follow up was 6.03±1.87 for volar plate group and 7.00±2.38 for k wire group.the perfect DASH score for extremity is "0" with range for normal extremity being 4-8.Orbay JL et al[19] found mean DASH score 8.28 and Rozental TD et al[20] found mean DASH score of 14 in their studies. In our study, there was no intra operative and immediate post operative complication .late complication encountered were consisted of pin tract infection in none of the patients undergoing plating while 3 patients undergoing wiring which was manged by antibiotic and early removal of implant.3 cases of complex regional pain syndrome and 1 case of carpal tunnel syndrome in wiring group which were managed with active physiotherapy and injection steroid .3 cases of hypertrophic scar in case of volar plating group which was managed by excision at the time of implant removal.loss of reduction causing malunion is seen in 4 cases of k wire group and 1 cases of volar plate group due to unstable fixation , high communition and reduction of post operative edema with subsequent tissue shrinkage causing less stretching of the ligaments holding the reduction in place. Costa et al[17] reported that in patients who underwent plating, 6% had neurological injury, 2% had tendon injury and 8% had superficial injury. Hull P et al[21] reported that 33% patients that underwent plating had numbess or tingling and 6% had superficial infection. 11% patients each that underwent wiring were reported to have numbness or tingling and superficial infection.

The main finding in this study was that patients treated with volar locking plate did return to pain free independence 6 weeks earlier than those with closed reduction and pinning. We think this is an extreamly relevent finding and could be used as a clinical tool by the surgeon to decide on the method of treatment for each patient group.

It is our opinion that highly functioning patients, would benefit from locking plate fixation with the advantage of early return to independent function on the other hand we suggest that patients those who have good supporting system can be treated with less expensive implants with equal functional outcomes.Our study suffered from several limitations including: The sample size was small, a multicentric trial with larger sample size would be more informative,blinding of the patients, the surgeons or the reviewers was not possible,our study was hospital based many distal radius fractures which were being managed conservatively in the community could not be reached.

V. Conclusion

Open reduction and internal fixation with a volar locking plate and closed reduction with percutaneous kirschner wire fixation provide comparable excellent clinical and radiographic results in patients with distal radial fractures in early follow up period. ORIF with volar locking plate provide better radiological outcomes with more stable fixation thus lesser degree of loss of reduction in comparison to percutaneous pinning. It also had better range of motion at wrist initially at 12 weeks ,however this difference is not significant in later months. At medium term follow up there is no difference between groups despite a better radiographic outcome. Unstable intra-articular radius fractures that cannot be reduced or held reduced with pinning should be treated with locking plate systems.K wiring remains a simple and inexpensive option for simple fracture patterns.

