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Locking compression plate fixation vs external fixator for distal radius fractures

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Abstract
Introduction: To assess the outcome of distal radius fractures treated with locking compression plate and external fixator.
Methods: 40 patients with fracture of distal radius were included in this study. Out of 40, 20 patients underwent open reduction and volar locking compression plate fixation and 20 patients underwent closed reduction and external fixation on random basis. The Demerit scoring system was used to assess the outcome of both groups. The average follow up period was 6 months.
Results: Using Demerit scoring system of Gartland and Werley, the plate group had 9(45%) excellent, 9(45%) good, 2(10%) fair and no poor results and the external fixator group had 1(5%) excellent, 9(45%) good, 8(40%) fair and 2(10%) poor results. In plate group, 1 patient had tendon irritation. In external fixator group, 2 patients had pin tract infection and 1 patient had pin loosening.
Conclusion: Open reduction and volar locking compression plate fixation group had stable fixation, early wrist range of motion and better Demerit score compared to external fixator group.

Keywords: distal radius fractures, locking compression, external fixator

Introduction
Distal radius fractures are among the most common fractures of upper extremity. It continue to pose therapeutic challenge. It constitutes 15% of all extremity fractures. 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 atleast 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.
Some of these caused by high energy trauma resulting in intraarticular involvement and communition. These are unstable and are difficulty to reduce. Intra articualr and extra articular malalignment can lead to various complications like posttraumatic osteoarthrosis, decreased grip strength and endurance, as well as limited motion and carpal instability.
Restoration of wrist function is primary goal in treatment. Open reduction and internal fixation is indicated to address the unstable distal radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through external manipulation and ligamentotaxis, provided sufficient bone stock is present to permit early range of motion. Internal fixation of metaphyseal bending fractures has become increasingly popular due primarily to (a) directly control and maintain physiologic palmar tilt, (b) prevent collapse with external fixation, and (c) avoid bridging the radiocarpal joint.

Methodology:
A prospective study of 40 patients was made. who were treated with 1) volar locking plating and 2) external fixator each of 20 patients.
In first group there were 16 M and 4F pts. Between age group of 26-62 with mean age of 43.35yrs.14 pts had right sided involvement and 6 pts had left sided involvement. Of the 20 cases injury occurred due to Road traffic accident (RTA) in 12 pts and fall on outstretched hand in 8 pts. One pt had type 1 compound fracture.
In second group there were 19M and 1F pts. Between age group of 24-52 with mean age of

36.8yrs.9 pts had rt sided involvement and 11 pts had lt sided involvemnt. of the 20 cases injury occurred due to RTA in 16 pts and fall on outstretched hand in 4pts. 2 pts had type1, 1 pt had type2 and 1 pt had type3 compound fractures.

Instruments and implants used

- Locking compression plates of varying length
- 3.5mm LCP drill bit and sleeve system
- Hand drill / power drill
- Tap for 3.5mm cortical screws and 3.5mm depth gauge
- Hexagonal screw driver for 3.5mm cortical screws and locking screw driver
- General instruments like retractors, periosteal elevators, reduction clamps, bone levers etc.
- Pneumatic tourniquet.

The duration from the date of injury to date of operation ranged from 1-6 days (average 2.35 days).

The incision for volar fixation of the distal radius is typically performed through the distal extent of the Henry approach. An incision is made between the flexor carpiradialis (FCR) tendon and the radial artery. This interval is developed, revealing the flexor pollicis longus (FPL) muscle at the proximal extent of the wound and the pronator quadratus muscle more distally. The radial artery is carefully retracted radially, while the tendons of the FCR and FPL are retracted ulnarly.

The pronator quadratus is divided at its most radial aspect, leaving a small cuff of muscle for later reattachment. Any elevation of the muscle of the FPL should be performed at its most radial aspect, as it receives its innervation from the anterior interosseous nerve on its ulnar side. After the pronator quadratus has been divided and elevated, the fracture is readily visualized, and reduction maneuvers can be accomplished under direct vision.

