Treatment of unstable intraarticular fracture of distal radius: POP casting with external fixation

Obaid ur Rahman, Mohammad Qadeem Khan, Haroon Rasheed, Saleem Ahmad
Department of Orthopaedic Surgery, Benazir Bhutto Hospital, Rawalpindi.

Abstract

Objective: To compare radiological and functional outcome of external fixation and distraction with conservative Plaster of Paris (POP) cast for unstable intra-articular fractures of the distal radius.

Methods: The study was conducted on 60 patients with unstable intra-articular fracture of distal radius who reported to emergency or outpatient Orthopaedic Surgery department of Benazir Bhutto Hospital, Rawalpindi, between March and August 2007. They were divided into two equal groups: Group A and Group B, treated by Plaster of Paris cast, and external fixation with distraction respectively. The functional outcome in terms of freedom from pain, range of movement, grip power and deformity, and the radiological outcome of radial length, incongruity and radio-ulnar joint position were analysed at three months follow-up using a 3-point scoring scale.

Results: In Group A, 1 (3%) patient showed excellent result, 8 (27%) patients good results, 19 (63%) patients fair results and 2 (7%) patients poor result. In Group B, 14 (47%) patients showed excellent results, 11 (37%) patients good results, 4 (13%) patients fair results and 1 (3%) patient poor result. The outcome score of the Group B patients was significantly better compared to the Group A patients (p value <0.05).

Conclusion: External fixation has definite advantages over conventional Plaster of Paris cast in the treatment of unstable intra-articular fractures of distal radius.

Keywords: Plaster of Paris, Intra-articular fractures, Rawalpindi (JPMA 62: 358; 2012).

Introduction

Fractures of distal radius account for one-sixth of orthopaedic emergency room visits.[1] Even though these fractures are common, there is a significant controversy regarding the best treatment for these fractures.[2] For simple extra-articular Colles fractures, good functional results can be achieved by conservative treatment; but for unstable intra-articular fractures of the distal radius, better clinical and radiological results have been advocated by external fixation,[2,3] fixation with Kirschner (K) wire,[4] plate fixation[5] and arthroscopically assisted reduction and percutaneous fixation with Kirschner (K) wire.[6]

Unstable distal radius fractures are those which are mechanically prone to re-displacement after closed manipulation. Several factors have been associated with the instability.[1] These include the following:

a) The initial displacement of the fracture .The greater the degree of the initial displacement is (especially radial shortening), the more energy was imparted to the fracture, resulting in a higher likelihood that closed treatment will be unsuccessful.

b) The age of the patient. Fractures in elderly patients with osteopenic bones tend to displace particularly late.

c) The extent of metaphyseal comminution (the metaphyseal defect) especially when comminution extends into the palmar buttress, collapse occurs even in the face of cast immobilisation.

d) The amount of intra-articular comminution and steps.

e) Finally, displacement after closed treatment is a predictor of instability, and repeat manipulation is unlikely to result in a successful radiographic outcome

As discussed, the initial reduction of unstable fractures of the distal radius achieved by closed reduction and Plaster of Paris (POP) cast immobilisation is difficult to maintain with this method alone. External fixation and distraction is one method to restore radial length and maintain reduction, thus improving radiological and functional outcomes.[7,8] External fixation represents the first line of treatment for unstable distal radius fractures.[9]

The purpose of this study was to compare the clinical and radiological outcomes of external fixation and distraction with conservative POP cast treatment for unstable intra-articular fractures of the distal radius in our hospital practice. Scoring system used for evaluation of the clinical outcome was modified from the scoring system used by Jakim I et al.[10] Further, complications arising from both procedures were also studied. No such study comparing these two methods of

treatment has been reported in Pakistan. Hence, the study may act as a guideline for future management of such patients.

Patients and Methods

A randomised control trial (concurrent parallel type) was conducted on 60 patients with unstable intra-articular fracture of the distal radius who reported to either the emergency or outpatient facilities of the Orthopaedic Surgery department of Benazir Bhutto Hospital, Rawalpindi, between March and August 2007. A total of 107 adult patients, age above 30 years, with diagnosed case of unstable intra-articular fracture of the distal radius were considered for the study. Patients who presented after one week of injury, open fractures or those who had other associated fractures were excluded. The final study population of 60 patients was divided into two equal groups. Patients meeting the criteria were divided by lottery method, with odd numbers to Group A and even numbers to Group B .The study was approved by the Ethical Committee of the hospital, and written informed consent of the patients was obtained.