References

[1]. Nijs S, Broos PL. Fractures of the distal radius:a contemporary approach.Acta Chir Belg 2004 Aug;104(4):401-12.
[2]. Colles A.On the fracture of the carpal extremity of the radius.Edinb Med Surg J 1814;10:181.
[3]. Crilly RG, Delaquerriere Richardson L, Roth JH,Vandervoort AA,Hayes KC,Mackenzie RA. Postural stability and colles fracture. Age ageing 1987 May;16(3):133-8.
[4]. Nguyen T,Sambrook P,Kelly P,Jones G,Lord S,Freund J,et al.Prediction of osteoporotic fractures by postural instability and bone density. BMJ 1993 Oct;307(6912):1111-5.
[5]. Perez AE.Fractures of the shoulder, arm and forearm.In: Canale ST,Beaty JH editors. Campbells' operative orthopaedics.12th ed.philadelphia:Elsevier mosby;2013.p.2890-1.
[6]. Kapoor H, Aggarwal A, Dhaon BK. Displaced intra-articular fractures of distal radius: a comparative evaluation of results following closed reduction, external fixation and open reduction with internal fixation.Injury 2000 Mar;31(2):75-9.
[7]. Nana AD, Joshi A, Lichtman DM. Plating of the distal radius. J Am Acad Orthop Surg 2005 May-Jun;13(3):159-71.
[8]. Doi K, Hattori Y, Otsuka K,Abe Y,Yamamoto H. Intraarticular fractures of the distal aspect of the radius: Arthroscopically assisted Reduction compared with Open reduction and Internal fixation. J Bone Joint Surg Am 1999 Aug;81(8):1093-110.
[9]. Downing ND, Karantana A. A revolution in the management of fractures of the distal radius? J Bone Joint Surg Br 2008 Oct;90(10):1271-5.
[10]. Karantana A, Downing ND, Forward DP, Hatton M, Taylor AM, Scammell BE et al. Surgical treatment of distal radial fractures with a volar locking plate versus conventional percutaneous methods: a randomized controlled trial.J Bone Joint Surg Am 2013 Oct;95(19):1737-44.
[11]. Rozental TD, Blazar PE, Franko OI, Chacko AT, Earp BE, Day CS. Functional outcomes for unstable distal radial fractures treated with open reduction and internal fixation or closed reduction and percutaneous fixation. A prospective randomized trial. J Bone Joint Surg Am 2009 Aug;91(8):1837-46.
[12]. .Marcheix PS, Dotzis A, Benko PE, Siegler J, Arnaud JP, Charissoux JL. Extension fractures of the distal radius in patients older than 50: a prospective randomized study comparing fixation using mixed pins or a palmar fixed-angle plate. J Hand Surg Eur 2010 Oct;35(8):646-51.
[13]. McFadyen I, Field J, McCann p, Ward J, Nicol S, Curwen C. Should unstable extra-articular distal radial fractures be treated with fixed-angle volar-locked plates or percutaneous Kirschner wires? A prospective randomised controlled trial.Injury 2011 Feb;42(2):162-6.
[14]. Hollevoet N, Vanhoutie T, Vanhove W, Verdonk R. Percutaneous K-wire fixation versus palmar plating with locking screws for Colles' fractures.Acta Orthop Belg 2011 Apr;77(2):180-7.
[15]. Costa ML, Achten J, Parsons NR, Rangan A, Griffin D, Tubeuf S et al. Percutaneous fixation with kirschner wires versus volar locking plate fixation in adult patients with a dorsally displaced fracture of the distal radius:randomized controlled trial.BMJ 2014 Aug;349:4807.
[16]. Wong KK, Chan KW, Kwok TK, Mak KH .Volar fixation of dorsally displaced distal radial fracture using locking compression plate.J Orthop Surg(Hong Kong) 2005 Aug;13(2):153-7.
[17]. Orbay JL, Fernandez DL. Volar fixed -angle plate fixation for unstable distal radius fractures in the elderly patient. J Hand Surg Am 2004 Jan;29(1):96-102.
[18]. Rozental TD, Blazar PE. Functional outcome and complications after volar plating for dorsally displaced, unstable fractures of the distal radius.J Hand surg Am 2006 Mar;31(3):359-65.
[19]. Hull P, Baraza N, Gohil M, Whalley H, Mauffrey C, Brewster M, Costa ML. Volar locking plates versus k wire fixation of dorsally displaced distal radius fractures-a functional outcome study.J trauma 2011 Jun;70(6):E125-8.
[20]. Lafontaine M , Hardy D, Delince P. Stability assessment of distal radius fractures . Injury. 1989 Jul;20(4):208-10.
[21]. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: The DASH (disabilities of the arm, shoulder, Hand).The upper extremity collaborative group (UECG). Am J Ind Med 1996 Jun;29(6):602-8.
[22]. Wilcke MK, Abbaszadegan H, Adolphson PY. Patient perceived outcome after displaced distal radius fractures. A comparison between radiological parameters , objective physical variables and the DASH score .J Hand Ther 2007 Oct-Dec;20(4):290-8.
[23]. Anakwe R,Khan L,Cook R,McEachan J.Locked volar plating for complex distal radius fractures:patient reported outcomes and satisfaction.J Orthop Res.2010 aug 5;5:51.

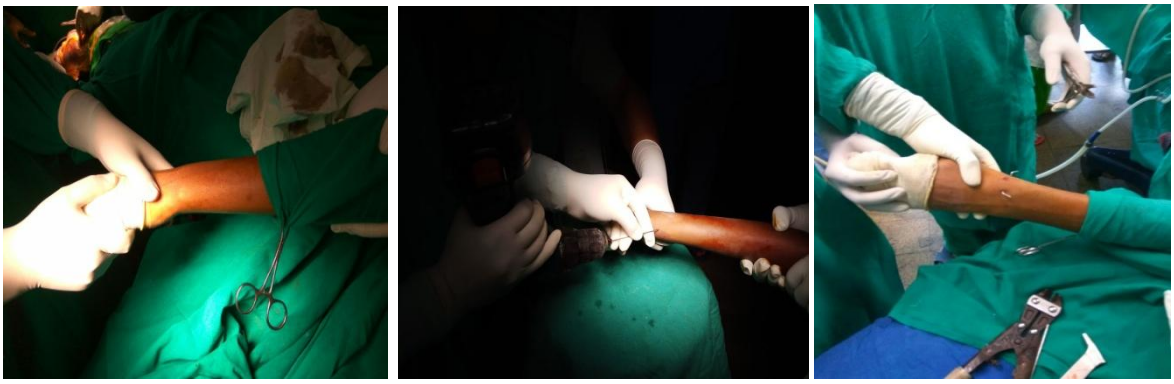

Figure no 1: Showing passing of K wire for fixation after initial reduction

Figure no 2: Showing some intra operative steps of volar plate fixation

Figure no 3: Showing some of the pre and post operative xrays AP and Lat view

Figure no 4: Immediate post operative range of motion at wrist.

Figure no 5: Range of motion at wrist at 1 year follow up.

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