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Open reduction internal fixation with plating versus external fixator in distal end radius fractures: A comparative study

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Abstract

Introduction: Low energy falls leading to stable variety of fracture patterns are seen most commonly, but young patients tend to have a high-energy mechanism of injury. Nonsurgical management remains main line of management; however, there are a variety of treatment options available for fractures too unstable for non-operative management. These include external fixation, percutaneous pinning, and internal fixation. The primary goal of treatment of these fractures is restoration of wrist function. Good functional outcome requires restoration of the disrupted radial anatomy, maintenance of accurate and stable reduction. There is no standard treatment algorithm for these fractures as most of the textbooks refer it as author's experience. Various studies have shown excellent result with volar plating and early functional recovery. Assessment of the functional outcome between the volar plating and the external fixation with or without pinning in displaced distal radius fractures was the purpose our study. We hypothesized that there would be significantly fewer complications and improved clinical results in the volar plating group when compared to the external fixation group.

Aim: To assess the functional outcome between the Volar plating and the external fixation with or without pinning in displaced distal radius fractures.

Materials and Methods: This is an observational type of retrospective study where 40 patients were included in the study and among them 20 with external fixator/k wire and 20 with distal radius plating on whom the study conducted. Assessment of the fracture was based on AO classification. Adult Patients above age of 18 years with AO type B and C included in study. Patients with open/compound, pathological fractures excluded from study. Patients followed up at 6 weeks, 3 months, 6 months, 9 months and 12 months. At the 12 month follow-up final assessment was done for fracture union and patients were assessed for pain, wrist range of motion (ROM), grip strength and activity and scored according to the Modified Green O'Brien Scoring System.

Results and Discussion: In present study, we got excellent functional results according to the G and O'Brein system in 11(55%) of patients treated with ORIF with plating group as compared to 4(20%) patients in the External fixation group. There was a significant difference in the mean value of the functional result in the Plating group (76.5) as compared to external fixator group (89.5). We evaluated our results and compared them with those obtained by various other studies utilising different modalities of treatment.

Conclusion: Both ORIF plating and external fixation are good treatment choices for distal end radius fractures. ORIF PLATING provides better functional outcome as assessed by Green and O'Brien score as compared to external fixation.

Keywords: reduction internal, plating versus, fractures, distal

Introduction

One consolation only remains, that the limb will at some remote period again enjoy perfect freedom in all its motions, and be completely exempt from pain; The deformity, however, will remain undiminished throughout life." stated Dr. Abraham Colles^[2], in reference to fractures of the distal end radius. It is the most common fracture of upper extremity with average incidence of 17.5% of fractures per year^[1] and has a bimodal distribution in children and the elderly^[4]. Overall, Low energy falls leading to stable variety of fracture patterns are seen most commonly, but young patients tend to have a high energy mechanism of injury^[3]. Nonsurgical management remains main line of management; however, there are a variety of treatment options available for fractures too unstable for non-operative management^[6, 7, 8]. These include

external fixation, percutaneous pinning, and internal fixation. The primary goal of treatment of these fractures is restoration of wrist function. [10] Good functional outcome requires restoration of the disrupted radial anatomy, maintenance of accurate and stable reduction [11, 12] There is no standard treatment algorithm for these fractures as most of the textbooks refer it as author's experience. Various studies have shown excellent result with volar plating and early functional recovery. Assessment of the functional outcome between the volar plating and the external fixation with or without pinning in displaced distal radius fractures was the purpose our study. We hypothesized that there would be significantly fewer complications and improved clinical results in the volar plating group when compared to the external fixation group. Thus we have retrospectively reviewed data on 40 patients with highly comminuted articular distal radius fractures treated by external fixation or locked volar plating.

Aim: To assess the functional outcome between the Volar plating and the external fixation with or without pinning in displaced Distal radius fractures

Materials and Methodology

Institutional review board approval was obtained for the study. The aim of this study was to compare Distal End Radius External Fixator to Distal End Radius Plating in terms of functional outcomes. This is an observational type of retrospective study where 40 patients were included in the study and among them 20 with external fixator/k wire and 20 with distal radius plating on whom the study conducted. Assessment of the fracture was based on AO classification [12]. Adult Patients above age of 18 years with AO type B and C included in study. Patients with open/compound, pathological fractures excluded from study. Below-mentioned are the acceptable radiological criteria kept in mind during the surgical procedures and were assessed intra-operatively after reduction was achieved under image intensifier guidance and on immediate post-operative x-rays. After discharge on the first follow up, patients check x-rays were also evaluated for any loss of reduction since discharge.