After exposure and debridement of the fracture site, the fracture is reduced and provisionally fixed under fluoroscopy with K-wires, reduction forceps or suture fixation. Reduction aids should be placed so as not to interfere with placement of the plate. The appropriate plate is selected following fracture reduction. First, a standard cortical screw was applied to the most distal oval hole of the vertical limb of the plate in order to temporarily secure the plate to the proximal fragment. This allowed concomitant proximal and distal plate adjustment. After fixing the distal fragment with subchondral locking screws, radial length was gained, when necessary, by pushing the plate distally. The first standard screw can be either left in situ or exchanged with another locking screw; the oval hole is a combination hole designed for locking head screw placement at the distal end and standard screw placement at the proximal end of the same hole.

The optimal placement of the distal screws is important: they must be inserted at the radial styloid, beneath the lunate facet, and near the sigmoid notch. The distal screws can be of either monocortical or bicortical engagement. More volar tilt can be achieved during distal screw placement when the wrist is volarly flexed as much as possible by an assistant. Moreover, radial length can be further improved by pushing the whole plating system distally while using the oval plate hole and screw as a glide. The final position of the plate was confirmed using fluoroscopy.

Pronator quadratus muscle was used at the time of closure, to cover, in part, the implants that were applied to the anterior surface of the radius. Once stable fixation was achieved and hemostasis secured, the wound was closed in layers.

Second procedure; external fixation

Instruments used are

1. 3.5mm schanz screw for radius 2 in number
2. 2.5mm schanz screw for 2nd metacarpal 2 in number
3. aesculup clamps 4 in number
4. 4mm connecting rods-2in number

Technique

2 stab incision about 2cm apart approximately 8cm proximal toradial styloid over the posterolateral aspect of radius made. Through drill sleeve radius was drilled with 2.5mm drillbit and two 3.5mm schanz screws were fixed using t handle.

1stab incision was given over posterolateral aspect of base of 2nd metacarpal. another over P-L aspect of shaft of second MC 2cm distal to proximal incision. drilled with 1.5mm drillbit andfixed with 2.5mm schanz screw. pins were placed in a midway between saggital and coronal plane. Aesculup clamps fixed to schanz pins and two 4mm rods were inserted. joints were loosened and longitudinal traction was given with manual moulding of fracture fragments back in to a more normal alignment. wrist was kept in mild flexion and ulnar deviation. At this point device was tightened. and reduction was carefully assessed flouroscopically and clinically.

Results

PREOPERATIVE IMMEDATE POSTOP AT 6 WEEKS

8 MONTHS 14 MONTHS

Table 1: Age incidence

Age incidence	IN LCP		IN EX-FIX	
Age in years	No of cases	Percentage	No of cases	Percentage
21-30	3	15	6	30
31-40	5	25	6	30
41-50	8	40	6	30
51-60	3	15	2	10
61-70	1	5	-	

Table 2: Type of fracture according to frykmans classification

	IN LCP		IN EX-FIX	
Type	No of Cases	Percentage	No of Cases	Percentage
I	4	20	-	-
II	2	10	2	10
III	7	35	5	25
IV	3	15	2	10
V	1	5	-	-
VI	0	-	-	-
VII	0	-	2	10
VIII	3	15	9	45

Table 3: Ao classification

	IN LCP		IN EX-FIX	
AO TYPE	NO	%	NO	%
A1	0	-	-	-
A2	2	10	-	-
A3	4	20	2	10
B1	1	5	-	-
B2	4	20	4	20
B3	4	20	2	10
C1	4	20	3	15
C2	1	5	3	15
C3	0	-	6	-

Table 4: Union

	IN LCP		IN EXFIX	
	NO	%	NO	%
EXTRA ARTICULAR	6	30	18	90
INTRA ARTICULAR	14	70	2	10

Table 5: Time of union

	IN LCP		IN EXFIX	
TIME OF UNION	NO	%	NO	%
2-3 MONTHS	16	80	14	70
3-4 MONTHS	3	15	4	20
>4 MONTHS	1	10	2	10

Age distribution

In our study, distal radial fracture was more common in the 3rd to 5th decade with average of 43.35 in LCP group and 36.8 yrs in EXFIX.

Most of the intra articular, comminuted and unstable fractures requiring operative management occurred in young individuals are due to high energy trauma such as road traffic accident and fall on out stretched hand.

