



## **Functional Outcome of Distal End of Radius Fractures Treated With Percutaneous Pinning and Dynamic Bridging External Fixator**

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### **Abstract**

**Objectives:** To study the functional outcome of distal end of radius fractures treated with dynamic bridging external fixator and percutaneous pinning using the Gartland and Werley scoring system and to correlate the functional outcome with the radiological outcome.

**Methodology:** 49 patients were followed up for a period of one year. They were selected for external fixation based on radiological parameters. External fixation was applied and adjusted over a period of approximately 6 weeks after which it was removed, and the patient resumed normal activities. Patients were followed up after a year and radiological and functional outcome re- evaluated.

**RESULTS-** The mean age was 41.76 with 35 males and 14 females, 31 left side and 18 right side. The mean fixator time was 43.96 days. The score improved at fixator removal time from mean 12.02 to 4.82. The radiological parameters such as radial height improved from 4.08 average to 10.96 average at one year. The radial inclination improved from 15.122 degrees to 23.163 degrees. But the volar tilt improved only to near neutral on average. No significant relationship was found between either radiological or functional outcome.

**Interpretation:** Despite only a reasonable improvement in radiological parameters at one year of follow up, the patients had marked improvement in functional outcome at one year.

**Conclusion:** The external fixator system is still a viable tool in the treatment of distal end of radius fractures.

**Keywords:** distal end of radius fractures, Colles fracture, dynamic external fixator, Gartland and Werley demerit point system, ligamentotaxis, Kirschner wires.

### **Methodology**

#### **Research Approach and Design**

We studied distal end of radius fractures treated with dynamic bridging external fixator and Kirschner wire augmentation for a period

of one year. This was conducted from the data collected from 2010 to 2016. The study design is that of a “Descriptive Study”.

#### **Study Setting**

The study was done in the Department of Orthopaedics at Amala Institute of Medical Sciences.

#### **Sampling and Sampling Technique**

Our inclusion criteria for external fixation as the primary mode of treatment included a radial shortening more than

3mm, dorsal tilt more than 10 degrees, intra articular step off greater than 2mm, presence of dorsal comminution, when closed reduction failed to restore a palmar tilt and failure of cast. Exclusion criteria included fractures requiring bone grafting, severe comminution, fractures associated with vascular injuries or any other major injury in the same or opposite limb.

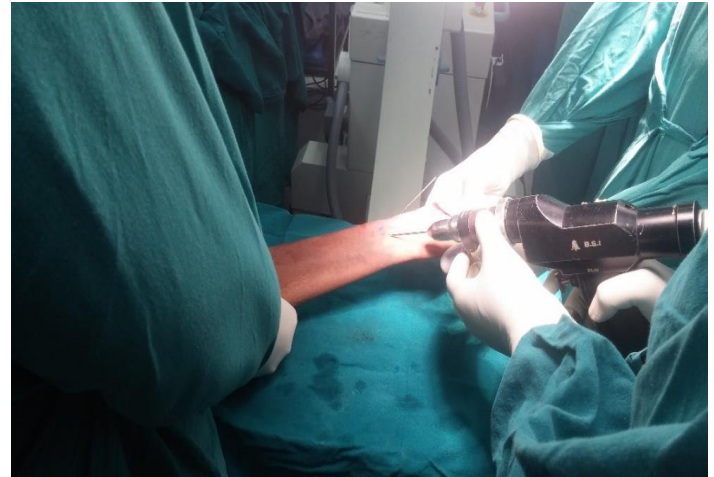
### **Population Studied**

All male and female patients who were more than 18 years and sustained a distal end of radius fracture with the inclusion and exclusion criteria in mind.