1. Radial Length within 2-3mm of the contra-lateral wrist joint.
2. Palmar tilt: Neutral tilt (0degrees)
3. Intra-articular step-off of <2mm
4. Radial Angle: <5degree loss
5. Carpal Mal-alignment: Absent

Patients followed up at 6 weeks, 3 months, 6 months, 9 months and 12 months. At the 12 month follow-up final assessment was done for fracture union and patients were assessed for pain, wrist range of motion (ROM), grip strength and activity and scored according to the Modified Green O'Brien Scoring System [4].

Statistical Methods Applied: Results are tabulated in Microsoft excel and statistical analysis was done using SPSS version 20 for Windows 10. The statistical evaluation included descriptive statistics; frequencies and percentages were calculated for the data. Also the Chi-square test was applied for comparison of qualitative categorical variables. For quantitative data comparison of 2 means of parameters, t-test was applied. This quantitative data was also represented in the form of mean and standard deviation. Both, the qualitative and quantitative data were presented in the form of bar diagrams. P-value was checked at 5% level of significance (<0.05).

Surgical Technique (External Fixator)

In supine position on the simple operating table, under regional

block anaesthesia (brachial block) or general anaesthesia, patient was placed, with the tourniquet applied over the arm. The forearm and hand were scrubbed with Betadine and saline and then painted with Betadine and draped. The operating forearm was placed on a radiolucent arm-board so as to achieve closed reduction under C-arm. In this technique, 5mm incisions were made for 4 schantz pins, 2 of them in the middle third of the radius on the dorso lateral aspect about 10-12cm from distal end and 2-3cm apart. Another 2 incision over the base of the second metacarpal on dorso lateral aspect about 1-2cm apart were done. 3mm shanz pins were inserted in the radius, and 2.5mm shanz pins were introduced in second metacarpal. Then fixator pins were secured in place with clamps and external fixator rods mounted to shanz pins. The clamps were loosened and longitudinal traction was given with manual molding of the fracture fragments back into a more normal alignment and gentle flexion and ulnar deviation was maintained. Through image intensifier, the reduction was confirmed and then external fixation device was locked into place. The tension across the wrist generated by the external fixator device which provides enough ligamentotaxis was confirmed by image intensifier wherein, radiocarpal articulation was seen to be 1 mm wider than the mid-carpal joint in A-P projection. Postoperatively, the fixator was kept in place for approximately 6 weeks. Finger ROM was encouraged from immediate postoperative period. At 2 weeks after surgery, the sutures are removed and. A supportive removable splint is prescribed and pin care initiated. Wrist ROM is started after external fixator removal. Strengthening is initiated as ROM improves and symptoms normalize.

Surgical Technique (Plating)

Volar approach (Henry's Approach) [25] is used, with forearm in supination, a 6-7cm longitudinal incision, beginning on ulnar aspect of thenar eminence till flexion crease of wrist is reached and then curving it slightly towards the ulnar side of forearm so it does not cross the flexion crease at right angle over the interval between radial artery and flexor carpi radialis. Develop the interval between the flexor carpi radialis and the radial artery. Retract the tendon toward the ulna and identify the median nerve between the tendons of the palmaris longus and flexor carpi radialis muscle. The nerve lies closer to the palmaris longus so, Median nerve is retracted medially. Expose the pronator quadratus muscle, and elevate it to expose the volar surface of the distal radius. Do not release the volar capsule or ligamentous insertions because carpal instability may result. Fracture site is reached by elevating periosteum around fracture site. With reduction clamps and bone holding clamps, reduction is achieved and augmented by K-wires fixation. Position of volar buttress plate is confirmed under image intensifier and fixation is secured with screws. Tourniquet is released. Haemostasis is achieved. Closure is done at subcutaneous layer and skin stitches are applied. Pressure bandage followed by crepe bandage is applied and below elbow slab is given and elevation is given. Post-operative x ray is taken at the night of surgery. Dressing was done at second post-operative day. Usually Stitch removal is done on 12th day with removal of slab and mobilization is done. Finger, wrist, elbow, shoulder physiotherapy is advocated as per protocol.

