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Original Research Article.

A Comparative Study of Operative Management of Intraarticular Fracture Distal end of Radius (External Fixator Versus ORIF with Buttress Plating)

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ABSTRACT

Background: Intraarticular fracture distal end of the radius is one of the most common fracture of upper extremities. Here is randomised comparative study of the most effective treatment modality to deal with such fracture by external fixator vs buttress plating.

Method: Patients were randomly allocated into two groups of 30 each (group A and group B). Patients treated with external fixator was put in group A while those treated with buttress plating was kept in group B. At the end of 8 months of 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. The mean duration of treatment and the outcome were comparable.

Results: In group A (external fixator) only 7 patients had excellent and 18 had good results while patient in group B (ORIF with plating) 14 patients had excellent and 11 had good result.

Conclusion: We found that plating predominantly provides more excellent results as long as the radiological parameters are met and fixation achieved as early as possible along with vigorous physiotherapy.

Level of Evidence: Level II randomised comparative series.

Keywords: Intraarticular Fracture Distal End Radius, External Fixator, Buttress Plating.

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INTRODUCTION

Fractures of lower end radius are the most common fractures of the upper extremity, encountered in practice and constitute 17% of all fractures and 75% of all forearm fractures.[1] Three column theory: The distal radius has been conceptualized as a three column model. The wrist is divided into medial intermediate and lateral column. This theory emphasizes that the lateral or radial column is an osseous buttress for the carpus and is an attachment for the intra capsular ligaments. The primary function of the intermediate column is load transmission and the medial or the ulnar column serves as an axis for forearm and wrist rotation as well as a post for secondary load transmission.[2]

Close reduction and cast immobilization has been the mainstay of treatment of these fractures but malunion of fracture and subluxation/ dislocation of distal radioulnar joint and radiocarpal joint resulting in poor functional and cosmetic results is the usual outcome.[3]

The residual deformity of wrist adversely affects wrist motion and hand function by interfering with the mechanical advantage of the extrinsic hand musculature.[4] It may cause pain, limitation of forearm motion, especially supination and decreased grip strength as a result of arthrosis of the radiocarpal and distal radioulnar joint. Recently surgical management has been widely recommended and performed to prevent disability. Several studies have shown convincingly that functional outcome is good when the anatomy is restored by obtaining good reduction of fracture fragments maintaining the angulations of the articular surface of radius and radial length, and to minimize those related complications as well.[5]

This study evaluates the surgical and functional outcomes of intra-articular fractures of distal end radius in a comparative study between closed reductions with external fixation versus open reduction internal fixation (ORIF) with buttress plating, and modified green O'brien scoring system was used to assess finaloutcome.[6]

MATERIAL AND METHODS

Source of Data

The study was conducted in the department of orthopaedics, North DMC medical college and Hindu Rao Hospital, Malkaganj, Delhi; between May 2015 to May 2017 on intraarticular fracture distal end of radius.

Study Design: Randomized comparative study.

Sample Size: Sample size of total 60 patients admitted in OPD as well as in emergency department. Study subject was systematically and randomly allocated into two group of 30 each, (Group A and Group B)

Sampling Method: Random sampling.

Inclusion Criteria

1. Only adult patients were taken for the study (more than 18 and less than 55 years of age)
2. All patients selected for the study had intraarticular fracture distal end of radius and the fracture was classified employing Frykman classification system.
3. Selection of the patients for operative treatment was random.

Exclusion Criteria

1. All those patients whose epiphysis plate has not been fused with diaphysis.
2. Extraarticular fracture distal end of radius.
3. Open fractures and pathological fractures.

Statistical Method Applied: Sample Size was determined based on the ability to detect the patient satisfaction rate. With 30 patients in each group, there was 80% power at an alpha 0.05 to detect a 30% (assumed difference) between the two groups in the ratio of patient satisfaction during the 8 months follow up period.

