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Comparison of volar locking compression plate Versus External Fixator in the Treatment of Distal Radius Fractures

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Abstract
Background: *This is a prospective study was done to compare results of locking compression plate to external Fixator in treatment of fracture distal end of radius*
Methods: *This study was conducted on 50 patients who were treated with operative fixation of fracture distal end of radius by locking compression plate and 25 cases were treated with external fixator in Department of Orthopaedics at Dr. S. N. Medical College Associated Hospital, Jodhpur within period of September 2014 to December 2017.*
Results: *The present study showed that the maximum no of cases were found in 31-50 years of age in both groups, male to female ratio was 3:2 in group I & 2.5:1 in group II and right side were more affected .End result by Gartland and Werley Scoring was statistical significant in group I 68% excellent as comparec to group II 32%.*
Conclusion: *Volar LCP plate had benefit of early physiotherapy and will improve patient function regardless of radiological outcome, with lower complication rate as compare to external fixator like residual joint stiffness, pain and arthritis. The functional outcome in younger patients suggests that proper articular reconstruction is essential and regular follow-up radiographs are required to assess that reduction of the fragments is maintained till fracture union is achieved*
Keywords: *Volar locking plate, External fixation, Fracture, Distal end of radius.*

Introduction

Fractures of the distal radius constitute one of the most common skeletal injuries treated by Orthopaedic surgeons. These injuries account for one sixth of all fractures evaluated in emergency room. Vast majority of fractures of distal radius are articular injuries that result in disruption of both radio-carpal and radio-ulnar joints. Better understanding of the spectrum of distal radius fractures has led to changing concepts of treatment.

Nearly 20% of all fractures that are treated in emergency departments in the United States involve the distal end of the radius and have a bimodal age distribution, with the adolescent or young adult and elderly populations being the most affected. About 50% of metaphyseal fracture of the distal aspect of the radius also have involvement of the radiocarpal and/or distal radioulnar joint.[1] Many fractures of the distal aspect of the radius are in fact relatively uncomplicated and are effectively treated with closed reduction and immobilization in a cast. However, fractures that are either unstable and/or involve the articular surfaces can jeopardize the integrity of the articular congruence and/or the kinematics of these articulations.

The goal of the treating physician should then be to restore the functional anatomy by a method that does not compromise hand function. The fracture pattern, the degree of displacement, the stability of the fracture, and the age and physical demands of the patient determine the best treatment option. Over the past years, more sophisticated internal and external fixation techniques and devices for the treatment of displaced fractures of the distal end of the radius have been developed.[2] The use of percutaneous pin fixation, external fixation devices that permit distraction and palmar translation low-profile internal fixation plates and implants; arthroscopically assisted reduction and bone-grafting techniques, including bone-graft substitutes, all have contributed to improved fracture stability and outcome.

Various methods for maintaining the reduction with additional fixation have been invented like Kirschner wire, JESS, Dynamic compression plate and other precontoured plates, arthroscopic assisted reduction, fluoroscopic reduction techniques.

The classical dynamic compression plate from seventies was the key to rigid fixation, leading to primary bone healing. Nevertheless, the use of strong plates disturbed the vascularization of the bone fragments, leading to non-union and delayed union. These insights lead to the development of the "biological osteosynthesis" a terminology introduced to indicate a new type of osteosynthesis leading to a sufficiently stable fixation of bone fragments allowing early mobilization, but without major disturbance of the vascularisation.[3]

To help to accomplish this new concept of biological plate fixation, new implants such as locking compression plate (LCP) have been introduced.[4] Locking minimizes the compressive forces exerted by the plate on the bone. This method of screw plate fixation means that the plate does not need to touch the bone at all. Precise anatomical contouring of a plate is no longer necessary because the plate does not need to be pressed on the bone to achieve stability. This prevents the loss of primary reduction of fracture fragments caused by inadequate contouring of a plate.[5]

Locking compression plate in distal radial fractures owes advantage to avoid possible deprivation of blood supply to the distal metaphyseal fragments. The intrinsically stable locking compression plate utilizes a threaded screw head that locks into the plate holes when the screws are tightened, providing angular and axial stability and minimizing the possibility of screw loosening. This is particularly useful in the prevention of secondary displacement of the unstable fractures in elderly with osteoporotic bone[6].

The recent advances in locking-plate technology have been applied to distal radial fractures. These implants are used for the treatment of many types of fracture pattern of the distal radius through a volar approach which may be less prone to complication seen with a dorsal approach.[7] The aim of this study to compare the volar locking compression plate Versus External Fixator in the Treatment of Distal Radius Fractures.

Material & Methods

This prospective study was conducted on50 patients group1 and 25 cases of group 2 with fracture of distal end of radius who attended and

treated at Dr. S. N. Medical College and associated group of hospitals, Jodhpur.

