

Outcome of Fracture Distal End of Radius Treated By Non-Bridging External Fixator

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Abstract

Background: Fractures of the distal radius are among commonly encountered problems, which need optimal reduction and early rehabilitation, to provide early functional independence. Non-bridging external fixation which is relatively easy to apply, versatile, maintains reduction and allows early joint mobilization. Thus we analysed the utility of non-bridging external fixator in fractures of distal end radius in terms of functional and radiological outcome in the rural Indian population.

Material & Methods: This prospective study is done in 22 patients (24 cases) of fresh fractures of distal end radius either extra or intra-articular. All patients were treated with non-bridging external fixator and were assessed for outcome functionally by DASH score, for union and radiological parameters.

Results: Average age of patients was 47.27 years. Mean flexion-extension arc was 147° (73° flexion and 74° extension), mean pronation-supination arc was 164° (79° supination and 85° pronation) and adduction and abduction was 32° and 11° respectively at 16 weeks post-operatively. The average radial angle restored post operatively to 18.93° (range 12.7° to 25°). The average radial length restored to 11.68 mm (range 8 mm to 14.4 mm). The average volar angle restored post treatment was 7.61° (range 3.4° to 15°). The average DASH score at 16 weeks was 9.92 (range 0.9 to 14.2).

Conclusion: Non-bridging external fixator in treatment of the distal radius fractures is an effective method of treatment, which can give excellent results in terms of functional and radiological outcome.

Keywords: Fracture distal end radius, Non-bridging external fixator, Fracture lower end radius.

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How to cite this article:

Sharma JK, Shrivastava S. Outcome of Fracture Distal End of Radius Treated By A Non-Bridging External Fixator. Ortho J MPC. 2019;25(2):67-71.
Available from:
<https://ojmpc.com/index.php/ojmpc/article/view/86>



Introduction

Fractures of the distal radius involving the metaphyseal-diaphyseal junction are among commonly encountered problems by orthopaedic surgeons. A good outcome demands optimal reduction and maintenance to provide early functional independence without potential complications.

Despite the recognized growth of internal fixation, external fixation has maintained a

role in the treatment of distal radius fractures because of its relative ease in application, versatility and reduced effects on the pericarpal soft tissues. The concept of non-bridging external fixator for distal radius fractures was first given by M. M. McQueen in 1998, subsequently procedural and technologic advancements have established its utility [1,2]. Few studies have been done on outcome of non-bridging external fixators in these fractures [3-11].

The purpose of this prospective randomised study was to analyse the utility of non-bridging external fixator in fractures of distal end radius in terms of functional and radiological outcome in the rural Indian population.

Material and Methods

This prospective study for assessment of the outcome of treatment of distal end radius with non-bridging external fixator is carried out from July 2010 to April 2012 at our institute after approval of the Ethical committee. Three hundred and forty nine cases of fracture distal end radius attending the outpatient department were registered, 23 of these cases who met the inclusion criteria were treated with non-bridging external fixator and included in the study. One case was lost at follow up. Thus 22 patients (24 radius – 2 bilateral), who were followed for a minimum of 6 months and whose data have been analysed for final conclusion formed the cohort.

All patients more than 18 years and with less than 3 days old dorsally displaced distal radius fractures either extra or intra-articular with minimum 2 large articular fragments and dorsal angulations of $>10^\circ$ and/or radial shortening of more than equal to 5 mm, simple or grade 1 compound, were included in the study. Patients having associated fracture ulna shaft, tendon injury, carpal injury or neuro-vascular involvement, were excluded from study.

After proper clinical evaluation and standard radiological assessment fractures were classified as per Frykman's classification system, mainly due to its better intra-observer reproducibility as compared with other systems [2].

All patients were admitted and after a preoperative workup, informed written consent and pre-anaesthetic check-up, were posted for the procedure. Standard preoperative surgical protocol and time out under appropriate anaesthesia four Schanz pins (2 pins proximally to fracture in shaft and 2 pin distally in the distal fragment) were inserted dorsolaterally and dorsomedially. Care was taken to avoid tendon injury or penetration. After that fracture was reduced

and confirmed fluoroscopically and the fixator frame application was completed (fig 1).

Postoperatively, patient's limb was kept elevated and active finger movements encouraged. Further shoulder, elbow and wrist, active and passive movements were started from day one as per the American Academy of Orthopaedic Surgeons Guidelines [12]. Patients were followed up regularly (2, 4, 6 and 16 weeks). Patients were assessed both clinically and on radiographs. The external fixator was removed at 6 weeks, when bridging callus was seen in at least three cortices in two views and clinically there was no pain / tenderness at fracture site.