The formula for calculated sample size is given below

$n = [z1-\alpha/2.\sqrt{2P(1-P)} + z1-\beta.\sqrt{\{P1(1-P1) + P2(1-P2)\}}]^2 / (P1-P2)^2$

Where, P1 = Anticipated proportion of patient satisfaction rate at 8 months in Group A; P2 = Anticipated proportion of patient satisfaction rate at 8 months in Group B

$P = (P1+P2)/2$

Data Management and Statistical Analysis: Statistical testing was conducted with the statistical package for the social science system version SPSS 17.0. Continuous variables were presented as mean SD or median if the data was unevenly distributed. Categorical variables were expressed as frequencies and percentages. The comparison of normally distributed continuous variables between the groups was performed using Student's t test. Nominal categorical data between the groups were compared using Chi-square test. For all statistical tests, p value less than 0.05 was taken to indicate a significant difference.

Table 1: Final outcome

Final outcome		Group		Total
		Group A (Ex-Fix)	Group B (Plating)	
Excellent	**Count**	7	14	21
	% of Total	11.7%	23.3%	35.0%
Good	**Count**	18	11	29
	% of Total	30.0%	18.3%	48.3%
Fair	**Count**	3	4	7
	% of Total	5.0%	6.7%	11.7%
Poor	**Count**	2	1	3
	% of Total	3.3%	1.7%	5.0%
Total	**Count**	30	30	60
	% of Total	50.0%	50.0%	100.0%
P-value		**0.012**		

RESULTS

In Group A (External Fixator) 7 (11.7%) patients had Excellent, 18 (30%) Good, and 3 (5%) had Fair with 2 (3.3%) patient having Poor results. In Group B (ORIF with plating) 14 (23.3%) patients had Excellent, 11 (18.3%) Good, 4 (6.7%) Fair and 1 (1.7%) patient had Poor results at the final 8 month assessment according to the Modified Green O'Brien Scoring System.[6] A p-value of 0.012, which was significant. Hence suggesting that plating predominantly provides more excellent results as long as the radiological parameters are met and fixation achieved as early as possible along with vigorous physiotherapy.

DISCUSSION

These results were similar to a study conducted by Shukla et al. on 110 patients where he concluded that 85.5% of patients treated with external fixation and 73.3% of patients treated with volar plating had an excellent or good result.[7]

Kapoor et al. Reported 80% and 63% with good or excellent results in external fixation and volar plating groups respectively and recommend that displaced severely comminuted intra-articular fractures should be treated with an external fixator[8], while Gradl et al. reported 100% and 97.5% with good or excellent results in these two groups respectively.[9]

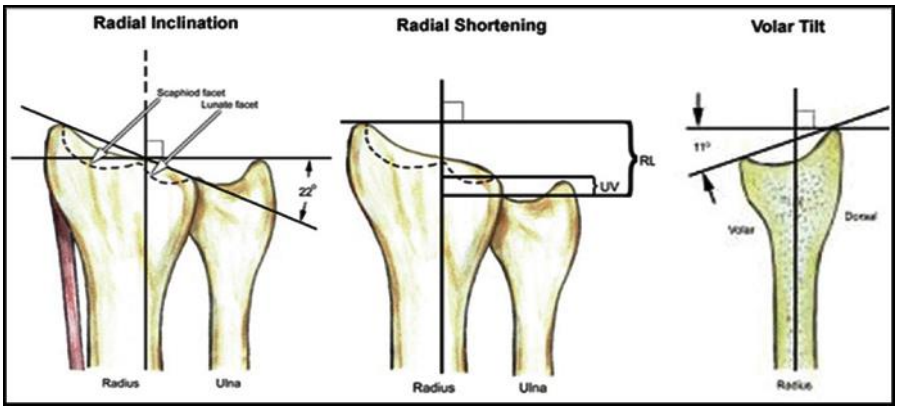

Figure 2: Radial inclination, Radial length (RL), Ulnar variance (UV), Volar tilt.

ACCEPTABLE RADIOLOGICAL CRITERIA FOR FRACTURE REDUCTION

1. Radial Length within 2-3 mm of the contra-lateral wrist joint.
2. Palmar tilt: Neutral tilt (0 degrees)
3. Intra-articular step-off of <2mm
4. Radial Angle: <5 degree less
5. Carpal Malalignment: Absent[10]

Above 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, patient's check x-rays were also evaluated for any loss of reduction since discharge.