Results and Data Analysis

The demographic profile suggested that 23(57.5%) patients were male and 17(42.5%) female, with the mean age at presentation for patients treated by External Fixator with K-wires being 38 and patients treated by ORIF with Buttress plating being 43.1

Majority of patients 16 (40 %) were between 51-60 age group and between 21-30 age group-14(35%), showing a bimodal distribution. In present study, out of 40 patients 23 (57.5%) patients had left side and 17 (42.5%) patients had right side involvement. Left side involvement was more common than Right side. In present study, fall on outstretched hand was the most common mechanism of injury seen in 21(52.5%) patients,

out of 40 patients.

Out of 40 cases, 02(5%) cases were AO type B1, 07(17.5%) were B2 type and 11(27.5%) were B3 type. In the type C fracture pattern, 06(15%) cases were C1 type, 10(25%) were C2 and 04(10%) were C3 type. Majority were B3 type followed by C2. Additional K wire fixation was done in 5 patients.

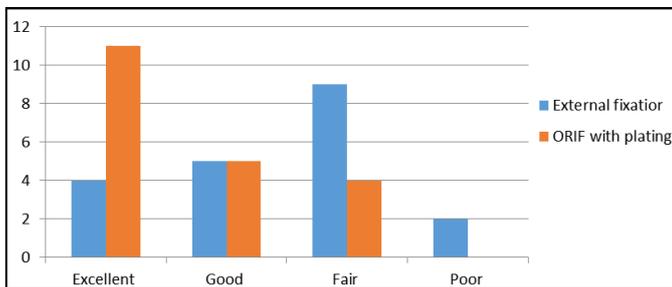
Table 1: Comparison of Functional outcome between the two groups with statistical significance

Functionality	External fixation	ORIF with plating	P score
Extension ⁽⁰⁾	62(SD=7.67)	71.35(8.24)	0.0006*
Flexion ⁽⁰⁾	59(SD=15.52)	68(SD=9.92)	0.04*
Supination ⁽⁰⁾	61(SD=11.65)	69.75(SD=10.44)	0.02*
Pronation ⁽⁰⁾	64.5(SD=9.162)	71.45(SD=12.59)	0.05
RD ⁽⁰⁾	15.05(SD=3.1)	17.01(SD=2.633)	0.04*
UD ⁽⁰⁾	17.8(SD=4.20)	22.3(SD=4.219)	0.002*

* Result is statistically significance (p < 0.05)

Table 2: Overall Functional results in the two treatment modalities

Treatment	Green and o'brein point system Functional results			
	Excellent	Good	Fair	Poor
External fixation	04(20%)	06(30%)	08(40%)	02(10%)
PLATING	11(55%)	05(25%)	04(20%)	-



Graph 1: Overall Functional results in the two treatment modalities

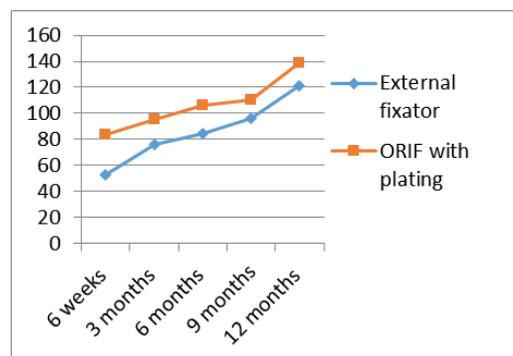
In present study, we got excellent functional results according to the G and O'Brein system in 11(55%) of patients treated with ORIF with plating group as compared to 4(20%) patients in the External fixation group.

We got good results in 5(25%) patient in Plating group as compared to 6(30%) in the ORIF group. We got fair results 08(40%) of patients in the external fixator group as compared to 4(20%) of patients in the ORIF group and poor result in 2(10%) patients of the external fixation group and none in the plating group.

