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External Fixation versus Open Reduction with Plate Fixation for Distal Radius Fractures

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Abstract

To begin with, a strong distal radius anatomical reconstruction is essential for a successful result, particularly in the case of an active patient. For distal radius fractures, recent studies have shown that surgical therapy is preferable to closed reduction and cast treatment, based on wrist biomechanics and complicated fracture instability. External fixation vs open reduction and plate fixation in distal radius fractures were compared in this thesis for functional and radiological results. The purpose of this research was to compare the surgical therapy of unstable distal radius fractures utilising external fixation versus internal fixation. At Benha University Hospitals and El-elahrar Educational Hospital, there were 30 adult patients with solitary distal radius fractures, separated into two groups. Results: Radiographs of the patients were used to gather the anatomical information. flexion, extension, ulnar deviation, radial deviation, and supination and pronation) at the 12-month mark were documented. In addition, grip strength and Quick DASH scores were measured at 3, 6, and 12 months. These two management tiers' radiological and functional results were compared. Surgical therapy of distal radius fractures with internal and external fixation was successful in our research, with satisfactory functional outcomes. Age, gender, fracture side, and mechanism of injury were not shown to affect fracture outcome in our research. The plate group had improved flexion, extension, supination and pronation, radial length, and palmar tilt in our research. Also, this group had lower Quick DASH scores and fewer problems. For distal radius fractures, both ORIF with a plate and external fixation are excellent options. More stable fixation, early wrist range of motion, and lower Quick DASH scores were seen in the open reduction and plate fixation group than in the external fixator group, which also permitted superior anatomical alignment and improved radiological results. In early follow-up visits, the plate group had better grip strength than the external fixator group. Complications were reported by a higher percentage of patients in the external fixator group than in the plating group. Plaque fixing was thus linked to improved results on both the functional and radiographic side.

Key words: External Fixation, Open Reduction with Plate Fixation**,** Distal Radius Fractures.

1.Introduction

Distal end fractures of the radius have been documented by Colles for about 200 years. The most frequent fracture in the upper extremity is a fracture of the distal radius, which is also likely the most common fracture in the human skeleton. One-sixth of all fractures seen and treated in emergency rooms are thought to be caused by this. The most common age groups for distal radius fractures are those aged 6 to 10 as well as those aged 60 to 69. Low-energy falls are the most common cause of these fractures, which are more common in women than males. It is difficult to treat some of these fractures because they are unstable and difficult to reduce anatomically, and they are linked with a high complication rate due to the difficulty of reducing these fractures anatomically. When the hand and carpal bones are impacted by a high enough force, articular fragmentation patterns and the amount of concurrent ligament and carpal bone injuries may be determined. The ultimate objective of distal radius fracture therapy is to get the patient back to where they were before the injury. Closed reduction and immobilisation in a cast may be used to treat simple fractures of this sort, however unstable comminuted fractures of the distal radius pose a significant problem. Conventional treatment with a plaster cast for a comminuted unstable fracture leads to significant deformity and poor outcomes. In cases when conservative measures have failed to preserve anatomical and functional stability, external and internal fixation procedures are now often utilised. Ligamentotaxis is used to reduce the amount of surgery required for external skeletal fixation. External fixators, both static and dynamic, are used to help keep the radial length and alignment stable. The wrist joint's anatomical and functional stability are directly controlled and maintained through internal fixation, which is becoming popular. [6]

External fixation vs open reduction and plate fixation in distal radius fractures were compared in this thesis for functional and radiological results.

2. Patients and Methods

Patients:

In this case-series study, thirty cases with fracture distal radius were managed over the past three years. The records of the patients with fracture distal radius treated in Elahrar educational hospital and Benha university hospitals were reviewed and all Cases with fracture distal radius either intra-articular or extra-articular AO class A3, B1, C1, C2, C3 were selected. Cases were randomly divided into two groups to compare the functional and radiological outcomes between external fixation and open reduction with plate fixation in distal radius fractures**.**

Inclusion criteria

- Cases with isolated distal radius fracture.
- Irreducible fractures.
- Initial shortening > 5mm.
- Initial displacement > 1cm.

- Initial dorsal tilt > 20°.
- Intra-articular extension.
- Three-part or more fracture distal radius.
- Dorsal comminution more than 50% of the AP distance.
- Palmar metaphyseal comminution.

Exclusion criteria

- Cases with open fractures.
- Neglected old cases more than 3 weeks.
- Cases with volar/dorsal intra-articular shear fracture.

Methods:

Patients were assessed using a variety of methods, including a review of their medical history, a physical examination, laboratory testing, and imaging studies. With specific emphasis on the risk of pin tract infection, mal-union and other sequelae, standard consents were obtained from each of the patients. In our investigation, no patients' names were revealed at all. Additionally, they have the option to withdraw at any moment.