Objective clinical assessment included range of motion of the wrist as measured in all the six planes with the help of a goniometer and grip strengths measurement on both sides. Standard antero-posterior and lateral X-rays were taken at each follow up to assess the position of the fracture fragments, union status and for measurements of parameters by like radial length, radial angle and volar angle. DASH questionnaire was used for functional assessment. Complications, if any were noted and suitably dealt. The data thus obtained were statistically analysed using Chi square and student t-test on SPSS (Statistical Presentation System Software) for Windows version 17.

Results

Out of 22 patients enrolled, 13 were males and 9 females with a dominant hand injury in 16, 4 had injury in non-dominant limb and bilateral involvement in 2 cases. The average age of patients was 47.27 years. Out of 22, 3 (13%) had a Frykman's type I fracture, 9 (41%) had a type II, 4 (18%) had type III, 4 (18%) had type IV injury and 2 (10%) had type VI injury. Four had associated ulnar styloid fracture.

The Flexion-Extension arc at the different follow up was analysed, there was an average change from 73° (36.2° flexion and 32.7° extension) at the 1st follow up at 2 weeks to 147° (73° flexion and 74° extension) at 16 weeks. Similarly the improvement in Pronation-Supination arc was 107° (48° supination and 59° pronation) at 2 weeks,

which improved to 164° (79° supination and 85° pronation) over the period of 16 weeks. Adduction and Abduction improved from 22° and 8° respectively at 2 weeks to 32° and 11° respectively at 16 weeks post-operative (fig 1).

Improvement in range of movement improvement in the patients on 4th week and 16th weeks on applying the paired t-test reveals a statistically significant change in the outcome with less than 0.0001 for Flexion – Extension, 0.004 for Abduction – Adduction and 0.001 for Pronation – Supination (fig 2).

The average radial angle restored post operatively to 18.93° (range 12.7° to 25°). The average radial length restored to 11.68 mm (range 8 mm to 14.4 mm). The average volar angle restored post treatment was 7.61° (range 3.4° to 15°). The radial length and volar angle observations were statistically significant.

The average DASH score at 4 weeks was 24.82 (range 10.3 to 40) and at 16 weeks was 9.92 (range 0.9 to 14.2). The DASH score comparison using the paired t- test reveals a statistically significant change over for 4 weeks to 16 weeks period.

Discussion

Fractures of distal radius are more common injuries predominantly, in females and in 6th decade [3-7]. In our study there is predominance of males and in 5th decade.

We analysed the results of non-bridging external fixator in treatment of the distal radius fractures in 24 cases. The operative protocol and the reduction technique was uniform in all the patients; but the anaesthesia protocol varied as per the anaesthetist preferences, using general anaesthesia, regional nerve blocks or Bier's block. Post-operatively patients getting Bier's block and the nerve blocks had a better immediate pain relief due to the residual effect of the drug, against the patients who received general anaesthesia, who required more analgesics [8]. Bier's block according to the literature is the most preferred modalities of anaesthesia, due to the low cost and excellent post-operative analgesia [9,10].

The flexion-extension arc achieved at the end of 6 weeks and 4 months was 124° and 147° respectively which reveals significant difference of value when compared to 105° and 127° respectively achieved in the study of Lozano-Calderón et al [13]. The results obtained in our study are early results which are clinically comparable with studies having achieved movements at 1 year after the trauma [3,14,15]. Early starting of the range of motion exercises should have an advantageous role in early healing, just as axial micro-motion has in distraction histogenesis. This has also been established in the study of Smith and David Slutsky [15,16].

The radiological assessment in the literature reveals improvement of the volar angle when non-bridging fixators are used [1,17,18]. The present series observations are consistent with the literature and reveal improvement in the radiological parameters [3-11].

The overall functional outcome as assessed with DASH scoring system has showed statistically significant improvement, with score improving from 4 weeks to 4 months. The most common complications encountered were wrist pain and radial subsidence. In addition, two cases have pin tract infection and subsequent loosening, which was treated by dressing and antibiotics. The incidence of wrist pain was 18.18% and located on the ulnar side noted during performance of heavy activity. The incidence of pain, as reported in literature varies from 10% to 57% in different studies [12,19,20]. Three of our four patients who had associated ulnar styloid fracture continued to have wrist pain even after 16 weeks on ulnar side.