Group A patients were treated with above-elbow POP cast after reduction of fracture, under sedation and haematoma block in the emergency room. The block was performed with 3 mL of 2% lidocaine without epinephrine, using an 18-gauge needle inserted under aseptic technique. The haematoma was evacuated, and the lidocaine was injected slowly until resistance was met. The distal metaphysis was reduced by increasing the degree of the deformity and then applying longitudinal traction. The distal metaphyseal fragment can be reduced on the shaft only when sufficient traction has been applied. Once the palmar cortex was re-aligned, the forearm was placed in neutral to 30 degrees of supination. Finally, the palmar tilt was restored, if required, using gentle pressure on the distal fragment. Care was taken to avoid excessive palmar flexion of the radiocarpal joint, which can result in an acute carpal tunnel syndrome. Above-elbow POP cast was applied. Post-reduction X ray films were taken and adequate reduction was confirmed. The patients came for follow-up at 2 weeks and 6 weeks with the cast. Active movements of the hand and shoulder were encouraged. The cast was removed at 6 weeks. Patients were followed up at 4, 8, and 12 weeks after removal of the cast.

Group B patients were treated by external fixation with distraction applied within 1 to 2 days of presentation. External fixator (AO type) was applied under general anaesthesia in the operation theatre. The fixator consisted of 3.5 mm schanz pins and attachment clamps and rods. Two to three schanz pins were inserted proximal to the fracture site in the radius while two pins were inserted at the base and shaft of 2nd metatarsal. All the 5 pins were inserted in the plane that was 45 degree vertical and true lateral, through 1 to 2 cm stab incisions. The radial nerve and tendons were protected by tissue protection sleeve. Closed reduction of the fracture was done under the image intensifier and post-operative radiographs were taken to ensure proper alignment and reduction (Figure-1). An active range of motion at hand, elbow and shoulder was encouraged. Most of the patients could hold a cup of tea within a week of surgery and felt comfortable with the fixator. Oral antibiotics were given for ten days. External fixator was removed at 6th to 8th week of surgery depending on the clinical and radiological signs of the union. Check X-rays were taken on 2nd week of the fixation, at the time of removal of the fixator, and on subsequent follow-ups. Patients were observed for any possible complications.

Clinical and radiological outcome was assessed for each patient at the final 12th week follow-up. Scoring system used for evaluation of clinical and radiological outcome was modified from the one used by Jakim I et al,[10] each criterion scored from 1-3, with worst outcome scored as 1 and best outcome scored as 3.

The clinical criteria evaluated were: (A) freedom from pain [score 1: pain during activity requiring off and on analgesics and other pain remedies; score 2: mild pain requiring no treatment; score 3: completely free of pain]; (B) range of movement measured by using goniometer [score 1: severely affected range of movement at wrist joint less then 50% of the normal wrist; score 2: decrease in movement between 50-80% of normal wrist movement; score 3: near normal range of movement]; (C) grip power measured by using an electronic dynamometer (Manufacturer's name "Camry") [score 1: severely affected grip power <50% of normal hand grip power; score 2: moderately affected grip power between 50-80% of normal grip power; score 3: near normal grip power >80% of normal hand grip power]; and (D) deformity [score 1: obvious deformity; score 2: slight deformity; score 3 no deformity}. The clinical criteria were assessed by a physiotherapist who was blinded by applying stockings to forearms and wrists of both groups thus hiding the pinhole marks of the external fixators.

The radiological criteria that were measured included: (A) radial length, [score 1: radial shortening of >5mm; score 2: <5mm radial shortening; score 3: normal radial length]; (B) joint incongruity [sore 1: severe incongruity with articular step >2mm; score 2: moderate incongruity with step between 1 -2 mm; score 3: acceptable incongruity with step <1mm] and (C) radio-ulnar joint position [score 1: distal radioulnar joint dislocation; score 2: mild subluxation; score 3: normal distal radioulnar joint position]. The radiological criteria were assessed by an orthopaedic surgeon and a final year resident independently. They were blinded to the procedure done by hiding the pin hole tracts area in both the groups.

The overall result was calculated by adding clinical

and radiological scores for each patient. A total score of 19-21 was considered excellent, 15-18 good, 9-14 fair, < 9 poor.

Data was computed using Microsoft Office Excel 2007. Descriptive statistics were used for all continuous variables. Categorical variables were tabulated as counts and percentages. Chi squares test was used to compare the clinical and radiological outcome between the two groups as well as epidemiological characteristics. Student t-test was used to compare total scores between the two groups. A p value of < 0.05 was considered to be significant.

Results

Since patients of age 30 or more, with mature bones, were included in the study, at enrolment the patients' characteristics (including socioeconomic group, age, height and weight) were not significantly different between the two groups (p=0.987). The age of patients ranged between 32 and 58 years, average 42.7 ±7. Male to female ratio was 38 to 22 i.e. 1.7:1.