History taking: was taken from all the patients fulfilling the following data:

- Patient's age, type, and work.
- Right or left-hand and which hand is the dominant.
- Mode of trauma.
- Special habits (e.g., smoking).
- Presence of chronic diseases (e.g., Diabetes mellitus, hypertension and cardiac disease).

Physical examination: Standard hand examination was performed on all patients in the form of:

- Skin condition.
- Functions of muscles and tendons.
- Hand grip and fingers movement.
- Neurovascular status.

Investigations:

- Laboratory: Routine pre-operative; complete blood picture, liver and kidney functions, random blood sugar, and bleeding profile. Electro-cardiogram and echo-cardiogram were done for all cases with cardiac diseases and age above 50 years for cardiology consultation.

Clinical Radiographs

- **X- rays:** affected wrist antero-posterior and lateral views were taken to detect site, articular extension, and pattern of fracture displacement. These were done pre-operatively, immediate post-operatively, and in follow up visits.
- **CT scan and 3-Dimentional CT:** pre-operative CT helped in detection of site and degree of articular comminution (scaphoid and lunate fossae). Also, it helped in pre-operative grading and planning. CT was not routinely needed in our thesis; we did CT scan for seven cases preoperativly.

Clinical photographes: Before and after the intervention (after notifying the patients), photographs of the patients' hands were taken to monitor the motions of their wrists and fingers. Photographs were taken of grip strength, range of motion, and radiological examinations, among other things.

Test of Chi Square

The chi-square statistic is calculated by dividing a variable into categories and then doing the Chi Square test on each one of those categories. Each category is tested to see whether the percentage of values in each category is the same, or if the proportion of values in each category is set by the user. The following findings were drawn from the study's data, which were presented in the accompanying table.

3. Results

There is statistically non-significant difference between the studied groups regarding age or gender.

Table (1) Comparison between the studied groups regarding demographic data.

	Closed reduction and external fixation group N=15 (%)	**Open reduction and plate fixation group N=15 (%)**	**χ^2/t**	**P**
Age (year):				
Mean ± SD	35.13 ± 13.46	38 ± 14.72	-0557	0.582
Range	19 – 63	21 – 62		
Gender:				
Female	6 (40.0)	5 (33.3)	0.144	0.705
Male	9 (60.0)	10 (66.7)		

χ^2Chi square test t independent sample t test

There is statistically non-significant difference between the studied groups regarding mode of trauma. RTA occurred in 66.7% and 40% of patients within closed and open reduction groups respectively.

Table (2) Comparison between the studied groups regarding mode of trauma.

	Closed reduction and external fixation group N=15 (%)	Open reduction and plate fixation group N=15 (%)	χ^2	P
Mode:				
RTA	10 (66.7)	10 (66.7)		
Fall on outstretched hands	5 (33.3)	5 (33.3)	0	>0.999

χ^2Chi square test RTA Road traffic accident

There is statistically non-significant difference between the studied groups regarding side or AO classification of fracture.

Table (3) Comparison between the studied groups regarding side and AO classification of fracture.

	Closed reduction and external fixation group N=15 (%)	Open reduction and plate fixation group N=15 (%)	χ^2	P
Side:				
Right	10 (66.7)	10 (66.7)		
Left	5 (33.3)	5 (33.3)	0	>0.999
AO classification:				
A3	2 (13.3)	3 (20)		
B1	2 (13.3)	3 (20)		
C1	2 (13.3)	5 (33.3)	2.011	0.156
C2	4 (26.7)	2 (13.3)		
C3	5 (33.3)	2 (13.3)		

χ^2Chi square test

There is statistically significant difference between the studied group regarding time till complete healing. About 80% versus 27% of patients within closed reduction and open reduction groups respectively had complete healing within 8 weeks.

Table (4) Comparison between the studied groups regarding time for bone healing.

	Closed reduction and external fixation group Mean ± SD	Open reduction and plate fixation group Mean ± SD	χ^2/t	P
Time (week)	7.6 ± 0.83	6.53 ± 0.92	3.347	0.002*
6 weeks	3 (20)	11 (73.3)		0.274
8 weeks	12 (80)	4 (26.7)		

χ^2Chi square test t independent sample t test

Table (5) Comparison between the studied groups regarding radiographic features pre and postoperatively.

