



A PROSPECTIVE STUDY OF INTRAARTICULAR DISTAL RADIUS FRACTURES OF PATIENTS TREATED WITH EXTERNAL FIXATOR AND VOLAR LOCKING COMPRESSION PLATE

Orthopaedics

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ABSTRACT

Aim of the study: To analyze and compare the role and effectiveness of Closed reduction and External fixation and open reduction and Internal fixation with volar locking compression plate of intra articular distal radius fractures.

Materials and methods: This Prospective study is conducted in Sree Balaji Medical College Chromepet from August 2016 to January 2018. About 40 patients with intraarticular distal radius fractures were selected and randomly classified into two groups namely the Ex Fix group and the LCP group and treated with dynamic external fixator (penning type II) with or without supplementary techniques and volar locking compression plate respectively. 23 patients in Ex fix group and 17 patients in LCP group were treated. Average follow up is 12 months in Ex fixgroup and 11 months in LCP group. The results were analysed as functional outcome using Green and O'Brien score (modified by Cooney et al).

Results: After proper analysis and doing statistical comparison, we got p- value of 0.478 for functional outcome which is considered insignificant. Hence we conclude that there are no major differences in the functional outcome of both the techniques in terms of pain, range of movements, grip strength and return to work, in treating comminuted intra articular distal radius fractures even though there is no statistical difference in the functional outcome, volar locking compression plate plays a better role than external fixator in certain radiological parameters like volar tilt, radial inclination and intraarticular step off and also successful in achieving patient's satisfaction with limited number of minor complications and early return to work.

KEYWORDS

Intraarticular distal radius fractures, external fixator, volar locking compression plate, multiplanar ligamentotaxis, volar approach to distal radius.

INTRODUCTION:

In day to day practice of most orthopaedic surgeons, fractures of distal part of radius are one of the most commonly occurring fractures and encountering problems in selecting treatment option, accounting about 16% of all fractures in orthopaedic casualty and it has bimodal age distribution. Distal radius fractures are mostly insufficiency fractures in osteoporotic bone of elderly and following high velocity injuries in young patients¹. Amazingly two hundred years before itself, Abraham Colles described extraarticular distal radius fractures are having good outcome from his statement —The nature of the injury once ascertained, it will be a very easy matter to explain the different phenomena attendant on it and to point out a method of treatment which will prove completely successful. But this is not applicable to all the fractures of distal end of radius as stated by Colles'. Once the fracture geometry becomes complicated, the treatment of the distal radius becomes a challenging one. Among all fractures of distal end of radius, about 50% of them involves the articular surface of either the radiocarpal joint or distal radioulnar joint and considered as unstable. Because premature axial loading causes displacement of the fracture fragments, impairs the articular congruity attained by the reduction technique and lead to post traumatic osteoarthritis. Hence the quality of reduction and fracture fixation technique are much more important for better outcome and patient satisfaction. Fernandez, Trumble reported that even as little as 1mm of articular incongruity will deprive the functional outcome. Though various fixation options are available, the most commonly practising technique are Closed reduction and External fixation with early dynamisation and Open reduction and Internal fixation with locking compression plate. This is because both the techniques allow early mobilization of the wrist joint with good functional outcome. Our study aim is to compare the functional outcomes of osteosynthesis of unstable distal radius fractures treated by Closed reduction with dynamic external fixator and Open reduction with volar locking compression plate.

INCLUSION CRITERIA

- 1) Patients in the age group 18 years to 60 years
- 2) Patients with distal radius fractures with intraarticular extension following road traffic accident or slip or fall on outstretched hand or assault
- 4) Patients with acute and open fractures presenting within 2 weeks of injury

EXCLUSION CRITERIA

- 1) Open fractures

- 2) Patients with head injuries and who are comatose
- 3) Patients with pathological radius fractures
- 4) Associated neurovascular injuries

PREOPERATIVE EVALUATION AND CARE

About 40 patients with distal radius intraarticular fractures were treated, among which 4 patients had lost follow up and only 36 patients are included in the study. All of them were skeletally mature, came with c/o pain, swelling, deformity and inability to use the wrist joint following injury. True posteroanterior and true lateral radiographs were taken. Distal radius fractures were classified according to Frykman's classification and AO classification and managed initially in the casualty with closed reduction and Dorsoradial short arm POP under hematoma block. Then patients were evaluated with for anaesthetic fitness for surgery. Patients were then posted for surgery within 1-5 days in elective operation theatre. Distal neurovascularity, adjacent joint movements, skin condition and other co-morbid conditions and associated injuries were assessed and treated accordingly.

