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Role of external fixator in surgical management of intra-articular distal radius fractures: Functional and radiological outcomes

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Abstract

Aim: The main aim of this study is to evaluate functional and radiological outcomes after treatment of intra-articular distal radius fractures by close reduction external fixation.

Materials and Methods: Twenty five patients of intra-articular fracture distal radius fulfilling the inclusion criteria were treated between Jan. 2016 to Nov. 2017 with close reduction external fixation using principle of ligamentotaxis. The fixator was removed after 6-8 weeks and patients were followed up for 6 months postoperatively. At final follow up functional assessment was done using Gartland and Werley score and radiological assessment done measuring radial inclination, volar tilt and ulnar variance.

Results: Seventeen (68%) male and eight (32%) females with mean age 45.4 years with intra-articular distal radius fractures were treated with external fixator. At 6 months follow up functional assessment was done using Gartland and Werley score, reported excellent to good outcome in 88% cases and satisfactory outcome in 12% cases and radiological parameters were within acceptable range. There was no correlation of age, sex or fracture type (as per AO classification) with functional outcome.

Conclusions: External fixator is a simple, cost-effective and reliable means of treating intra-articular distal radius fractures with good functional outcomes.

Keywords: Intra-articular distal radius fractures, external fixation, ligamentotaxis

Introduction

Distal radius fractures are one of the most common fractures of human skeleton, accounting for one sixth of all the fractures presenting in the emergency room ^[1]. They contribute to considerable disability, increased dependence for the injured patient and cause a major challenge to the health care system. The bimodal age distribution of distal radius fractures can be described into young patients with high energy trauma leading to wide displacement and marked comminution in bone of normal quality and elderly patients with low to moderate energy injuries in poor quality bones secondary to osteopenia and osteoporosis. There is an overall increase in the incidence of these fractures in the last few decades. In order to treat these fractures optimally, we must understand the extent of displacement, degree of articular disruption ^[2, 3], the reducibility of each fracture and stability of reduction. The principal goal of fracture treatment in distal radius fractures is to achieve bony union as well as to have a pain-free, stable and functional mobile joint. The external fixator provides a simple, quick and reliable means of treating unstable intra-articular fracture of the distal radius using principle of Ligamentotaxis, proposed by Vidal ^[4]. Ligamentotaxis is the term used to emphasize that, for traction to be effective it must be balanced by counter traction provided by ligaments and soft tissue surrounding the bone ^[5]. Close reduction external fixation has the advantage of being less invasive to fracture site as principle of indirect reduction is employed, less operative time, so preferable in patients with comorbidities, short hospital stay and is cost effective while has risk of pin site infection which can be avoided with proper care and stiffness which can be improved with physiotherapy ^[6]. The purpose of this study was to evaluate the clinical and radiological outcomes of close reduction external fixation in the treatment of intra-articular distal radius fractures.

Materials and Methods

Study was conducted on indoor patients with intra-articular distal radius fracture at Sir Ganga Ram Hospital, New Delhi from Jan. 2016 to Nov. 2017 and comprised 25 patients of both gender having (1) an intra-articular fracture distal radius radius (AO type B or C) (2) reported within 2 weeks of injury (3) had an age 18 years and above (4) gave informed consent for operative care.

Patients were excluded if they had (1) open fractures or neurovascular injury (2) age <18 years (3) reported late >2 weeks after injury. The approval for the study from Ethics Committee of the hospital was taken and informed consent was obtained from all patients.

After appropriate radiological and pre-operative investigations the individual was posted for surgery. All fractures were classified as per the AO classification⁷ and pre-operative planning done. All surgeries were performed under general anesthesia. One dose of pre-operative antibiotic given and continued post-operatively. The standard surgical steps were followed. Close reduction of fracture was done by manipulation under image intensifier with traction and counter-traction method. Two or three K-wires inserted in distal radius to hold fracture fragments and external fixator was placed using 2 schanz pins in radius, 2 schanz pins in second metacarpal and connected with distraction rod. Fracture reduction confirmed under image intensifier. Postoperatively operated arm was kept elevated and wrist radiographs were taken within 24 hours of surgery. Patients were discharged 24-48 hours after surgery or thereafter when stable (in case of associated injury) with the instructions to perform active finger, elbow and shoulder movements, limb

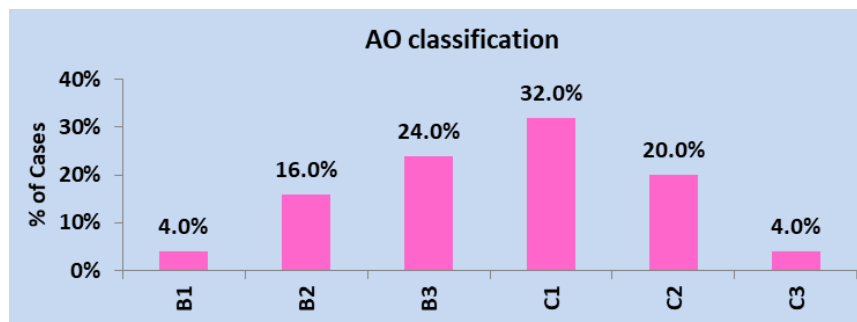
elevation and regular pin site cleaning. All cases were followed up regularly for 6 months. At follow up the fracture union was assessed clinically by absence of tenderness and radiologically by the bridging callus formation. The external fixation was removed after 6-8 weeks in the outpatient clinic and supervised wrist mobilization started.