	Closed reduction and external fixation group Mean ± SD	Open reduction and plate fixation group Mean ± SD	T	P
Radial inclination:				
Pre-operative	17.79± 3.94	20.06 ± 3.39	-1.697	0.101
12 months postoperative	24.65 ± 3.57	26.36 ± 3.4	-1.345	0.189
p (pt)	<0.001**	<0.001**		
Radial length:				
Pre-operative	8.18 ± 1.63	6.8 ± 2.26	1.933	0.063
12 months postoperative	9.47 ± 2.17	11.27 ± 1.79	-2.48	0.02*
p (pt)	0.105	<0.001**		
Ulnar variance:	**Median (range)**	**Median (range)**		
Pre-operative	0.8 (0.2 – 1.0)	0.7 (0.1 – 3.0)	-0.168‡	0.867

12 months postoperative	-0.9 (-2.0, -0.4)	-1.0 (-2.5, -0.5)	-1.407‡	0.159
p (Wx)	**0.001****	**0.001****		
Palmar tilt:				
Pre-operative	5 (2 – 11)	9 (2– 12)	-0.711‡	0.477
12 months postoperative	9 (3 – 13)	14 (8 – 19)	-2.865‡	0.004*
p (Wx)	**0.001****	**0.001****		

t independent sample t test ‡Mann Whitney test pt Paired sample t test Wx Wilcoxon signed rank test *p<0.05 is statistically significant **p≤0.001 is statistically highly significant

Radial inclination

There is statistically non-significant difference between the studied groups regarding pre-operative or 12 months postoperative radial inclination. In each group, there is significant increase in radial inclination postoperatively.

Radial length

There is statistically non-significant difference between the studied groups regarding pre-operative while there is significant change between them 12 months postoperative radial length. In ORIF group, there is significant increase in radial length postoperatively.

Ulnar variance

There is statistically non-significant difference between the studied groups regarding ulnar variance pre-operatively or 12 months postoperatively. In each group, there is significant change in ulnar variance postoperatively.

Palmar tilt

There is statistically non-significant difference between the studied groups regarding pre-operative palmar tilt. On the other hand, there is significant difference between the studied groups regarding palmar tilt 12 months postoperatively. Better restoration of plamar tilt was in plate group. In each group, there is significant increase in palmar tilt postoperatively**.**

There is statistically non-significant difference between the studied groups regarding ulnar deviation, or radial deviation.

There is statistically significant difference between the studied groups regarding, flexion, extension, supination and pronation (all were significantly higher in open reduction group)**.**

Table (6) Comparison between the studied groups regarding functional assessment pre and postoperatively.

	Closed reduction and external fixation group Mean ± SD	**Open reduction and plate fixation group Mean ± SD**	**T**	**P**
Flexion	52.33 ± 16.33	83.67 ± 6.51	-7.123	<0.001**
Extension	53.67 ± 18,75	84.33 ± 10.33	-6.022	<0.001**
Ulnar deviation	22.0 ± 10.49	26.0 ± 5.07	-1.33	0.194
Radial deviation	26.0 ± 10.39	30.67 ± 6.78	-1.457	0.156
Supination	49.33 ± 27.96	78.0 ± 12.93	-3.604	٠0.002*
Pronation	65.33 ± 11.57	74.33 ± 11.93	-2.097	0.045*

t Independent sample t test *p<0.05 is statistically significant **p≤0.001 is statistically highly significant

There is statistically non-significant difference between the studied groups regarding hand grip 6, and 12 months however there is significant difference between the studied groups regarding grip strength at 3 months which was significantly higher among patients within open reduction and internal fixation group. In each group, there is significant increase in grip strength over time.

Table (7) Comparison between the studied groups regarding hand grip pre and postoperatively.

	Mean ± SD	**Mean ± SD**	**T**	**P**
Grip (kg/cm^2)				
3 months postoperative	4.17 ± 0.56	5 ± 0.63	-3.851	<0.001**
6 months postoperative	5.97 ± 0.52	5.49 ± 0.96	1.68	0.107
12 months postoperative	7.37 ± 1.01	7.1 ± 1.62	-0.542	0.593
p (F)	<0.001**	<0.001**		

F repeated measure ANOVA *p<0.05 is statistically significant t Independent sample t test **p≤0.001 is statistically highly significant

There is statistically significant difference between the studied groups regarding quick DASH score which was significantly lower among open reduction with internal fixation group.

Table (8): Comparison between the studied groups regarding Quick DASH (Q-DASH) score pre and postoperatively:

	Closed reduction and external fixation group N=15	**Open reduction and plate fixation group N=15**	**T**	**P**
QDASH score:				
Mean ± SD	49.63 ± 9.01	17.55 ± 7.51	10.59	<0.001**
Range	25 – 60.4	6.9 – 31.0		

t Independent sample t test **p0.001 is statistically highly significant

There is statistically non-significant difference between the studied groups regarding complications. Two cases within external fixator group had wrist stifness. Also, two cases within this group had pin tract infection. One patient within open reduction and internal fixation group had tendon and muscle injury.