There was loss of the radial height in 4 patients (range 2 to 6 mm) with maximum of 6 mm shortening in a 75 years old male, graded as grade 3 with articular incongruities according to the Kirk and Jupiter [21]. This patient also had pin tract infection leading to swelling and progressing into Sudeck's osteodystrophy with poor functions requiring additional management. This is probably attributable to the fact that fixator configuration was supported by indigenously single bent rod connecting pins in two planes, and with early rehabilitation, excessive stress

on the pins in osteoporotic bone lead to loosening, fixation failure and radial collapse.

Extensor tendon injuries are common complications of the non-bridging fixators due to the fact the distal pins go through the extensor compartment of the wrist as reported to be 10% by McQueen and 6.7 % by Krishnan [1, 22]. In our study we noted going through the tendons of extensor indicis on one occasion, but the complication was diagnosed on the table by doing passive finger and thumb movement (table 1). These patients developed pain on movement which subsided in 2 weeks. None of the patient had tendon rupture in our study. The reported incidence of

tendon rupture in distal radius fracture is 0.9% due to the bony spikes at the distal fracture fragment [23].

Table 1 – List of complications

Complication	Frequency
Finger Stiffness	1/22
Pin Tract Infection	4/22
Sudeck's Osteodystrophy	1/22
Wrist pain	3/22
Compression neuropathy	0/22
Pin Breakage	0/22
Schanz Pin loosening	1/22
Superficial Radial Nerve Palsy	0/22
Iatrogenic Tendon Injury	1/22
Loss of Radial Length	4/22

Fig 1 – Pre operative AP (a) and lateral (b) view and post-operative AP (c) and lateral (d) view radiograph showing fracture distal end radius which was treated with non-bridging external fixator. Final follow-up clinical photos (e and f) and AP view (g) of the same patient showing excellent results.

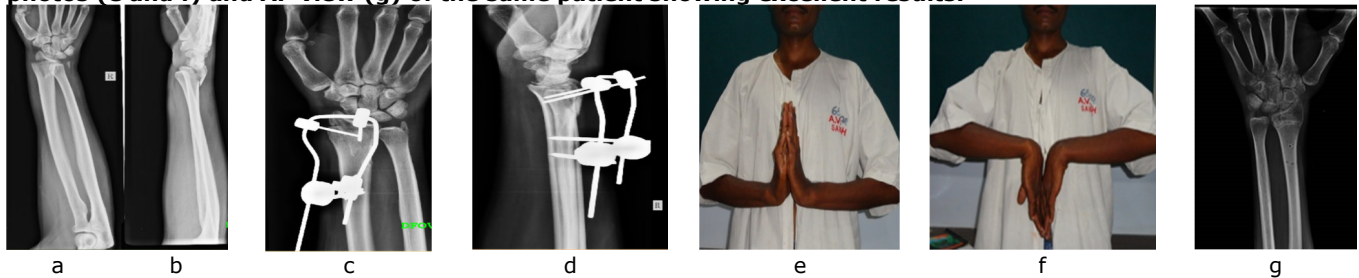
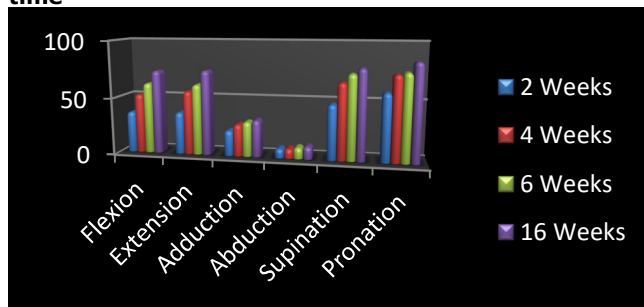


Fig 2 - Improvement of range of movement with time



In our series, finger stiffness and sudeck's osteodystrophy was seen in less than 5% (one case), who was non-compliant for the physiotherapy, the subsequent stiffness

persisted even at 6 weeks. By the 16 weeks follow up the stiffness was reduced but the grip strength was nearly 75% of the dominant hand. The incidence of finger stiffness and Sudeck's Osteodystrophy reported in literature was 0 to 31% and 0 to 6 % respectively [24,25] which increases with increasing traction.

Conclusion

Non-bridging external fixator in treatment of the distal radius fractures is an effective method of treatment, which can give excellent results in terms of functional and radiological outcome.

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