At final follow up, functional assessment was done in terms of Demerit Point System of Gartland and Werley Score⁽⁸⁾ and Radiological assessment was done in terms of standard anteroposterior and lateral x-rays measurements of Volar tilt, Radial inclination and Ulnar variance. Statistical analysis of the data will be done using Statistical Package for Social Sciences (SPSS) and MS EXCEL.

Observations and Results

Twenty five patients ranging from 19 to 75 years with mean age 45.4 years with intra-articular distal radius fracture were treated with close reduction external fixation. In our study, male preponderance was 68%, with road traffic accident (52%) being the most common mode of injury. Right (60%), dominant side (64%) was commonly affected. AO type C1 (32%) were the most common type of fractures, as shown in graph 1. Most cases (64%) operated within 24 hours following trauma and mostly (56%) discharged after 24 hours of surgery. Average duration of external fixation was 46.04 days and patients were followed up for 6 months.

At 6 months follow up, average range of movements measured were Dorsiflexion – 65.8⁰, Palmarflexion – 58.2⁰, Ulnar deviation – 24.2⁰, Radial deviation – 17.2⁰, Supination – 77.2⁰, Pronation – 71.6⁰ and were within acceptable range.



Graph 1: The distribution of type of fracture as per AO classification (n = 25)

Table 1: Functional outcome as assessed by Gartland and Werley score

Outcome	No. of cases	% of cases
Excellent	12	48
Good	10	40
Fair	3	12
Total	25	100

In our study, the fracture united in all cases (100%) by 3 months. The radiological assessment parameters at 6 months were - mean Radial inclination of 19.3⁰, mean Volar tilt of 6⁰, mean ulnar variance of -0.48⁰, all were within acceptable range.

Complications were observed in a total of 7 cases (28%). Four cases had Residual wrist pain, which was mild and reproduced on exertion and rarely required analgesics. Two cases had superficial pin tract infection which resolved with local wound care and antibiotics. One case had mild residual dorsal tilt, but was able to do daily living activities satisfactorily.

