

A PROSPECTIVE RANDOMISED STUDY OF CLINICO-RADIOLOGICAL AND FUNCTIONAL OUTCOME AFTER SURGICAL FIXATION OF INTRAARTICULAR FRACTURES OF DISTAL END OF RADIUS BY EXTERNAL FIXATOR VERSES LOCKED VOLAR PLATE

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Abstract

Background: Intra- articular fractures of the distal radius represent high energy, complex, unstable injuries and the optimal method of treatment remains controversial.

Methods: This Observational Randomized uncontrolled Study from January 2019 to August 2019. Fifteen patients underwent open reduction and palmar locking plate fixation, and 15 patients underwent closed reduction and K-wire augmented external fixation on random basis. For functional and radiological assessments, Demerit score were used and grip strength was measured using a Dynamometer. Subjective functional assessment was made using the DASH scale. The follow-up period was at least 6 months.

Results: The radiological parameters at three and six months were better in patients treated with plate group. Patients in the plate group had better functional outcome score (DASH). The findings were statistically significant at three months period but did not show any significance at six months period. Functionally and radiologically (DEMERIT Score) plate group had better score. The findings were statistically significant in three months period, but did not show any significance at six months period. Patients in the plate group showed better grip strength. In patients whose right hand was involved the findings were statistically significant at three months but at six months there was no statistical significance.

Conclusion: Treatment with open reduction and internal fixation for intra articular fractures of distal end of radius provides good radiological results. However, objective and subjective functional assessment showed no significant superiority between external fixation and volar plate fixation at 6 months follow-up.

Keyword: DASH & DEMERIT Score, External fixator, Fracture distal radius, Functional assessment, Volarplate.

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INTRODUCTION

Treatment of displaced fractures of the distal end of the radius has changed over the course of time. In the past, closed reduction with immobilization in a plaster cast was considered the treatment of choice. Dr. Abraham Colles, in reference to fractures of

the distal aspect of the radius, stated: "One consolation only remains, that the limb will at some remote period again enjoy perfect freedom in all its motions, and be completely exempt from pain; the deformity, however, will remain undiminished throughout life".[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.

Most orthopaedic surgeons today would agree that a patient with a malunited fracture of the distal end of the radius who "enjoy[s] perfect freedom in all motions, and [is] exempt from pain," is the exception, not the rule. 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.[2]

In theory plating of intra articular fractures gives early mobility and the patient is free from cast. The long term results are not very different when compared with minimal fixation group. The purpose of this study was to find the difference between radiological and functional outcome of patients having intra articular fractures of distal radius treated by two different methods a) Minimal fixation with external fixator and K-wire and b) Internal fixation with volar plate and to establish any significant difference between the two groups.[3]

Material and Methods

A Prospective randomised study of 30 patients was made, who were treated with palmar locking plate or K-wire augmented external fixation for intra-articular distal radius from January 2019 to August 2019.

Patients included in the study were adults (Age 20 – 60), patient with intra articular fractures of distal end of radius (AO Type B/C), all closed and Grade I (Gustillo and Anderson) compound fractures and presenting within 72 hours of injury. Patients with Grade II and III open fracture distal radius, pathological fractures, rheumatoid arthritis, unresolved contracture of forearm and neurovascular injuries were excluded.

Based on the patient's entry into the study registry, even numbered cases were treated with plate fixation and odd numbered cases were treated with external fixator. Fifteen patients were treated with open reduction and fixed-angle palmer locking plate and 15 patients were treated with closed reduction under fluoroscopy, distraction with the external fixator and K-wire fixation.

The fractures were assessed preoperatively by wrist radiographs and were classified according to the AO/ASIF classification system. Four patients (13.33%) had 23.B2 type of fracture, 10 patients (33.33%) had 23.B3 type of fracture, 5 patients (16.66%) had 23.C2 type of fracture and 11 patients (36.66%) had 23.C3 type of fracture.

During surgery, a palmar Henry incision was used for the palmar approach.

In the external fixation group, distraction with the Orthofix type external fixator was performed following closed reduction under fluoroscopy. For additional stability, the fragments were reduced and fixed with 1.5 and 1.7 mm K-wires. The ends of the wires were left in the skin. Following surgery, a wrist slab was used in the palmar locking plate group. Active finger exercises were started on the day after surgery. The plaster slab was removed at 12th day when the suture line was healthy and the sutures were removed. Rehabilitation was started with active and passive exercises. The patients were allowed to carry load and do heavy work after completion of three months.