### **Representation of the Study**

So, all patients who sustained a distal radius fracture were seen in the casualty and under conscious sedation, an attempt at reduction was made. If the check x ray was satisfactory, patients were usually send home on the same or next day and asked to follow up after a week. The x rays were repeated and if they were found to be unsatisfactory, those patients were considered for some sort of fixation. Also, those patients who were reduced in casualty and didn't have a satisfactory reduction were posted for operative intervention the next day. These two groups, namely, those patients for whom a satisfactory reduction was not obtained in casualty and those for whom one week follow up x rays were unsatisfactory were posted for surgical correction of the fracture. These patients were given general anaesthesia with or without supra clavicular brachial plexus block and under C arm image intensifier guidance (Figure 1) closed reduction was again attempted in the operating room. Those fracture configurations that were deemed satisfactory were either given an immediate short arm cast or augmented with K wires and cast (Pin and Cast technique). For those unstable fracture patterns that would benefit with ligamentotaxis, external fixation was done. 49 patients

were followed from 2010 to 2016



**AP View**



**Lateral View**



### Data Collection Process

An immediate post-operative x ray is taken and the radiological parameters noted including radial inclination, radial height and radial tilt. Patients were usually at one week, four weeks and six weeks till removal of external fixator with serial radiographs to assess position and adjustments were made using the frame of the Orthoplus external fixator. It consisted of a cylindrical component that could be distracted or compressed using an Allen key, this cylindrical component is attached to the elements used to perch the Scahnz screws via 2 ball joints that can be adjusted using a spanner of size 10/ 11. We usually provide the patient with a pair of spanners and Allen keys to bring with them on every follow up. Patients are trained to administer pin tract care by themselves using cotton buds and povidine iodine solutions twice daily, in a sterile and hygienic manner. At fixator removal and at one year follow up the Demerit Score of Gartland and Werley are applied looking for residual deformity, subjective evaluation of the pain, an objective evaluation including grip strength and movements and finally complications like osteoarthritis, nerve complications and poor finger function in cast. The demerit system means that the higher the score, the lower is the overall function meaning a score of 0- 2 is excellent and that of more than 21 is poor.

### Plan for Data Analysis

The data collected was analysed using IBM's SPSS (Statistical Package for Social Sciences) software Version 23.

### Inclusion Criteria

1. Fractures with post-reduction radial shortening greater than 3 mm,
2. Post reduction dorsal tilt greater than 10°,
3. Post reduction intra-articular displacement or step-off greater than 2 mm
4. Presence of dorsal comminution

5. When closed reduction fails to restore anatomic palmar tilt;
6. For any unstable or intra-articular distal radial fractures which cannot be held in a reduced position with a cast
7. All Adults greater than 18yrs of age.

### Exclusion Criteria

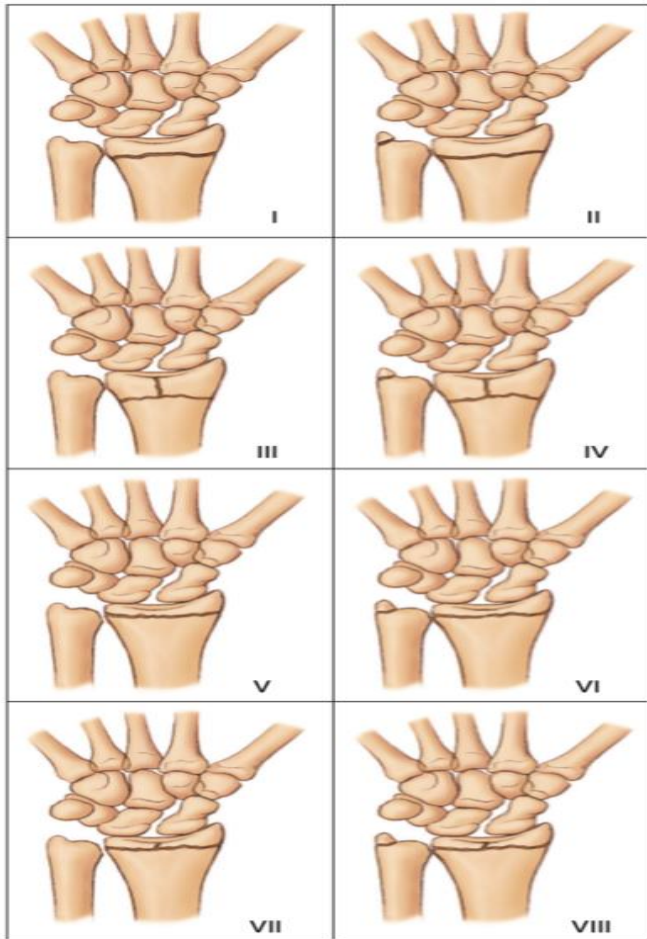
1. Open Fractures
2. Fractures associated with Vascular Injuries
3. Any other major fractures in the same limb.