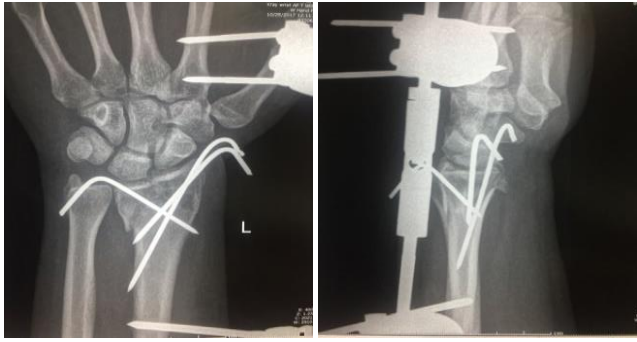
Case - 1



Pre-op x-ray



Immediate post-op x-ray



6 weeks post-op x-ray



6 months post-op x-ray

Functional outcomes



Dorsiflexion

Palmar flexion

Ulnar deviation

Radial deviation

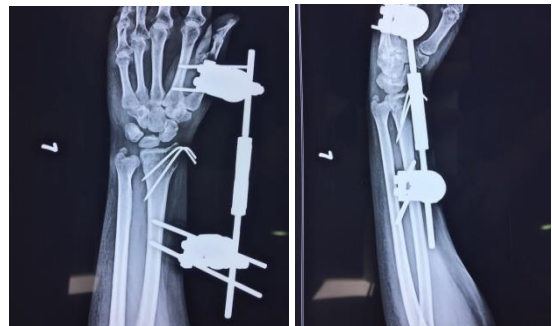
Supination

Pronation

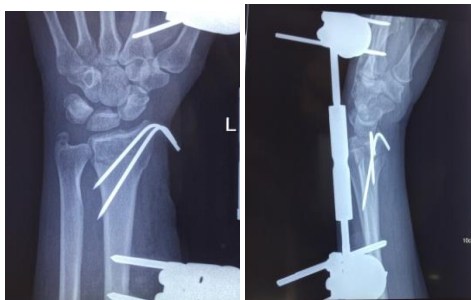
Case - 2



Pre-op x-ray



6 weeks post-op x-ray



Immediate Post-op x-ray



6 months post-op x-ray

Functional outcomes



Dorsiflexion

Palmar flexion

Ulnar deviation

Radial deviation

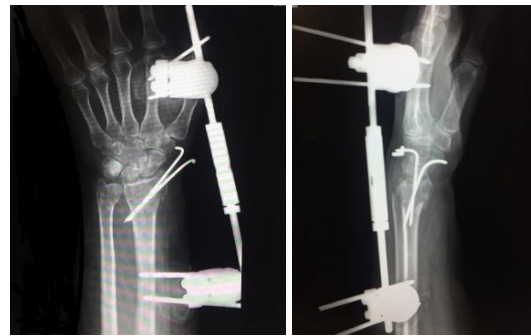
Supination

Pronation

Case - 3



Pre-op x-ray



6 weeks post-op x-ray



Immediate Post-op x-ray



6 months post-op x-ray

Functional outcomes



Dorsiflexion

Palmar flexion

Ulnar deviation

Radial deviation

Supination

Pronation

Discussion

Many years after its description by Sir Abraham Colles the management of Colles' fracture continues to pose a dilemma with poor results occurring in a significant number of patients. The ultimate goal of its management is to achieve proper reconstruction of disrupted anatomy and allow quick return to function without complications. Increased understanding of wrist anatomy and mechanism of injury has stimulated a growing interest and prompt new ideas regarding optimal management of distal radius fractures. Various surgical methods have evolved, with minimally invasive techniques and approaches towards soft tissue that are more biological, i.e. less aggressive towards the soft tissue. External fixation is a less demanding, less invasive and faster procedure. There is the additional advantage of not devascularising bony fragments and not creating a surgical wound. If adequate closed reduction can be obtained, external fixator maintains the reduction with constant distraction of ligaments which hold the fracture fragments in place until solid union occurs. In our study of 25 patients, mean age of patient with distal radius fracture was 45.4 years, comparable to study conducted by Alam *et al.* [9] and Chilakamary *et al.* [10]. The high incidence of cases in males (68%) may be due to high susceptibility to injury due to occupational and ambulant life led by them. High incidence of dominance side involvement (64%) may be attributed to tendency of stretching the dominant hand as a reflex while RTA/fall so as to avoid

injury to face and head, predominance of dominant side involvement also seen in study conducted by Cooney *et al.* [12] and Alam *et al.* [9]. Road traffic accident (52%) being the most common cause, also seen in Chilakamary *et al.* [10] and Vishwanath *et al.* [11] study. All 25 of our cases operated within 3 days of injury, also in study conducted by Chilakamary *et al.* [10]. Average duration of external fixation in our study was 46.04 days, comparable to study conducted by Alam *et al.* [9] and Chilakamary *et al.* [10]. Functional result at 6 months showed excellent to good outcome in 88% cases and satisfactory outcome in 12% cases which is comparable to other studies.

Table 2: Comparison of functional outcome at final follow up

Study	No. of cases	Excellent to Good	Fair to Poor
Cooney <i>et al.</i> [12] (1979)	60	87%	13%
Jakim I <i>et al.</i> [13]	132	83%	17%
Alam <i>et al.</i> [9]	25	80%	20%
Chilakamary <i>et al.</i> [10]	26	88.5%	11.5%
Tontanahal <i>et al.</i> [14]	350	83.14%	16.84%
Vishwanath <i>et al.</i> [11]	50	86%	14%
Present study	25	88%	12%

Functional outcome did not differ across various age groups, didn't differ significantly between male and female group and was comparable in all AO fracture types. Average range of

movements in our study was comparable with Cooney *et al.* [12] and Tontanahal *et al.* [14] studies and also were more than minimum requirements for daily activities.

Union rate was 100% in our study by 3 months, also in study conducted by Tontanahal *et al.* [14]. Radiological evaluation at 6 months showed mean radial inclination of 19.3°, mean volar tilt of 6° and mean ulnar variance of -0.48°. Our findings were comparable with Tontanahal *et al.* [14] study and were within acceptable anatomical range.

Of 25 cases, residual wrist pain was seen in 4 (16%) cases, most of which was mild and reproduced on exertion, it was not disabling as far as activities of daily living was concerned and rarely required analgesics. Two (8%) cases had superficial pin tract infection which resolved with local wound care and antibiotics and no case had pin loosening. One (4%) case had mild residual dorsal tilt because of some loss of reduction, but was able to do daily living activities satisfactorily. Complications rate in our study were less as compared to study conducted by Anderson *et al.* [15] and Chilakamary *et al.* [10].

The major strength of our study is the 100% follow up rate. However, the strength of our results was limited by small sample size and shorter follow up period in our study. A larger sample size and longer follow up are required to extensively evaluate this method of treatment.

Conclusion

In conclusion, external fixator is a simple, cost-effective and reliable means of treating intra-articular distal radius fractures with proved and accepted concept of ligamentotaxis. The procedure is quick and less damaging to surrounding tissue. It is a stable fixation which permits movements of fingers, elbow and shoulder and can produce excellent to good results.

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