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Clinical outcomes in management of unstable distal radius fractures treated with external fixation and internal fixation: a prospective comparative study

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ABSTRACT

Background: Management of Distal Radius fracture that are inherently unstable is still a matter of debate. There is no conclusive evidence that support one surgical fixation method over another. An attempt was made to analyze patients treated with Ex-Fix and Internal-Fixation for unstable distal radius fractures and evaluate the clinical efficacy of Ex-fix using principles of ligamentotaxis and Internal-fixation and compare functional recovery, fracture healing time and complications.
Methods: A prospective trial was undertaken at our hospital with 35 patients,all aged >20 yrs with closed distal radius fracture and divided into two groups: group I (Ex-fix with or without percutaneous k-wire, and JESS) and group II (Int-Fixation) including 14 and 21 patients, respectively. Periodic clinical examination and x-ray review was carried out to find out fracture union, and functional assessment. Patients were followed up for 1 year, 6 months average.
Results: Group I consumed significant less operative time, fluoroscopic exposure, reduced hospital stay, quicker post-operative pain relief. Quick DASH score were significantly high in elderly treated with Ex-Fix in comparison to young in which DASH score was higher with internal-fixator. Functional recovery was early with int-fixation but post-operative wrist stiffness was also higher. 2 cases of delayed wound healing &1 case of pin tract infection with ex-fix application was observed.
Conclusions: Internal-fixation remains the treatment of choice for unstable distal radius fracture involving the articular surface and in the young, while ext-fixation can be considered as a primary treatment modality in the extra-articular fractures in young or even intra-articular fractures in the elderly.

Keywords: Distal radius, Ex-fix, Ligamentotaxis, DASH score

INTRODUCTION

Orthopaedics literature widely accepts that the restoration of the distal radius anatomy is strongly linked to functional restoration.[1] Any treatment modalities should be primarily aimed at restoring radial articular congruity, alignment, length, motion and stability. This mostly implies that operative intervention becomes essential for management unstable DRFs to achieve successful outcomes.[2] However, exact management of patients with unstable DRFs remains controversial. There is no definitive evidence to support one surgical fixation method scores over another.

Currently, operative management of unstable DRFs mainly includes external fixation (EF) and internal

fixation (IF). For Ex Fix, there are two popularly used techniques: 1) closed reduction with or without pin augmentation; 2) open reduction with pin augmentation (usually used for open/infected DRF fractures). For internal fixation there are also three popular techniques: 1) dorsal plating; 2) volar plating; and 3) fragment specific fixation. Volar plating being more popular.

Among these techniques, many authors believed open reduction with pin augmentation could successfully achieve near anatomical reduction.[3] However other authors have reported satisfactory outcomes following EF for unstable DRFs although few authors have reported complications related to over distraction of articular injuries, including severe digital stiffness, reflex sympathetic dystrophy, and nerve dysfunction in cases managed with Ex-fix.[4-6]

For IF, dorsal plating and fragment specific fixation techniques are less frequently performed. Many authors have reported excellent outcomes following IF with volar plating for unstable DRFs.[7-9] However, some authors have reported association of complications, such as tendon rupture, hardware malposition, and loss of fixation.[10,11] In addition, IF with volar plating requires longer duration of operation and high treatment costs.

Few meta-analysis and randomized control trials (RCTs) comparing IF and EF have been published in recent years.[12-14] However, results were still inconclusive. In addition, all those studies recommend further studies to establish strong differentiating points between the two treatment modalities. Therefore, in this study, we retrospectively reviewed the clinical data records of patients treated with EF and IF for unstable DRFs, and compared the outcomes of these two fixation methods.

METHODS

This study reports a prospective review of clinical data records of patients admitted with the diagnosis of distal radius fracture at Hi-tech medical college & adjoining hospital.

Out of 57 cases who presented to hospital, 35 cases of distal radius fracture were selected according to the pre-determined inclusion and exclusion criteria. This study was conducted between 1st August 2015 and 31st may 2016.