### Discussion

Here we present the functional outcome of patients who sustained distal end radius fractures, treated with dynamic bridging external fixator. We used Sarmiento's modification of the demerit point system of Gartland and Werley(20).

Gartland and Werley System of Classification

Group	Description
1	Simple Colles' fracture with no involvement of the radial articular surface
2	Comminuted Colles' fracture with involvement of the radial articular surface
3	Comminuted Colles' fracture with involvement of the radial articular surface with displacement of the fragments
4	Extra-articular, nondisplaced (added by Solgaard in 1985)



### Frykman classification

We preferred this scoring system over the DASH(132,133) (Disabilities of Arm, Shoulder and Hand) questionnaire since it was not only a patient rating scoring system. Such scoring systems have a high ceiling effect(134). The external fixator device we used was by Orthoplus external fixator and it could be distracted, compressed or manipulated based on the radiological features. After a satisfactory reduction, under C arm guidance, we used 2 or 3 Kirschner wires to stabilize the fracture and then apply the external fixator(98,125,135). Radiological parameters were collected immediately after fixator application and at removal of fixator. Immediately after application of fixator on post-operative day 1, we encouraged elevation and digit movements. Fixator was loosened, and active wrist movements were usually

allowed on the 4<sup>th</sup> post-operative week after radiological confirmation of satisfactory bony union. The mean time for fixator removal was 43.96 days, approximately 6 weeks post-operatively. We did not encounter any pin tract infections(136) that needed any intervention, nerve complications or complex regional pain syndrome. One possible cause for the decreased pin tract infection was the lower average age of patients treated. There may have been a better bicortical purchase for the pins. The antibiotic prophylaxis (intravenous antibiotics for the 5 days in hospital and oral antibiotics to be taken at home after discharge from hospital) we followed along with the diligent twice daily pin tract care also may have contributed. We could not find any significant correlation between overall score and the varying radiological parameters.

Radiological parameters were recorded immediately after the trauma, after reduction using fixator, at removal of fixator and at one year follow up. Radial height was 4.08mm, 10.224mm, 11.02mm and 10.96mm. Showing a mild decrease in radial height with respect to values seen at fixator removal. Radial inclination at these 4 points were 15.122 degrees, 22.265 degrees at correction with fixator, 22.84 degrees at fixator removal and 23.163 at one year follow up showing improvement at one year of follow up. Radial tilt was initially dorsal in all cases studied and mean value was 24.735 degrees. After correction 34 patients has a volar tilt of 2.294 degrees and in 15 patients it was still dorsal, with mean of 2.07 degrees, depicted as negative 2.07 degrees. At fixator removal, 10 patients had -1.7 and 39 patients +2.74, and at one year follow up, 6 patients had -1.83 and 43 patients +2.81 degrees. So, 43 of the 49 patients, at one year follow up had an acceptable reduction with mean of 2.81 degrees.