Age Distribution: In the current study the mean age at presentation for patients treated by external fixator was 40.66±11.80 (range 20-55 years) and patients treated by ORIF with buttress plating was 40.40±11.71 (range 20-55). Shukla et al. reported similar observations. Rizzo et al. reported average age at presentation as 45 years in the external fixator group and 48 years in the ORIF group.[11]

Sex Distribution: In the current study 40 (66.7%) patients were male and 20 (33.3%) female with a male female ratio of 2:1. Fakoor et al. in a study reported 75.1% Male patients compared to 24.9% female patients suffered from distal and radius intra-articular fractures.[12]

Mode of Injury: In our study 39 (65%) patients had a high velocity trauma mostly by Road Traffic Accident 31 (52%) and 21(35 %) had a low velocity trauma predominantly by fall on outstretched hand, most of which were osteoporotic patients. In a study done on 180 patients by Phadnis et al, it was suggested that increasing incidence of these injuries may be attributed to an ageing population (osteoporotic fractures) and the growing participation in outdoor pursuits (higher energy fractures).[13]

Dominant Extremity Affection: In our study 33 (55%) patients had their dominant extremely affected, out of which 17 (28%) patients were in the external fixator group and 16 (27%) patients were in the buttress plating group. In a study conducted by Rizzo et al. 30 (54.5%) patients had their dominant extremity affected out of a total of 55 patients.

Frykman's Classification: In our study majority of Frykman type VIII was treated by ex-fix with 9(15%) while plating is done in type VII 9(15%) mainly. In a study conducted by Siripakarn Y et al. reported the same results.[14] Kapoor et al. In this study 22 (44%) patients suffered an AO classification Type B fracture with 11 (22%) patients being treated by External Fixation + K-wires group and Plating each. In the Type B fracture patients all 11(22%) patients treated by External Fixator + K-wires had Excellent or Good results at the final 8 months assessment whereas in the Plating group 9 (18%) patients had excellent or good results and 2 (4%) patients having fair or poor results.

Table 3: Group statistics

Group Statistics						
	Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**P-value**
Age	**Group A (Ex-Fix)**	30	40.66	11.80103	2.15456	.930
	Group B (Plating)	30	40.40	11.71383	2.13864	
Duration Of Surgery (Minutes)	**Group A (Ex-Fix)**	30	47	10.22168	1.86622	<.001
	Group B (Plating)	30	61	9.59526	1.75185	
Trauma To Surgery Duration	**Group A (Ex-Fix)**	30	2.20	.61026	.11142	.085
(Days)	**Group B (Plating)**	30	2.56	.97143	.17736	
Hospital Stay (Days)	**Group A (Ex-Fix)**	30	3.63	.66868	.12208	.002
	Group B (Plating)	30	4.23	.72793	.13290	
Time To Union (Weeks	**Group A (Ex-Fix)**	30	10.10	2.29467	.41895	.592
	Group B (Plating)	30	9.76	2.48698	.45406	
Green O " Brien scoring system	**Group A (Ex-Fix)**	30	82.83	7.66579	1.39958	.259
	Group B (Plating)	30	85.33	9.79825	1.78891	

Duration of Surgery: In our study the average duration of surgery for Group 1 (External Fixator + K-wires) was 47.00±10.20 minutes, whereas in Group 2 (Plating) was 61.00±9.51 with significant p-value of < 0.001. In a study conducted by Shukla et al. mean surgery time was 35.1±2.5 mins in the external fixation group and 56.5± 2.7 mins in the volar plate fixation group.

Duration of Hospital Stay: In our study 14 (23%) patients were discharged after 3 days of hospital stay, 45 (75%) were discharged in 4-6 days, 7 (14%) and 1 (1.7%) in >6 days from the time of admission. Average duration of stay being 3.94 days. Average duration of the stay for the External Fixator group being 3.63 days, whereas with the plating group 4.23 days. Duration of hospital stay proved to be significant with a p-value of 0.028.

Time to Fracture Union: In our study the average time to fracture union for the External Fixator group was 10.10±2.2 weeks, whereas for the Plating group it was 9.76±2.4 weeks, with a p-value of 0.592, which was not significant. This corresponds to a study done by Oliveira et al.