The final outcome (Table) of the two modes of treatment was assessed by evaluating specific clinical and radiological criteria as already described. The difference in clinical and radiological outcomes was significantly better in Group B as compared to Group A for all criteria.

In group A, POP cast produced excellent result in only one patient, good result in 8 while the remaining 21 (70%) showed poor or fair results. In group B, external fixation produced excellent or good results in 25 patients (83%) and only 5 (17%) patients were left with fair or poor outcome (Figure-2). The results of Group B were significantly better than Group A (p<0.05).

Superficial pin-tract infection occurred in 3 (10%) patients in group B, but was resolved with oral antibiotics. The proximal radial pins were mostly involved. There were 2 cases of pin loosening. Loss of reduced position occurred in 18 patients with POP cast within the first 2 weeks of injury, while there were only 2 cases of loss of reduced position in the other group. Wrist stiffness occurred in nearly a quarter of the patients[7] in group A, but only in 2 patients in group B. The cause in both groups was mainly attributable to poor

Table: Clinical and radiological outcome in Group A and Group B patients.

	Clinical Outcome			
	Score 1	Score 2	Score 3	CHITEST
Pain freedom				**p-value**
Group A	12 (40%)	16 (53%)	2 (7%)	<.05
Group B	4 (14%)	13 (43%)	13 (43%)	
Range of movement				
Group A	5 (17%)	20 (67%)	5 (17%)	<.05
Group B	3 (10%)	9 (30%)	18 (60%)	
Power				
Group A	13 (43%)	13 (43%)	4 (14%)	<.05
Group B	2 (7%)	11 (37%)	17 (57%)	
Deformity				
Group A	13 (43%)	17 (57%)	0	<.05
Group B	0	9 (30%)	21 (70%)	
	Radiological Outcome			
Radial length				**p-value**
Group A	2 (7%)	25 (83%)	3 (10%)	<.05
Group B	1 (3%)	8 (27%)	21 (70%)	
Incongruity				
Group A	5 (17%)	19 (63%)	6 (20%)	<.05
Group B	1 (3%)	13 (43%)	16 (53%)	
Radio-ulnar joint				
Group A	9 (30%)	7 (23%)	14 (47%)	<.05
Group B	1 (3%)	5 (17%)	24 (80%)	

Group A: POP patients
Group B: External Fixator patients
CHITEST: Comparison between outcome of Gp A and Gp B.

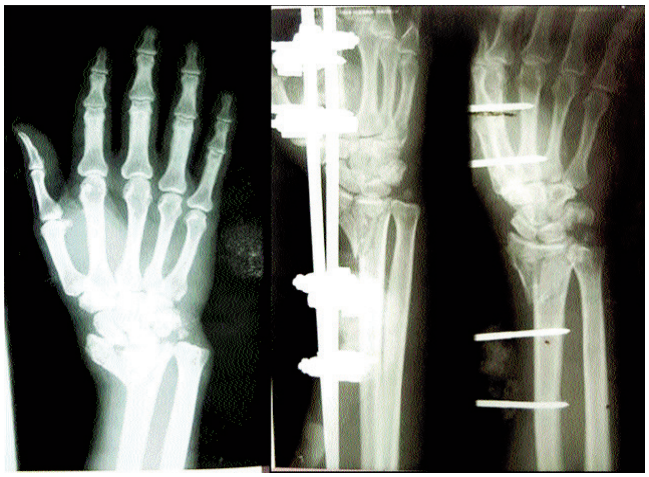

Figure-1: X-ray (Rt) Comminuted intra-articular fracture of the distal radius with radial deviation and shortening. (Lt) After external fixation in group B patient: Radial length and alignment achieved, Distal Radioulnar joint restored and intra-articular steps minimised.

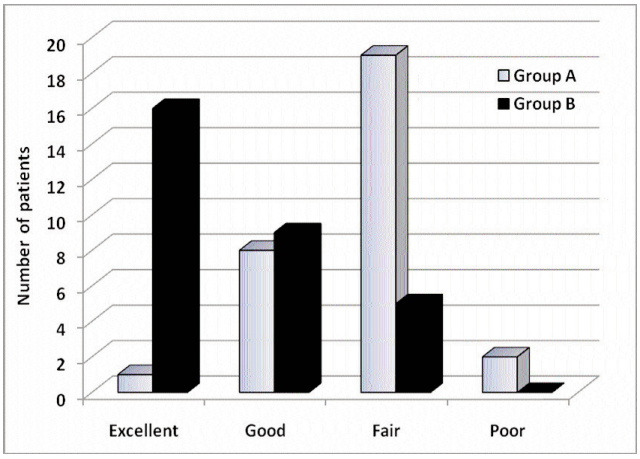

Figure-2: Comparison of overall results obtained in the two groups.

compliance and lack of physiotherapy. There were 2 cases of tight plaster in group A, which was loosened or revised within 3 days of application. Reflex sympathetic dystrophy developed in 3 cases of group A and 2 of group B.