Sex distribution

Our study has male predominance with 16:4(M: F) in LCP and 19:1 in EXFIX.

Increased incidence in males is probably due to their involvement in outdoor activities, riding vehicles and heavy manual labour.

Side involvement

In our study in LCP 14:6 (R: L) and in EXFIX 9:11(R: L)

MODE OF INJURY

In LCP RTA -12 cases and fall on outstretched hands in 8 cases and in EXFIX RTA-16 and FOOH 4 cases

Table 6: complications

	IN LCP	IN EXFIX
Pintract Infection	-	2
Pin Loosening	-	1
Malunion	-	-
Radial Nerve Injury	-	1
Tendon Irritation	1	-
Radiocarpal Arthritis	1	2

In LCP 1 pt had extensor pollicis longus tendon irritation and 1 had radiocarpal arthritis. In EXFIX 2 pts had pin tract infection, 1 had pin loosening, 2 had arthritis and 1 had sensory branch radial nerve injury.

In our study in LCP 45% excellent 45% good, 10% fair and no poor result.

In EXFIX 5% excellent, 45% good, 40% fair and 10% poor results. Patients, who obtained excellent results, had no residual deformities or pain.

Range of motion was within the normal functional range. They had no arthritic changes or other complications. Patients with fair results, along with residual deformity, pain and limitation also had pain in the distal radio-ulnar joint and minimal complications. Few of their movements were less than that required for normal function.

Patients with poor results had limitation, disability and weakness. Most of his movements were not within the range required for normal function. He also had pin tract infection. He was non-compliant with regard to post-operative physiotherapy.

Table 7: Evaluation of results

	IN LCP		IN EXFIX	
Results	**No of Cases**	**%**	**No of Cases**	**%**
EXCELLENT	9	45	1	5
GOOD	9	45	9	45
FAIR	2	10	8	40
POOR	0	0	2	10

Discussion

More than 190 years have passed since Colles described the fracture of the distal end of the radius. It is remarkable that this common fracture remains one of the most challenging of the fractures to treat. There is no consensus regarding the description of the condition and the appropriate outcome.

Numerous studies have shown that extra-articular fractures as well as impacted stable fractures with minimal shortening can be managed conservatively. However, more often than not, distal radius fractures involve the radiocarpal joint and/or the distal radioulnar joint. These require an anatomical reduction of the joint surface to reduce the incidence of post-traumatic arthritis and to guarantee a successful treatment outcome. In contrast, the results of conservative treatment of intra-articular fractures, especially in young individuals have been poor. Thus, intra-articular fractures that cannot be reduced by conservative methods and are comminuted, displaced and unstable, require operative treatment.

The operative method selected to achieve the treatment objectives requires a careful study of the individual fracture pattern, level of activity, quality of bone and general medical condition.

The present study was undertaken to assess the functional outcome of operative management of distal radial fractures using closed reduction and external fixation and open reduction and internal fixation with locking compression plate.

In 2000, Orbay reported his initial experience with a plate designed specifically for the volar aspect of the radius and incorporated locking pegs for subchondral support [1].

Utku Kandemir, *et al*. (2008) did biomechanical study in 10 matched pairs of fresh frozen cadaveric arms, the fixation obtained with volar locking plates is as stable as fixation with a dorsal plate in acute healing period and can withstand the functional demands of the immediate postoperative period in dorsally comminuted unstable extra articular distal radius fractures [3].

The development of fixed angular stable fixation techniques thoerotically improves stability to maintain the reduction of fractures in osteoporotic bones and fractures considered to be unstable [7].

Wright *et al* concluded that use of open reduction internal fixation with volar fixed angle plate resulted in stable fixation of articular fragments allowing early wrist motion. Wei DH *et al* concluded open reduction and internal fixation yields significantly better functional outcomes and restoration of anatomical volar tilt. However EXFIX results in better grip strength and wrist flexion. Mosgrave *et al* concluded volar plate fixation provide stable fixation with early range of motion without compromising fracture reduction. Leung F *et al* concluded plate fixation is better than external fixator for treatment of intra articular fractures.

Conclusion

Open reduction and volar locking compression plate fixation group had stable fixation, early wrist range of motion and better Demerit score compared to external fixator group.

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