Complications: Complications were seen in 10 (16.66%) patients in the study conducted. 5 (8.33%) were in Group A (External Fixator) and 5 (8.33%) belonged to Group B (Plating). Kapoor H et al. Had similar results in a study conducted on 179 patients.

Following were the complications faced in our study:

I. Implant Loosening: 1 (1.7%) case in Group A (External Fixator) had loosening of a Schanz Pin which required revision under sedation. Phandis et al. reported similar findings.

II. Pin-Tract Infection: 1 (1.7%) patients in Group A developed pin tract infection which was managed with oral antibiotics (3rd generation cephalosporins) and good pin-tract care.

III. Stiffness of Metacarpo-Phalangeal Joints: 2 (3.3%) patients developed stiffness of MCP joints (1 from Group A and 1 from Group B) which was treated with rigorous physiotherapy.

IV. Superficial Radial Nerve Neuropraxia: 1 (1.7%) patients in group A developed neuropraxia of the Radial Nerve and were treated with NSAIDs, short course steroids and physiotherapy. All patients recovered completely.

V. Complex Regional Pain Syndrome (CRPS): 2 (3.3 %) patients developed CRPS (1 from Group A and 1 from Group B) and were managed with physiotherapy, short course steroids and Amitriptyline.

VI. Superficial Infection: 2 (3.3%) patients from group B developed superficial infection at the suture site and were managed with oral antibiotics (3rd Generation cephalosporins). The superficial infections healed completely.

VII. Deep Infection: 1 (1.7%) patient in group B developed deep infection which did not subside with oral antibiotics. Implant removal was done in this case with thorough debridement and was the managed with an external fixator and k-wires.

VIII. Median Nerve Neuropraxia: 1 (1.7%) patient in group B developed median nerve neuropraxia and was managed with NSAIDs, short course steroids and physiotherapy (TENS). The patient recovered completely.

CONCLUSION

Fracture of distal end of radius has a predominantly bimodal age distribution in our study with young individuals between 21-30 years and older patients above the age of 40. There is more of male population affected than a female population. Road traffic accidents were a major mode of trauma in the younger aged population while a fall on outstretched hand in the older. The affection of the dominant hand did not have an influence on the final outcome in either of the study groups. Duration of surgery was significantly lesser in the external fixation group with lesser surgical soft tissue trauma. There was a significant difference in the duration of hospital stay in the two study groups with the patients in the external fixation group requiring a shorter hospital stay.

Early post-operative mobilization is possible in the patients treated with ORIF and plating but does not affect the final outcome with rigorous physiotherapy initiated in the patients treated with external fixator once implant is removed. Rigorous physiotherapy is key to avoiding post-operative arthritis and achieving good range of motion in the external fixator group. Not crossing the watershed line landmark, is crucial during the placement of hardware (plate) during the ORIF and plating procedure with care taken to prevent damage to the neurovascular structures (radial artery and median nerve) around the operative field. Care should be taken not to damage the superficial radial nerve while drilling for and inserting schanz pins in the radius during the procedure of external fixation. Over-distraction should be prevented while using the external fixator and pin tract care is a must to avoid infection at pin-tract sites. Time to fracture union is similar in both study groups as the acceptable radiological criteria are met.

SUMMARY

There was a significant difference in the final outcome in both the study groups, assessed using The Modified Green O"Brien System. However, we preferred using the external fixator application in the treatment of intra-articular fractures of the distal radius (Frykman Type VII and VIII). Although open reduction and internal fixation has advantages such as direct visualization and manipulation of the fracture segments, stable fixation and the possibility of immediate postoperative motion but we preferred the use of external fixator since it provides continuity of reduction under fluoroscopic control, improved reduction by ligamentotaxis,[15] and the ability to protect the reduction until healing occurs, with advantages such as the relative ease of application, minimal surgical exposure, reduced surgical trauma, and easy removal of hardware. External fixation neutralizes the axial load imparted by the physiological load of the forearm musculature, while the use of a percutaneous k-wires improves the stability of the external fixation and prevents loss of bone reduction.

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