Table (9): Comparison between the studied groups regarding complications:

	Closed reduction and external fixation group N=15	**Open reduction and plate fixation group N=15**	**χ^2**	**P**
Wrist stifness	2 (13.3)	0 (0)	Fisher	0.483
Pin tract infection	2 (13.3)	0 (0)	Fisher	0.483
Tendon and muscle injury, and intra-articular screw	0 (0)	1 (6.7)	Fisher	>0.999

χ^2Chi square test

4. Discussion

The patients' ages varied from 19 to 63. A total of 19 men and 11 women took part in the research. Twenty of the patients had fractures of the right distal radius, whereas 10 had fractures of the left distal radius. All patients' dominant hand was the right. A 12-month follow-up period was used in these investigations.

The AO categorization system was employed in this investigation. Among the classes covered were those in A3, B1, and C1. Volar and dorsal shear classes B2 and B3 were left out. In addition, situations that had been ignored for an extended period of time were not considered.

Both a fall on an extended hand and a car collision caused the injuries. Injury was mostly the result of an RTA. According to the manner of trauma, there was no difference between the two groups.

According to Agrawal et al [7], distal radius fractures are more common in the 20-50-year-old age range and in men than females.

In this research, the open reduction and plate fixation group had a faster healing period, with 11 instances healing at the six-week mark and four at the eight-week mark. At the six-week mark, three of the external fixator patients had healed, compared to 12 of the other patients.

In this investigation, a significant difference was seen between the groups in terms of palmer tilt and radial length restoration. After a year, ulnar varience and radial inclination revealed essentially identical outcomes in both groups, with no discernible difference. There is a statistically significant difference between pre- and postoperatively measured radial lengths, palmer tilt, ulnar varience, and radial inclines within each group, demonstrating the superiority of both approaches for treating distal radius fractures.

Radiographic evidence suggests that palmer plating is connected with improved corrections of palmer tilt. (Greli et al, [8] It's possible that this is due to the fact that distraction largely occurs via palmer structures and the palmer plate offers stronger support for the fracture. Because ligamentotaxis largely acts via strong palmer connections, traction alone in external fixation cannot rectify palmer angulations.

According to Kapoor and colleagues [8], radial length restoration is the most essential aspect in getting a successful outcome. Patients who undergo open reduction and internal fixation are less likely to develop arthritis in the future.

A substantial difference in flexion, extension, supination, and pronation ranges was seen between the plate group and the control group in this research. In terms of ulnar and radial deviation, there was no statistically significant difference. The plate group had better functional results.

Using a comparable design, Musa et al. [10], observed that the plating group had a greater range of motion (flexion, extension, supination and pronation, radial and ulnar deviation) than did the external fixation group in a similar research After a 12-month follow-up, the ROM in the external fixation group was equivalent to that in the plating group.

Because the ORIF group began finger and grip strength exercises earlier, the plate group's grip strength was superior to that of the external fixation group by the third month of the study. A patient's grip strength steadily improves once the external fixator is

removed and treatment is completed. At the 3rd and 12th months, there was no statistically significant difference between the groups. Both groups' grip strength improved with time.

The open reduction group had lower Quick DASH ratings than the closed reduction and external fixation groups, indicating that the plate fixation group had superior function restoration.

Volar plate fixation is linked with lower DASH ratings than external fixation, according to Gupta and Mandapalli [11], who compared ORIF utilising plate and K-wires with K-wires for the treatment of unstable distal radius fractures.

Two patients with pin track infection were in the external fixator group. They were treated with saline and vasline gauze irrigation and dressings on a regular basis. The patients were administered antibiotics based on their cultures and sensitivity levels. Pin track infection was much worsened as a result of removing the pins and the frame from the track.

Wrist stiffness occurred in two patients who used external fixators. Physiotherapy helped them get well, and the patients were happy with the outcomes.

One instance in the plate group had irritation of the flexor pollicis longus tendon from the upper edge of the volar plate. In the same patient, an intra-articular screw was inserted. Plate removal was used to alleviate these complications nine months after surgery.

Fortunately, none of the frequent side effects of operational fixation of a distal radius fracture, such as nerve problems, Sudek's atrophy, dupuytren's contracture, and mal-union, were seen in any of our cases. In distal radius fractures, the plate group had less problems, indicating that plates are a better treatment option.

ORIF with plating was compared to closed reduction and external fixation by Abramo et al [12]. When it comes to early mobilisation and subjective appraisal, internal fixation outperforms outward fixation, according to his findings. The plating group also had a lower complication rate than the external fixator group.

5. Conclusion

For distal radius fractures, both ORIF with a plate and external fixation are viable options. More stable fixation, early wrist range of motion, and lower Quick DASH scores were seen in the open reduction and plate fixation group than in the external fixator group, which also permitted superior anatomical alignment and improved radiological results. In early follow-up visits, the plate group had better grip strength than the external fixator group. Complications were reported by a higher percentage of patients in the external fixator group than in the plating group. Plaque fixing was thus linked to improved results on both the functional and radiographic side.

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