In the external fixation group, finger exercises were started the day after surgery. After clinical and radiographic evaluation at

2 and 4 weeks, the K-wires used for support were pulled out between week 4 and week 6. When radiographic findings of solid union were observed, the external fixator was removed under sedation after an average of 6- 8 weeks, and rehabilitation with active and passive exercises were started with the support of a brace.

The patients were allowed to carry load and do heavy work after three months. Immediate post-operative check X-rays was taken in both AP and lateral views. Radiographic Parameters that were taken are Radial length, Palmer tilt and Radial angle. Patient was followed up at 3 weeks, 6weeks, 3 months and at 6months till patient was rehabilitated.

Results

It was observed that the immediate post-operative radiological parameters were better in patients treated with plate group than in the external fixator group and was statistically significant with respect to radial angle (p value= 0.011) and the radial height (p value= 0.0002). The radiological parameters at three months were better in patients treated with plate group than in the external fixator group and was statistically significant with respect to radial angle (p value= 0.003), radial height (p value= 0.0001) and palmer tilt (p value =0.005). The same findings were seen at six months (Table 1).

Table 1: Radiological evaluation: Preoperative, immediate and 3 months post operative (mean± SD) (n=30) (Ext. Fix.- External fixation)

		Palmar tilt (degree)	Radial angle (degree)	Radial height (mm)
Pre-op	Ext. Fix.	5.06±4.57	11.2±8.23	4.73±6.27
	Plate	7.06±6.37	14.22±3.66	3.66±3.41
Post-op (immediate)	Ext. Fix.	9.13±2.13	18±2.90	10.13±1.76
	Plate	10.2±1.52	20.13±0.91	13±1.92
	P value	0.124	0.011	0.0002
Post-op (3 months)	Ext. Fix.	7.26±3.49	16.6±3.83	7.93±3.59
	Plate	10.2±1.52	19.9±0.96	12.9±1.98
	P value	0.005	0.003	0.0001

DASH questionnaire is a validated self-reported thirty item metric of the upper extremity function based on 100- point scale, with 0 points indicating no disability and 100 point indicating maximum disability (Table 2). In the plate group the worst DASH score at three months was seen in a case which was noncompliant to post-operative physiotherapy protocol but showed marked decrease in the score after vigorous physiotherapy at end of six months. In the external fixator group the worst DASH score which was seen in one of the patients at three months had collapse of the fracture fragment This patient also had improvements in DASH score at six months, with physiotherapy. The above findings showed

that the patients in the plate group had better functional outcome score than in the fixator group. The findings were statistically significant at three months period (p value = 0.045), but did not show any significance at six months period (p value = 0.126).Demerit system consists of subjective evaluation, objective evaluation and complications assessment. The evaluations were graded as excellent, good, fair and poor according to the demerit score and recorded as per Table 3. The above findings say that functionally and radiologically plate group had better score. The findings were statistically significant in three months period (p value= 0.009), but did not show any significance at six months period (p value=0.076).

Table 2: DASH Score at 3 and 6 months (mean \pm SD) (n=30)

DASH score	Plate	External Fixation	P value
3 months	33.13 \pm 20.30	50.89 \pm 25.93	0.045
6 months	8.79 \pm 6.46	13.79 \pm 10.46	0.126

Table 3: Demerit score at 3 and 6 months (n=30)

Demerit score	3 months		6 months	
	Plate	External Fixation	Plate	External Fixation
Excellent (0-3)	4	0	9	5
Good (4-9)	9	5	6	6
Fair (10-15)	2	5	0	4
Poor (16-26)	0	5	0	0
P value	0.009		0.076	

Grip strength (Dominant hand):-The mean grip strength at three months in external fixator group was 12.8 \pm 5.82 and 21 \pm 7.91 in the plate group. The mean grip strength at six months in external fixator group was 18 \pm 5.99 and 23 \pm 5.52 in the plate group.

Grip strength (Non-dominant hand):-The mean grip strength at three months in external fixator group was 13.2 \pm 3.03 and 15.42 \pm 2.22 in the plate group. The mean grip strength at six months in external fixator group was 17.2 \pm 1.09 and 19.14 \pm 1.95 in the plate group. The above findings show that the patients in the plate group showed better grip strength than the external fixator group. The findings were statistically significant at three months (p value= 0.022) in patients whose dominant hand was involved but at six months there was no statistical significance. In the plate group two patients (6.66%) had screw impingement and three patients (10%) had developed stiffness at final follow up. In the external fixator group four patients had stiffness (13.33%), three (10%) had collapse of the fracture segment and two patients (6.66%) developed features of reflex sympathetic dystrophy (Figure.3). None of the cases had any non union.