ANAESTHESIA:

Among 40 patients, 23 patients were treated with dynamic external fixator and 17 patients were treated with volar locking compression plate, all of them were given pre operative test dose of anaesthetic drugs and antibiotics. Among 40 patients, 28 patients were given supraclavicular block, 12 patients were given combined supraclavicular and axillary block and six patients were given General anaesthesia.

SURGICAL PROCEDURE FOR DYNAMIC EXTERNAL FIXATOR APPLICATION:

The limb to be operated was cleanly shaven and painted with betadine from hand to axilla and kept on the hand table. After draping, wrist was placed in neutral position with small folded towel under the ulnar crease of wrist for support. The fixator pins were inserted by open technique both in second metacarpal and radius. Preliminary reduction with closed manipulation and traction attempted and traction maintained with an assistant. Radial pins were inserted about 4 cm proximal to the fracture end by a 2.5 cm small incision made on the true lateral side of radius diaphysis. Blunt dissection was done upto bone to avoid injury to the superficial branch of radial nerve and extensor tendons. Two 3.5 mm schantz pins were inserted after predrilling with 2.7mm drill bit and by using jig and template. Bicortical insertion of schantz pins confirmed with image intensifier. Similarly metacarpal

pins were inserted at the radial side of second metacarpal base and distal shaft using 2.0 mm drill bit and 2.5 mm schantz pins with a small incision. Then the double ball joint external fixator with all the locks open was applied into the schantz pins on both the radius and metacarpal using clamps and they were tightened using T-wrench or Allen wrench.

REDUCTION TECHNIQUE

After preliminary reduction which maintains radial length, it is crucial to ensure the position of distal ball and socket joint at the capitulate junction which is the centre of rotation of the wrist joint. The principle of multiplanar ligamentotaxis is achieved by the palmar translation of the carpal bones at the level 58 of unlocked proximal ball joint to restore the normal palmar tilt. After verifying the fracture site and joint congruity under image intensifier final tightening of all the clamps done. Over distraction was avoided by checking the flexion of the fingers passively. Thorough wound wash given and wound closed in layers. Sterile dressing done.

SUPPLEMENTARY TECHNIQUES:

Through a 2-3 cm dorsal incision, the depressed lunate facet was elevated with a small osteotome and buttressed subchondrally with K-wire. **K WIRE FIXATION:** 1.5/1.8 mm K- wires passing through the subchondral bone to buttress and to hold the fracture fragments is highly recommended in comminuted fractures.

DRUJ STABILISATION:

In DRUJ instability, one or two K-wires inserted transversely from radius to ulna in supination to stabilise it.

BONE GRAFTING:

Cancellous bone or pegs from ipsilateral olecranon or iliac crest to fill the void of elevated lunate facet and comminution can be done.

POSTOPERATIVE PROTOCOL:

Patients were advised for gentle active finger movements and limb elevation for 3 days. Distal neurovascularity assessed regularly, intravenous antibiotics given for 3 days and then converted to oral antibiotics for 5 days. Patients were discharged on 2-5 th postoperative day and suture removal done on 11th post operative day. Advised about weekly visit, pin site cleaning and care and physiotherapy. During each visit, pin site care, loosening of the clamps or pins, fracture healing were checked. At the end of 2nd week dynamisation was started by loosening the distal ball joint using Allen wrench, which allows an arc of motion of about 50 degree of flexion and extension. Dynamisation was postponed to 3-4 weeks in highly comminuted fractures. Supplementary K-wires were removed at 3 weeks. External fixator was removed at 6-8 weeks after clinically and radiographically assessing the fracture healing. Follow up X rays were taken at recommended hospital visits on immediate post operative 6 weeks, 3 months, 6 months and 12 months interval.