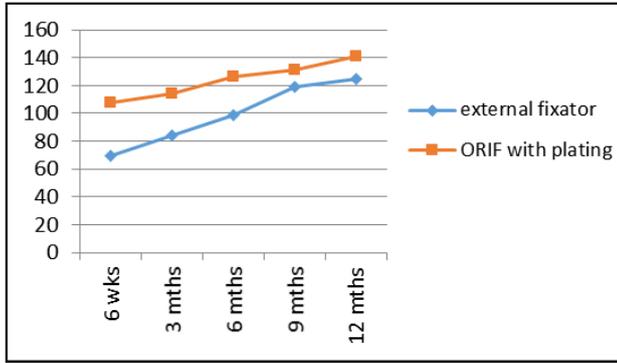
Table 3: Objective outcome during the follow-up at 6 weeks and at 3, 6, 9 and 12 months postoperatively in the two study groups.

ROM arc in three Planes	External fixator+/k wire Group					ORIF with Plating				
	6 wks	3mth	6mth	9mt	12mth	6wk	3mth	6mth	9mths	12mth
Fx/Ex	52.5	76	84.25	96	121	83	95.45	106	110.6	139
(M/SD)	-11.41	-13	-12	-10	-11.06	-10.7	-8	-15	-9.7	-9
S-P*	69.5	84.25	98.9	119	125	107.6	114	126	131	141
(M/SD)	-9.44	-7.65	-7.74	-7.18	-10.4	-10.8	-11.4	-11.1	-15.5	-11.5
RD-UD	15.35	17.8	20.3	24.9	32.8	27.6	30.6	34.7	36.9	39.3
	-5.27	-5.06	-4.8	-4.78	-3.6	-4.8	-2.6	-3.6	-2.55	-3.4
Grip Strength	10(5.65)	19.5	58.5	74	81.75	24	46.5	69.25	90.4	92.75
		-5.1	-8.12	-8.82	-12.27	-5.9	-6.7	-11	-6.8	-9.66

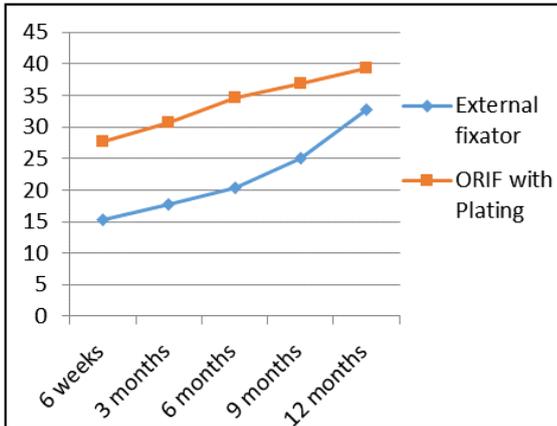
*Fx/Ex: Flexion- Extension, S-P: Supination -Pronation, RD-UD: Radial -Ulnar deviation M/SD- Mean /Standard Deviation Grip Strength - % of the normal side In the present study, grip strength was significantly better (p=0.003) in the plating group as compared to the EXTERNAL FIXATOR group.