Discussion

The treatment of distal radius fractures has undergone changes owing to the advances in technology. Improved imaging methods providing better understanding of fractures

and elucidation of the effects of injury type on fracture formation and factors leading to instability have given way to new fixing methods and materials appropriate for the fracture, resulting in today's treatment options in distal radius fractures.[4]

The wrist joint is composed of three separate joints: the radio-carpal, the ulno-carpal and the distal radio-ulnar joint. A malalignment or dysfunction of one of these joints inevitably leads to a dysfunction of the wrist as a whole. Beside the bony cartilaginous anatomy, also the radio-carpal, ulno-carpal and intercarpal ligaments and the triangular fibro cartilaginous complex seem to be of utmost importance.

Dysfunction of these structures can lead to bad outcome after a fracture of the distal radius. The distal aspect of the radius functions as an articular foundation of the wrist joint. Integrity of the osseous, articular, and ligamentous structures is needed to maintain motion and transmit load.[5]

Displaced fractures especially the unstable ones, need stable fixation. Lafontaine, Hardy and Delince identified the following predictors of instability :- Patient over 60 years, an intra articular fracture, dorsal comminution, dorsal angulations more than 20° and associated ulnar fracture.[6]Dorsal angulations in distal radial fractures are common and there is tendency towards secondary displacement after conservative

management. Distal radius is important in the kinematics of radiocarpal and radioulnar joints. Hence, open reduction of the articular surface, stable reduction, restoration of the radial length, volar angulation and radial inclination are the prerequisite for good clinical outcome. All this reduces the incidence of post-traumatic osteo-arthritis and allow early functional rehabilitation.[7]

The degree of disability after distal end radius fracture has been seen to correlate with the amount of residual deformity. Treatment options include closed reduction and pinning, bridging and non-bridging external fixation and open reduction with dynamic compression plate (DCP), precontoured locking and non-locking plates and screw fixation through a variety of approaches.[8]

Failure to reduce intra-articular fractures of the distal radius predisposes to pain, restricted movement and degenerative arthritis. Malposition is related to the radial height, radial angle, volar tilt and the accuracy of intra-articular reduction. Knirk and Jupiter found that radiological arthritis developed in 91% of wrists which had any degree of articular step and in all of those with a step greater than 2 mm.[9] In the treatment of comminuted distal radius intra articular fractures, surgeons may encounter serious complications such as difficult

reduction and stabilization, loss of reduction, limitation of range of movement, post traumatic arthritis of the wrist. A brief classification should be made before treating the distal radial fractures. Among various classification systems, the AO classification system is the most suitable one because it reflects the severity of the fracture and helps the surgeon and the patient to know the possible outcomes.[10]

The use of an external fixator alone or in conjunction with percutaneous or limited internal fixation, for unstable fractures of the distal end of the radius has produced good or excellent results. Early removal of the fixator allows early range-of-motion exercises and to avoid complications commonly associated with the prolonged use of external fixators.[11]

Anatomic reduction with stable fixation is the treatment of choice for displaced intra-articular fractures of the distal part of the radius. The operative treatment goals are the prevention of radial shortening, malunion, and articular incongruity because these factors have been reported to be associated with poor outcomes and an increased risk of development of posttraumatic arthritis. Over the past decade, there has been increasing interest in plate fixation, especially volar plate fixation, of distal radial fractures.[12,13]



Figure 1:

Common Complications following External Fixation of fracture of distal end radius

*, †: Pre operative Skiagram (AO Type: 23.C3)

‡, §: 3 months follow up showing features of reflex sympathetic dystrophy.

(note: External fixator was removed at 6 weeks.)

||, **: 45 year old male with comminuted AO Type: 23.C3 fracture distal radius.

††, ‡‡: Post operative Skiagram at 3 months showing collapse of the fracture site

(note: after external fixator removal at 7 weeks)

Conclusion

We conclude that treatment with open reduction and internal fixation for intra articular fractures of distal end of radius provides good radiological results. However, objective and subjective functional assessment showed no significant superiority between external fixation and volar plate fixation at 6 months follow-up. Volar plate fixation also provides an overall decreased rate of complications when compared to external fixation.

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