Discussion

Intra-articular fractures of the distal radius are common injuries. They usually occur as a result of high-energy trauma and are often unstable. Intra-articular fractures occur mainly in young individuals with good bone stock as a result of violent compression forces, and are associated with substantial articular and peri-articular tissue damage. In our study, majority (80%) of the cases were in the age group of 30 to 45 years. Male population is 1.7 times more prone to such injuries as is supported by our work and other studies.[11-13]

Current treatment goals are centered on restitution of bony anatomy of the distal radius (radial angle, radial length and volar tilt) with specific attention to the restoration of articular surfaces of radio-carpal and radio-ulnar joints.[13-15] External fixator is a versatile tool that is now well established in the treatment of these fractures. It has several distinct advantages over conventional POP cast and plate fixation. The principles of external fixation involve longitudinal traction (ligamentotaxis) and most importantly palmar translation. While reviewing papers reporting on external fixation versus cast treatment for unstable distal radius fractures, the data showed that external fixation was favoured over closed reduction and casting.[2,16-19] Our findings also supported external fixation of the intra-articular unstable fractures of the distal radius. We found external fixation to be an effective, economical and time-saving method for the treatment of such fractures. It also has a short learning curve and can be performed at resident level.

Failure to reduce intra-articular fractures of the distal radius adequately predisposes to pain, restricted movement and degenerative arthritis. Malposition is related to the radial height, radial angle, volar tilt and the accuracy of the intra-articular reduction. Several studies have also noted the importance of the restoration of articular congruity to avoid osteoarthritis. 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.[15] Their work and that of Melone[20] had resulted in the acceptance of a step in the articular surface up to 2 mm. Mehta et al[6] in their arthroscopic assisted treatment of intra-articular fractures of the distal radius demonstrated that the incidence of pain is significantly related to the size of the step. Patients with no step, <1 mm step and >1 mm step had an incidence of pain of 18%, 38% and 100%, respectively in their study. In our study, we found that intra-articular step of more than 1 mm leads to residual pain and arthritis, and recommend anatomical reduction and acceptance of a step of <1 mm since the size of the step is related to the incidence of pain.

The limitation of external fixation to achieve articular congruity in the comminuted intra-articular fractures of the distal radius has been documented in the available literature.[11,12] This could be because external fixation alone does not expand crushed cancellous bone and cannot work without soft tissue hinges. Procedures like K-wires, limited open reduction with or without bone grafting[16] and arthroscopic assisted reduction[11] have been occasionally used to augment external fixation and we feel that adjuvant procedures may be needed to supplement external fixation in such fractures. Open reduction and internal fixation of comminuted intra-articular fractures of the distal radius has been recommended, but this can be difficult since a dorsal and volar approach may be required. Exposure of the fracture strips the soft tissues with devascularisation of the bony fragments. Further capsular and ligamentous dissection is required to provide adequate exposure of the articular surface. This produces additional soft-tissue injury and may lead to post-operative stiffness and radio carpal instability.[5] Full open reduction of severely comminuted fractures is technically difficult, if not impossible, when metaphyseal support has been lost. This method requires excessive stripping of soft tissues and necessitates external immobilisation, leading eventually to fibrous ankylosis and a poor functional result.

Most of the older studies[20-22] on plate fixation for comminuted intra-articular fractures of the distal radius have not shown encouraging results. In fact, a meta analysis of the literature on distal radius fractures reviewing 615 articles showed that external fixation gives superior results to plate and screw fixation.[2] However, some recent papers are favouring plate fixation.[23-25] They have shown better results both clinically and radiologically compared with the external fixation method.

Most complications seen in the study have been previously reported and were related to pin tracts. Since self-tapping radial pins were inserted by hand through a 1-2 cm incision after identifying structures, we did not encounter any damage to the superficial branch of radial nerve or adjacent tendons. Hand and wrist stiffness encountered mostly in conventional POP treated group (23%) was much less in the external fixator group (7%). Extension of the wrist by external fixation helps in flexing the metacarpo-phalangeal joints and allows active hand function while the fracture unites with time.

A small sample size and a comparatively short follow-up period were two basic limitations of our study.

Conclusion

External fixation is an effective method for the

treatment of unstable intra-articular fractures of the distal radius. It has superior radiographic and clinical outcome than the conventional POP cast. The complications of the procedure are uncommon and are not potentially serious in nature.

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