All included patients were divided into two groups: group I-21 cases (*internal fixation*: open reduction with volar plating), and group II- 14 cases (*Ex-Fix*: closed reduction with /without pin augmentation and distraction) and for each included patients, complete demographic profile including age, sex, address, duration since fracture, mode of injury were noted. Preoperative radiological evaluation was done and recorded.

Obtained data from group I and group II were tabulated separately, and following endpoints were analyzed: operation time, hospital stay, a quick DASH scores and Range of movement. In this study, AO system of fracture classification, and three major subgroups of three major types, i.e. type A (A1, A2, A3), type B (B1, B2, B3) and type C (C1, C2, C3) were only used.

Inclusion criteria

Inclusion criteria were patients treated with internal fixation (volar plates) and external fixation (with/without pin augmentation); patients operated within the week after injury; AO 23 fractures; who gave consent for study.

Exclusion criteria

Exclusion criteria were patient who did not give consent for study; patients treated conservatively; patients treated with dorsal plates or fragment specific fixation; patients treated with "pin and plaster technique"; patients presented with open distal radius fractures or extensive soft tissue trauma; patients presented with multiple fractures (except distal ulnar fracture); patients presented with special scenario: e.g. wound infection, mal-union, and non-union.

All surgeries were performed either in brachial plexus block or general anesthesia under tourniquet control. For external fixation the fracture was reduced with traction and direct manipulation under c-arm guidance and stabilized with convention Ex-fix clamps percutaneous k-wires were inserted to maintain the reduction wherever required. ORIF cases were performed with modified Henrys approach and volar plating was chosen as preferred mode of fixation. Post-operative radiological estimation was performed in the OT itself under fluoroscopy. Operative time, complications during surgery, C arm exposure were recorded.

Postoperative x-ray and evaluation were done. Active finger movement exercises were advised for each patient. Post-operative dressing was done on day 2 and 5 and close watch was kept on wound healing, wound infection, pin track infection. Patients were followed up at 6 weeks, 3 months, 6 months and one year after surgery and radiographs were taken. Functional evaluation was assessed with the clinical assessment using quick DASH scoring and ROM measurement (Table 2).

Data recording was done using Microsoft Excel 2007 and statistical analysis was done using SPSS 16.0. Chi square and student t tests were used for analysis and level of significance was set on 0.05.

RESULTS

Demographic evaluation

Out of 57 patients of distal radius fractures, after careful assessment by predetermined inclusion and exclusion criteria, 35 patients with distal radius were selected and

included in the study. Out of those 35 patients, group I included 21 patients and group II included 14 patients.

In group I, patients' age ranged from 15 to 70 years (average, 34 years). Sex (M/F) ratio was 16:5. Mechanism of injury included high energy trauma (i.e. RTA, sports injuries and fall from greater heights) in 15 patients and accident fall over outstretched hand (low energy) in 6 patients. AO fracture classification distributed as type A (5 patients), type B (7 patients) and type C (9 patients) fractures. Right and left (R/L) wrist involvement ratio was 17:4. There was associated ulnarstyloid fracture in 6 patients and neurovascular compromise in form of median nerve compression was seen in 4 patients.

Table 1: Data collection format.

Demographic	Age	Sex	Type of injury	Mechanism of Injury
Pre-operative	Fracture classification	Associated injuries	Presence of ulnar styloid fracture	Median nerve injury
Intra-operative	Treatment method	Surgical time	Approach	Intra-operative fluoroscopy
Immediate post-operative	Neurovascular injury	Loss of reduction in post op radiograph	Compartment syndrome	
Late post-operative	Duration of hospital stay	Wound Infection	Pintract infection	Tendon rupture
Follow Up	Duration of follow up	Functional outcome	Range of movement	Quick DASH score

DASH: Disability of arm shoulder and hand.

Table 2: Master observation chart.