SURGICAL PROCEDURE FOR VOLAR LOCKING COMPRESSION PLATE: THROUGH MODIFIED HENRY'S (AO) APPROACH:

Preoperative preparation of the patient was the same like for external fixation and posted in elective operation theatre. Patient's wrist was placed on the hand table and after painting with betadene and draping, wrist was placed supine and neutral, a 5cm skin incision was made starting just distal to the proximal wrist crease and medial to the radial artery pulsation, incision deepened by dividing the deep fascia. Flexor carpi radialis was retracted ulnarwards and radial artery with brachioradialis retracted radially exposing the pronator quadratus. Care should be taken not to injure the sensory branch of median nerve and radial artery. The wrist is pronated and pronator quadratus was divided and elevated from the radial side of radius exposing the distal radius fracture. The fracture was then reduced by direct visualization of the fragments. The central lunate fragment which plays a key role in load transmission if found depressed should be elevated with a small osteotome and subarticular cancellous or peg bone grafting can be done if needed. 61 Then the locking compression plate was placed on the smooth curved volar surface of distal radius and after correcting its placement just proximal to the imaginary watershed line (2mm from the radiocarpal joint surface), the plate is temporarily stabilized with a K wire or a unicortical screw in the sliding hole of the shaft. True AP, lateral views were taken under C-arm image intensifier and any fine adjustments if needed can possibly be done on the plate, so that the

screws were aimed to be placed 2mm below joint line and should not penetrate into the articular area. The distal screws were put which should be 2mm short from the dorsal cortex so that the screws would not irritate the extensor tendons. Finally AP, lateral and oblique views should be taken to check the fracture reduction and distal screw penetration. After thorough wound wash and achieving hemostasis, wound closed in layers and sterile bandage applied.

THROUGH ELLIS APPROACH:

In this approach, the skin incision is centered over the ulnar border of Palmaris longus tendon and after dividing the deep fascia, medial retraction of Palmaris longus and lateral retraction of flexor carpi radialis reveals the median nerve entry into the carpal tunnel. In this approach pronator quadratus was released from ulna after supination to expose the distal radioulnar joint, sigmoid notch and lunate facet fragments. The median nerve could be decompressed by division of the flexor retinaculum proximally. The reduction and plating techniques were similar to the other volar approach.

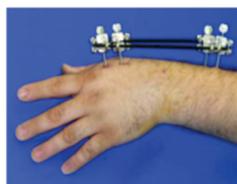


Fig 1 : Ex-Fix



Fig 2 : Ex-Fix X-Ray



Fig 3 : VLCP



Fig 4 VLCP X-Ray

POST OPERATIVE CARE AND REHABILITATION:

Patients were encouraged limb elevation and active finger mobilization exercises in immediate post op period. Distal neurovascularity was assessed regularly and intravenous antibiotics were given for 3 days and after that changed to oral antibiotics for 5 days. Post operatively the wrist was immobilized in a short arm POP for 10-12 days. Suture removal was done for all the cases between 10 to 12 days from post op. After suture removal the slab was removed on POD 14 and gentle active wrist mobilization exercises were started. Resisted exercises were started about 6 weeks after surgery. Patients were recommended for follow up at 6 weeks, 3 months, 6 months and 12 months interval and routine xrays were taken to assess the fracture healing

DYNAMISATION IN EX FIX GROUP PATIENTS:

Dynamisation of wrist joint by loosening the distal ball joint of external fixator was started after a mean period of 2 weeks. Only in 4 cases we started dynamisation at the 3rd week, in all other cases it was started at the end of 2nd week.

EX FIX REMOVAL:

Fixator removal was done after an average period of 6 weeks. For 10 patients we have done fixator removal at 6th week, for 9 patients done at 7th week, for 4 cases done after 8th week.

MOBILISATIONS OF WRIST IN LCP GROUP PATIENTS:

Out of 17 cases, 13 cases were applied loose short arm splint till suture removal. All cases suture removal done on 11th or 12th post operative day.

Gentle active wrist mobilization was started in an average of 3 weeks. For 9 cases, wrist mobilization was started only after 4 weeks interval. Active range of movement exercises were started at an average of 7 weeks. Only for 2 cases in locked volar plating technique, we did implant removal because those patients complained of pain on movements of wrist joint.