Inclusion Criteria

1. Age ≥20 years, Both males and females
2. Close fracture distal end of radius

Exclusion Criteria

1. Age < 20 years
2. Compound fracture
3. Patients not fit for surgery
4. Patients refuse for surgery
5. Compartment syndrome
6. Isolated Distal radioulnar joint dislocation (due to ligamentous injury).
7. Pathological fracture.

Methodology

All patients admitted with fractures of distal end of radius, a careful history was elicited from the patient and/or attendants to reveal the mechanism of injury and the severity of trauma.

The patients were then assessed clinically to evaluate their general condition and the local injury. It was done in accordance to Acute Trauma Life Support protocol. Vital parameters were recorded. Methodical examination was done to rule out fractures at other sites. Local examination of injured forearm and hand such as attitude and position of the affected upper limb compared with normal counterpart, any abnormal swelling and deformity, their level and direction.

Palpation to check any local rise of temperature, soft tissue tenderness, any palpable step, breach in continuity of bone, any revealed abnormal mobility, crepitus and shortening of the forearm.

Distal vascularity was assessed by radial artery pulsations, capillary filling, pallor and paraesthesia at finger tips.

Neurological examination: Sensory system was examined for pain and touch sensation in the radial. ulnar and median nerve innervated arrears. Power including handgrip was tested in forearm and hand muscles.

Movements: Flexion and extension of elbow. supination and pronation of forearm. Abduction and adduction and palmar flexion and dorsiflexion of the wrist were performed and any restriction of motion and pain observed.

External fixation technique

Under the effect of anesthesia, the patient was shifted supine on the operating table, side radiolucent table was attached. The arm, fore-arm and hand was drapped under aseptic precaution. Longitudinal traction was given at thumb and flexed elbow by assistants and manual moulding of the fracture fragments back into a more normal alignment by surgeon (severe hyper-flexion or hyperextension was avoided). The wrist was maintained in mild flexion and ulnar deviation. The injured upper limb was place do the side arm board. A stab incision was made approximately 10cm proximal to the radial styloid process at an angle of 30 degree to the radial direction.

Through the stab incision the periosteum was stripped and the drill sleeve was fixed centrally. Care was taken not to injure the tendons, muscles, nerves in the process of drilling. The radius was drilled with 2.5mm drill bit, and 3.5mm schanz screw was fixed.

A stab incision was made over the at 30 degree of the just below the head of the 2nd metacarpal. It was drilled with 1.5mm drill bit, and then fixed with 2.5 mm schanz screw. The 4mm connecting rod was fixed to the schanz screw with the clamps and reduction was checked under image intensifier in both planes AP view and lateral view.

The other 2 schanz screw, one in the shaft of radius about 2 cm from fracture site and the other in base of second metacarpal was fixed in similar fashion. Now the external fixation device was tightened and the reduction carefully assessed again clinically and under image intensifier.

Volar locking compression plate

Fractures was exposed through the distal part of the Henry approach between the FCR and radial artery via an 8 to 9cm longitudinal incision directly over the distal course of the FCR tendon.Then reduced with an initial hyperextension maneuver, followed by flexion of

the wrist while the apex of the deformity is stabilized with a thumb. The fracture was then temporarily fixed with an oblique Kirschner wire inserted percutaneously through the radial styloid. A volar locking plate applied and fixed with 2.7mm screw after positioning to fit the volar metaphyseal flare of the radius.

Follow-up

At each follow up, AP and lateral x-rays was taken and patientswas instructed about the exercises of the elbow, digits and shoulder. At the end of the first week, the splints were replaced by dynamic splint which allow movements of wrist and hand freely. At the end of six weeks, radiographs were taken and active motion of the wrist consisting of wrist movements, supination, pronation, finger grip were started.

Patients was assessed, which included the subjective impressions of the patient, objective grading of function and deformity, comparison of final and initial radiograph. A detailed questionnaire was completed with each patient to evaluate subjective factors such as pain, functional limitations and occupational considerations.

Objective examination including inspection of the wrist for deformity, tenderness, abnormal mobility of the distal radioulnar joint, measurement of the range of movements and grip strength was done.

The assessment of anatomical and functional outcome was made according to modified Gartland and Werley scoring system[8] as follows

Demerit score system modified after Gartland and Werley[8] (1951).		
		1Points
Deformity	• Prominent ulnar styloid	1
	• Radial deviation	1-2
	• Dinner fork deformity	1-3
	• Maximum	6
Subjective Evalution	• No pain, no limitation of motion	0
	• Occasional pain, some limitation of motion, weakness pain, limitation of	4
	• Activities restricted	6
	• Maximum	6
Range of Motion	• Limitation of motion<20%	0
	• Limitation of motion< 50%	2
	• Limitation of motion> 5 0%	6
	• Stiffness of wrist	6
	• Maximum	6
Complications	• None or minimal	0
	• Slight crepitation	1-2
	• Severe creptitation	3-4
	• Median nerve compression	1-3
	• Pulp-palmdistance 1 cm	3
	• Pulp-palm distance> 2 cm	5
	• Pain in distal radio-ulnarjoint	1-3
	• Maximum	15

Results

The present study showed that the maximum no of cases were found in 31-50 years of age in both groups, male to female ratio was 3:2 in group I & 2.5:1 in group II and right side were more affected (table 1). The most common mode of injury (high impact) was road traffic accident in both groups (table 2).