Characteristics	Group I (n=21)	Group II (n=14)	P value
Demographics			
Age (years)	34±17	60±13	NA
Sex (M/F)	16-May	04-Oct	NA
Right hand/left hand	17-Apr	11-Mar	NA
Fracture classification (AO)			
A (A1,A2,A3)	5 (0, 1,4)	5 (1,1,3)	NA
B (B1,B2,B3)	7 (2,2,3)	2 (2,0,0)	NA
C (C1,C2,C3)	9 (6,1,2)	7 (4,2,1)	NA
Mechanism of energy			NA
Low energy	6	11	NA
High energy	17	3	NA
Ulnar styloid	10	4	NA
Median nerve compression	6	3	NA
Surgical outcomes			
Operation time (min)	68.5±15	42±8	0
Hospital stay (days)	8±3	6±2	0.005
Follow-up (months)	9±2	8.5±2	0.8
Quick DASH (6th month)	12.9±4.3	18.9±8.5	0.001
ROM (degrees)			
Flexion	54±10.6	48±10	0.12
Extension	60±12	62±14	0.7
Supination/pronation	65±7	55±9	0

Table 3: Pain of visual analogue scale (10 point score) mean value.

	Group I	Group II
Immediate Post-Op	3.8± 2.1	3. 4±2.0
6 weeks	2.4±1.6	1.9±1.8
3months	1.9±1.0	1.8±1.2
6 months	1.6±1.0	1.6±0.8
1 year	1.5±0.8	1.6±1.6

In group II, patients' age ranged from 35 to 71 years (average, 60years). Sex (M/F) ratio was 4:10.Mechanism of injury included low energy trauma (accidental fall over outstretched hands) in 8 patients and high energy trauma in 6 patients. AO fracture classification distributed as type A (2 patients), type B (5 patients) and type C (7 patients) fractures. Right and left (R/L) wrist involvement ratio was 11:3. There was associated ulnar styloid avulsion fracture in 8 patients and median nerve compression in 3 patients.

Outcome evaluation

In group I, the mean duration of operation was 68.5 minutes (range, 53 to 130 minutes). The mean duration of hospital stay was 8 days (range, 5 to 20 days). The mean duration of follow up was 9 months (range, 6 to 12 months). Wound infection was seen in 2 cases; both patients were diabetic and elderly average age of 62 years. There were no implant mal-position or failure, and tendon rupture. At 6th post-operative month, the average quick DASH score (QD) was 12.9 (range, 6.8 to 18.2). At final follow up visits, the average ROM of wrist joint included, flexion 50 degrees (range, 30 to 70 degrees), extension 60 degrees (range, 45 to 80 degrees), and pronation-supination 65 degrees (range, 60 to 90 degrees) (Table 2).

In group II, the mean duration of operation was 40 minutes (range, 30 to 60 minutes). The mean duration of hospital stay was 6 days (range, 5 to 9 days). The mean duration of follow up was 7 months (range, 6 to 12 months). There pins tract infection in 1 case. At 6th post-operative month, the average quick DASH score (QD) was 18.9 (range, 9.1 to 29.5). At final follow up visits, the average ROM of wrist joint included, flexion 45 degrees (range, 30 to 70 degrees), extension 62 degrees (range, 35 to 75 degrees), and pronation-supination 55 degrees (range, 40 to 75 degrees) (Table 2).

There was significant difference ($p<0.05$) regarding operation time, hospital stay, quick DASH scores and supination-pronation (ROM) function whereas no difference ($p>0.05$) was seen regarding follow-up time and flexion and extension (ROM) functions (Table 2).