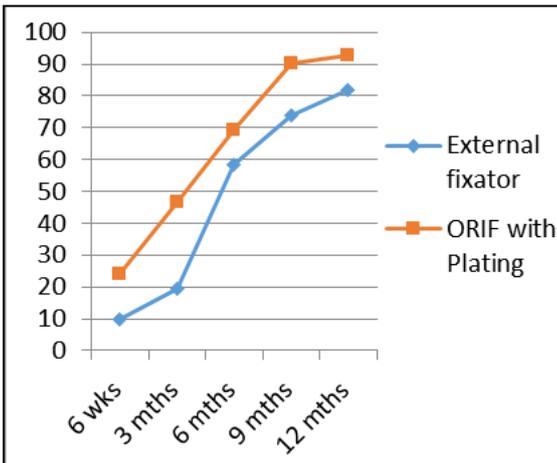
A) In Flexion-Extensio



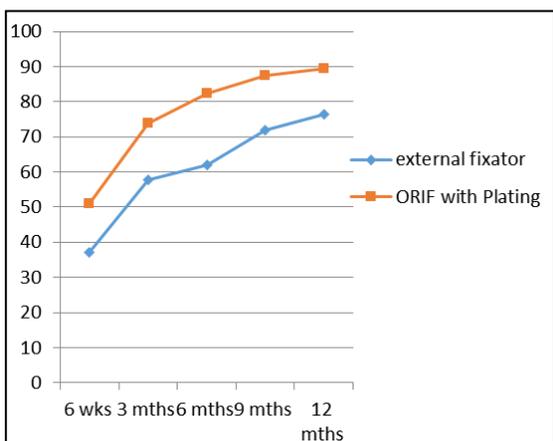
B) ROM in Supination-Pronation



C) ROM in Radial and Ulnar deviation



D) Grip Strength (%)



E) Functional Outcome as per G & O B'rein scoring system

In our series, we found that the range of motion (ROM) (Flexion-extension, Supination-Pronation, radial and Ulnar deviation) was better in the plating group as compared to the external fixation group. In the external fixation group the ROM improved over the follow-up period being comparable to plating group at the end of 12 months follow-up. The grip strength was significantly better in the Plating group in the initial follow-up period (6wks, 3months) but later improved in the external fixation group. The Functional score of G & O B'rein was considerably better in the Plating group in the initial part of the follow-up, which later improved in the external fixation group over a period of 12 months of follow-up

CASE 1



PRE OP POST OP 1 MONTH 6 MONTHS



FOLLOW UP

CASE 2:



PRE OP POST OP



1 MONTH 6 MONTHS



Follow up

Discussion

In present study, we got excellent functional results according to the G and O'Brein Functional scoring system in 11(55%) patients treated with Plating as compared to 4(20%) patients in the external fixator group, good results in 5(25%) patients in the plating group as compared to 06(30%) patients in the external fixator group. We got fair result in 8(40%) patients in the external fixator group as compared to 4(20%) patients in the Plating group. We got poor result in 2(10%) patients of the external fixator group and none in the plating group. There was a significant difference in the mean value of the functional result in the Plating group (76.5) as compared to external fixator group (89.5).

We evaluated our results and compared them with those obtained by various other studies utilising different modalities of treatment.

Zamzuri *et al* (2004) in their short term study comparing external fixation versus internal fixation for closed unstable intra-articular fractures of distal radius reported that the anatomical results were better in the internal fixation group compared to the external fixation group. The radial height, volar tilt and radial inclination were well maintained. However, the functional results at six months and one year showed no differences between these two types of fixation. The complication rate was higher in external fixation group^[55].

Antonio Abramo *et al* (2009) in their study comparing ORIF with plating to closed reduction external fixator, found that internal fixation gives better results as compared to external fixator in terms of early mobilisation, better grip

Strength and better subjective evaluation. Also the rate of complication was less as compared to external fixator in the plating group, which was also seen in our study. The only difference being they had used fragment-specific wrist fixation system TriMed as a method of internal fixation as compared to non-locking plate used in our study^[54]. N. Schmelzer *et al*. (2009) in their study comparing the effectiveness of locking and non-locking palmar plating and external fixation for unstable distal radius fractures in the elderly and concluded that the locking palmar plate fixation method demonstrated significantly better radiological and functional results in comparison to external fixation and the non-locking palmar plating methods. The subjective assessment of plate fixation proved to be better than that of external fixation. Complications and reoperations were fewer for both plate fixation groups^[53].

Conclusion

Both ORIF plating and external fixation are good treatment choices for distal end radius fractures. ORIF PLATING provides better functional outcome as assessed by Green and O'Brien score as compared to external fixation. It allows for early postoperative range of motion exercises as compared to external

fixator and also allows better anatomical positioning of the fracture segments. The grip strength is better in the plating group as compared to external fixation group. IN patients treated with external fixator, the grip strength gradually improves after frame removal and after physiotherapy sessions and longer follow-up becomes comparable to the plating group. Limitations of the study were small number of patients and duration of the follow-up. We believe that a larger group of patients with longer follow-up would be more conclusive.

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