Pin tract infection was in 5 patients, which was effectively controlled by antibiotics in group II & pain in wrist occur in 4 patients in group I (table 3).

End result by Gartland and Werley Scoring was statistical significant in group I as comparec to group II (table 4).

Table 1: Demographic profile of patients

Demographic profile	Group I (Locking plate) (N=25)	Group II (external fixation) (N=25)
Age (yrs)		
18-30	6 (24%)	5 (20%)
31-50	14 (56%)	15 (60%)
>50	5 (20%)	5 (20%)
Sex		
Male	15 (60%)	18 (72%)
Female	10 (40%)	7 (28%)
Side		
Right	15 (60%)	14 (56%)
Left	9 (36%)	10 (40%)
Bilateral	1 (4%)	1 (4%)

Table 2: Mechanism of Injury

Injury	Group I (Locking plate) (N=25)	Group II (external fixation) (N=25)
Road Traffic Injury	19 (76 %)	17 (68%)
Fall	6 (24%)	8 (32%)
Total	25 (100%)	25 (100%)

Table 3: Complications

Complications	Group I (Locking plate) (N=25)	Group II (external fixation) (N=25)
Superficial infection	1	3
Painful wrist	4	6
Sudeck's osteodystrophy	1	2
Deformity	2	2
Pin tract infection	0	5
Superficial radial nerve neuropathy	1	2
Non-union	0	1

Table 4: End result by Gartland and Werley Scoring

Outcome	Group I (Locking plate) (N=25)	Group II (external fixation) (N=25)
Excellent (0 to 2)	17 (68%)	8 (32%)
Good (3 to 8)	5 (20%)	12 (48%)
Fair (9 to 20)	3 (12%)	4 (16%)
Poor (21 to 24)	0 (0%)	1 (4%)

Discussion

In our study, majority (58%) of the cases were in the age group of 31 to 50 years. This was similar to study conducted by Rakesh K. Yalavarthi et al[9], in this study majority of patients were between the age group of 20 years to 40 years and was simillar study conducted by Rajiv Sukla et al[10], in this study the mean age group was of 40.07 years.

Male population is 66% as compared to female (34%). This was similar to other studies. The study conducted by Waqaralamet al[11]. also had 72% male patients and 28% female patients. The study conducted by Rakesh k. Yalavarthi et al[9] also had 76% male patients and 24% female patients.

These injuries mostly involved right side 58% as compared to left side 38%.Right side was more commonly involved in other studies also. Waqaralam et al[11] showed right side was involved in 64% cases as compared to left side (36%). Rakesh k. Yalavarthy et al[9] showed right side was involved in 58% cases as compared to left side(42%).

Mechanism of injury is mostly road traffic accident (72%) which was more common than fall (28%). This was similar to other studies. Rakesh k. Yalavarthi et al[9] have RTA in 60% cases and fall in 40% cases as mode of injury. Waqar alam et al[11] also have RTA (48%) most common mode of injury as campared to assult (16%) and fall (13%).

Complications with external fixation have occurred and in some reports can be common[12,13]. One study has reported that displacement can occur up to 6 months after fracture[14]. Another paper noted 16 of 24 patients treated with external fixation had complications ranging from infection to superficial nerve neuropraxias[12]. Hutchinson et al. also noted a 45%complication rate of which halfwere considered serious or major[13]. The most common problems again included pin tract infections, radial neuritis, and complex regional pain syndrome. We encountered one case of finger stiffness and two cases of superficial pin tract infections in the current series.

Volar locking plates have gained popularity over the last several years. The potential advantages of the volar fixed angle implants include a decreased rate of complications when compared with dorsal plating or external fixation, subchondral support through the fixed-angle tines, and initiation of early wrist motion exercises.[15-17]

The overall outcome according to the Gartland and Werley scales showed 19 excellent and 12 good results. Many other investigators using alternate plating systems mirror these results[17]. The results of ORIF in the current study are similar to previously reported outcomes. Good clinical, patient-related, and radiographic measures were obtained. In addition, no complications to date have been observed in patients treated with ORIF. Because of the strength and stability of the construct, the use of locked plates allows early wrist motion and this has been shown to enhance hand and finger functions.[18]

However, early motion may only provide a theoretical benefit as shown by the study of Krishnan et al.[19] Their study compared a nonbridging external fixator with a bridging external fixator system for the treatment of comminuted intraarticular fractures of the distal

radius in a prospective randomized control trial. The results did not demonstrate a statistically significant difference in the radiological and clinical outcomes achieved with these two treatments. Our study similarly did not demonstrate a significant difference in ROM between groups despite the fact that the ORIF population started wrist motion much sooner than the external fixation patients. However, it was observed that patients were quite pleased to initiate early ROM.

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