CASE 1.Volar Locking Compression plate



Fig 5.1 :SUPINATION



Fig 5.2 : PRONATION



Fig 5.3 :ULNAR DEVIATION



Fig 5.4 : RADIAL DEVIATION



Fig 5.5 :PALMAR FLEXION



Fig 5.6 :DORSI FLEXION



LCP-POST OP XRAY

**CASE 2: EXTERNAL FIXATOR WITH K WIRE
THE PATIENT CANNOT DO SUPINATION AND PRONATION
IN HIS LEFT HAND WHERE HE IS OPERATED**



Fig 6.1 :DORSI FLEXION



Fig 6.2 :PALMAR FLEXION



Fig 6.3 :ULNAR DEVIATION



Fig 6.4 :RADIAL DEVIATION



EX FIX - POST OP XRAY

RESULTS

In our comparative study about 40 patients were treated for intra articular distal radius fractures, among which 23 patients were treated with double ball and socket joint type of external fixator and 17 patients, were treated with volar locking compression plate and they were designated as Ex fix group and LCP group respectively. Out of which 2 patients from Ex fix group and 2 patients from LCP group had lost follow up. Hence 21 patients with dynamic external fixator and 15 patients with volar locking plate were considered for the analysis. Average follow up among Ex fix group was done for 12 months with maximum follow up for 17 months and minimum follow up for 6 months and average follow up among LCP group was 11 months with maximum follow up for 16 months and minimum follow up for 6 months. There were 14 cases with more than 12 months follow up and 7 cases with less than 12 months follow up in Ex fix group, similarly there were 13 cases with more than 12 months follow up and 8 cases with less than 12 month follow up in LCP group. We had analysed the functional outcome as per Green and O'Brien scoring system modified by Cooney et. al

GRADE

GRADE	FUNCTIONAL OUTCOME	
	EX FIX	LCP
Good	29%,n=6	20%,n=5
Fair	33%,n=8	38%,n=8
Poor	20%,n=5	7%,n=3
Excellent	18%,n=4	35%,n=7

In our study among Ex fix group, 3 patients had superficial pin tract infection, one patient had deep infection, one had malunion and one had pin bending complications. Among LCP group one had screw penetration into joint space and one had secondary collapse of the fracture.

We have done the statistical comparison between the outcomes of external fixator and volar locking compression plate and level of significance is determined by p value <0.05. Using Pearson Chi square test for functional outcome, p value comes as 0.478. It was considered statistically insignificant.

DISCUSSION :

In our comparative study we have compared the functional of external fixator with or without supplementary techniques and volar locking compression plate in the treatment of comminuted intraarticular fractures of the distal radius. We have randomly classified the patients with distal radius fractures into two groups considering the demographic characters in equal distribution into Ex fix group and LCP group and analysed the results. Marco Rizzo et al in his retrospective study compared the outcomes of open reduction and internal fixation with locked volar plating with closed reduction and bridging external fixation and percutaneous K wire fixation of unstable distal fractures. The demographic characters were almost similar to our study but in his study, for Ex fix group he started wrist mobilization after fixator removal on an average of 6 weeks post op, but in our study we used the double ball and socket joint type external fixator for allowing the wrist a 50 degrees arc of motion after 3 weeks. But the range of movement and strengthening exercises were started after 6 weeks in both the studies. Unfortunately, most of the studies are comparing the bridging external fixator where the dynamisation started after 6 weeks with the volar locking compression plate for unstable /distal radius fractures.

CONCLUSION

We conclude that there are no major differences in the functional outcome of both the techniques in terms of pain, range of movements,

grip strength and return to work, in treating comminuted intra articular distal radius fractures. Eventhough there is no statistical difference in the functional outcome, volar locking compression plate plays a better role than external fixator in certain radiological parameters like volar tilt, radial inclination and intraarticular step off and also successful in achieving patient's satisfaction with limited number of minor complications and early return to work.

Green and O'Brien scoring system

Table 1: Clinical scoring system of Green and O'Brien (1978) modified by Cooney, et al. (1989) score.

Score	Findings
25	None
20	Mild, occasional
15	Moderate, noticeable
10	Severe or intolerable
5	Returned to regular employment
0	Restricted employment
	Unable to work but unemployed
	Unable to work because of pain
Range of motion	
25	Full
20	75-99% of normal
15	50-74% of normal
10	25-49% of normal
5	Less than 25% of normal
Grip strength	
25	120% or more
20	91-119%
15	61-90%
10	31-60%
5	30% or less
On evaluating dorsiflexion-palmar flexion arc of injured hand	
25	75-99% of normal
20	50-74% of normal
15	25-49% of normal
5	0-24% of normal
Final result	
90-100	Excellent
80-89	Good
70-79	Fair
60-69	Poor

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