The amount of pain perceived by the patient was scored on a 10 point scale using visual analogue scale. Follow up at 3 month, 6 month and 1 year did not reveal any significant difference in amount of pain perceived (Table 3). However group with Ex-fix had reduced early post-operative pain which can contribute a great deal towards post-operative rehabilitation especially in the elderly

DISCUSSION

The treatment goals when treating distal radius fractures are to restore the articular congruity, achieve radial alignment and height, provide mobility for maintenance of finger-wrist, and ensuring stability of the fracture to protect alignment- joint surface congruency until recovery. Using the same mode of treatment in different fractures types of the distal radius may not be possible as the anatomical and mechanical forces are different.[13,14]

External fixation is used to maintain axial length while reduction is attained by manipulation of fracture fragments with supplemental Kirschner wires and ligamentotaxis. Traction alone in external fixation cannot correct palmar angulation as ligamentotaxis primarily functions through strong palmar links.[15] Open reduction and internal fixation has the advantage of directly manipulating the fragments and reduce them. Several studies have shown that volar locking plate has been a good option for treating unstable distal radius fractures with minimum complications.

The advantages of external fixation are the relative ease of application, minimal surgical exposure, and reduced surgical trauma. Similarly, the advantages of IF include stable rigid fixation, and the possibility of immediate postoperative motion. Fixed-angle plate designs minimize screw loosening in the distal fragments and thus reduce the risk of secondary displacement. Most fractures can be managed through a single volar access despite the presence of dorsal fragments, resulting in acceptable outcomes and good implant stability.

Cui et al. and Wei et al., in their respective meta-analyses comparing IF versus EF, have concluded that there is only some evidence available to support IF over EF which could be mainly due to early wrist mobilization and weight bearing in cases managed with volar plates but the complications in form of wrist stiffness and pain specially in elderly population remained questionable.[12,13] Similarly, Grewal et al and Wilcke et al recommended IF over EF in unstable fractures through their RCT and comparative study, respectively.[16-18]

Xie et al., in his meta-analysis comparing IF versus EF, concluded that the IF yields better subjective functional outcomes in form of better wrist grip and forearm supination-pronation and provides quick recovery than EF.[14] However, the doubts still remain and EF is equally popular among modern day surgeons, especially in elderly population where the increased risks associated with open surgery along with comparable results in close methods makes it the procedure of choice.

In this study, 21 patients who received IF were compared with 14 patients who received EF. Our study clearly suggests that, despite increasing popularity of IF with new generation fixed angle volar plates, the usage of EF devices have not been reduced significantly. The comparable good outcomes in 23- B1,2,3 and 23C 1 fractures managed with external fixation with percutaneous k wire fixation under fluoroscopy suggest that combined good orthopedic skills, good set up, good

understanding of fracture biomechanics and ligamentotaxis can reduce need for open surgical interventions and complications like pin tract infection, tendon rupture even in the young. However for 23 C 2 & 3 in the young internal fixation with volar plates yielded far acceptable results and remains the treatment of choice for all 23-C 2,3 and most of type B fractures though the chances of operative complication remains higher.

Our results showed that, the patient treated with EF had greater functional disability (greater QD, $p<0.05$) than those treated with IF for type C1, 2,3 and type B 3 in the younger age group. The supination-pronation function was also less (lower ROM degrees, $p<0.05$) in patients treated with EF than those treated with IF. Flexion/extension ROM were similar ($p>0.05$) with upper limit of 70/70 degrees. However, EF done for type B 1,2,3 and type C 1, in elderly (>60 y) showed results comparable to those of internal fixation at same age group with far less surgical risks and required shorter operation time and shorter duration of hospital stay ($p<0.05$). The amount of pain perceived by the patient in either cases were comparable at year follow up as determined by Visual analogue score using a 10 point scoring system. However there was decreased incidence of pain in cases managed with external fixator in early post up period which could be additional benefit to the elderly.

CONCLUSION

Internal fixation of unstable distal radius fracture is certainly superior compared to Ext Fixation regarding post-operative functional recovery, especially in high demanding younger age group. However, the usage of EF could not be neglected altogether because of similar flexion/extension ROM, pain relief, and requirement of shorter operation time and hospital stay in Cases of AO 23 B1,2,3 and C1 in young and AO 23 B & C fractures among elderly patients with co-morbid conditions and relatively lower functional demands, EF would be the treatment of choice.

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