As far as residual deformity in the form of prominent ulnar styloid process, residual dorsal tilt, radial deviation of the hand, none of the patients had these at either fixator removal or at one year follow up. The subjective evaluation was on average 1.1, where 1 was good and 2 was fair. It improved to 0.96 where 0 was considered excellent and 1 good, showing an improvement in the average patient's subjective evaluation over a one-year period. The average available wrist dorsiflexion at fixator removal was 24.63 degrees which improved to 57.27 degrees at the one year follow up mark. The palmar flexion improved from 37.7 degrees to 61.76 degrees over the one year follow up. The ulnar and radial deviation were 16.33 and 11.59 which improved to 34.43 and 26.27 respectively. The supination and pronation improved from 50.16 and 63.33 to 83.53 and 89.51 degrees respectively. These values clearly show an overall improvement in range of movement over a period of minimum one year follow up. Loss of circumduction was noted in 8 patients all more than 60 years except one. But this improved in all patients at one year follow up probably owing to the increase in overall range of movement. DRUJ pain was noted in 12 individuals the youngest of whom was 22 years and oldest 70 years. But this DRUJ pain persisted in even 9 patients at one year follow up. Grip strength was reduced on the affected side to less than 60% of the normal side in 7 patients, all above the age of 50yrs. It improved in all but 4 of them, all above 60 years. Regarding the associated complications, osteoarthritis was graded from minimum, minimum with pain to severe and severe with pain. 12 patients had signs of osteoarthritis more than the minimum which remained more or less the same at one year follow up when considering the average. No patients had any nerve related complaints. 2 patients complained of pain in the fingers, but it improved after 1 year of follow up.

When comparing the final scores, at fixator removal and later at one year follow up, initially 0 had excellent scores, this improved to 14. 15 patients who has a good score improved to 30. 28 who had fair improved to 5 and 6 patients who had poor reduced to naught. This demonstrates the improvement in function over a period of one year, with the majority having a good or excellent function.

A point also must be made on the overall cost of external fixator device. The device itself costs on average 5500 Rupees with total cost of procedure and hospital stay being under 25,000 Rupees. The total number of hospital visits are also comparable with other modalities of treatment including conservative management, though we did not specifically study these parameters. The weight of the device comes to roughly 135 to 155 grams and is comfortable to use.

#### **Definitive External Fixation: Indications**

Indications for definitive external fixation include the following:

1. Unstable extra-articular distal radius fractures
2. Two-part and selected three-part intra-articular fractures without displacement
3. Combined internal and external fixation

#### **Contraindications**

Bridging external fixation should not be used as the sole method of stabilization in the following situations:

1. Ulnar translocation resulting from an unstable distal radioulnar joint
2. Intra-articular volar shear fractures (Barton's, reverse Barton's)
3. Disrupted volar carpal ligaments and radiocarpal dislocations
4. Marked metaphyseal comminution

Combined index and middle finger metacarpal fractures preclude the use of this technique because of the interference with distal pin site placement.

#### **Augmented External Fixation- Indications**

1. Intra-articular radial styloid fractures
2. Three-part intra-articular fractures
3. After percutaneous reduction of a depressed lunate fragment
4. Arthroscopic-aided reduction of distal radius fractures

#### **Contraindications**

1. Marked metaphyseal comminution
2. Volar/dorsal intra-articular shear fractures

#### **Summary and Conclusion**

The external fixator as a device is easy to apply. When augmented with K wires, obtaining reduction of the fracture configuration is easier. The principles of ligamentotaxis makes it useful in comminuted fractures where a plate fixation would prove tedious and counterproductive at times. The functional outcome as depicted by the modified Gartland and Werley scores show a reasonably fair outcome at fixator removal with excellent to good outcomes at one year follow up. This study shows the external fixator as a viable treatment option in distal radius fractures.(137)

#### **Limitations of the Study**

As with all studies, ours too is not without its limitations. Firstly, it is only a Descriptive study and thereby no comparison can be made to other methods of treatment available for the same fracture pattern. The follow up of patients is only one year and a considerable amount of follow up is usually required for fracture fixation to label a treatment modality superior or otherwise. Within the purview of External Fixators themselves, we did not compare with other options such as static external fixator, the ubiquitous Joshi's external stabilisation system or even non-bridging external fixators. Another limitation of this

study is the heterogenous group studied. We included both elderly with milder trauma and younger age with more severe trauma into the study sample by focussing on radiological criteria.

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