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Comparison of External Fixation and Internal Fixation of Unstable Distal Radius Fracture

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Abstract : *Management of patients with unstable DRFs is controversial. There is no definitive evidence to support one surgical fixation method over another. Currently, operative management of unstable DRFs mainly includes external fixation (EF) and internal fixation (IF). Few previous reports have concluded that IF is superior compared to EF. However, the results were still inconclusive. In this study, authors retrospectively reviewed the clinical data records of patients treated with EF and IF for unstable DRFs. A total of 55 patients were selected for the study and divided into two groups: group A (IF) and group B (EF) including 35 and 20 patients, respectively. 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. Therefore, IF is better compared to EF for unstable DRFs regarding post-operative functional recovery.*

Keywords: *radius; wrist fractures; operative treatment; fracture fixation; surgical outcomes*

I. Introduction

It is now widely accepted that the restoration of the anatomy of the distal radius is closely linked to restoration of function [1, 2]. Any treatment modalities should seek to restore articular congruity, radial alignment and length, motion and stability. Keeping this in mind, operative management is essential for unstable DRFs to achieve successful outcomes [2, 24]. However, management of patients with unstable DRFs is controversial. There is no definitive evidence to support one surgical fixation method over another.

Currently, operative management of unstable DRFs mainly includes external fixation (EF) and internal fixation (IF). For EF, there are two popularly used techniques: 1) closed reduction with or without pin augmentation and 2) open reduction with pin augmentation. Among these techniques, many authors [2-4] believed open reduction with pin augmentation could successfully achieve anatomical reduction. Some authors [4-6] have reported satisfactory outcomes following EF for unstable DRFs. However, some authors reported complications related to over distraction of articular injuries, including severe digital stiffness, reflex sympathetic dystrophy, and nerve dysfunction [7, 8].

For IF, there are also three available techniques: 1) dorsal plating; 2) volar plating; and 3) fragment specific fixation [9-15]. However, IF with dorsal plating and fragment specific fixation techniques are less frequently performed. Many authors [11-13] have reported excellent outcomes following IF with volar plating for unstable DRFs. However, some authors [14, 15] have reported association of complications, such as tendon rupture, hardware malposition, and loss of fixation. In addition, IF with volar plating requires longer duration of operation and high treatment costs.

Few meta-analysis [16-18] and randomized control trials (RCTs) [19-22] comparing IF and EF have been published in recent years. 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.

II. Patients And Methods

This study reports a retrospective review of clinical data records of patients admitted with the diagnosis of distal radius fracture our hospital. Patients were selected according to the pre-determined inclusion and exclusion criteria given in table 1 [Table 1]. This study was conducted between 1st February 2014 and 31st July 2015.

All included patients were divided into two groups: group A (IF: open reduction with volar plating) and group B (EF: open reduction with pin augmentation and distraction), and for each included patients, following data were recorded: [Table 2]

Obtained data from group A and group B were tabulated separately, and following endpoints were analyzed: operation time, hospital stay, a quick DASH scores and ROM. In this study, we used AO [23] 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.

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.

III. Results

3.1 Demographic Data

Primary data search resulted in identification of 158 admissions with diagnosis of DRFs. After care full assessment by two independent authors, through predetermined inclusion and exclusion criteria, 55 patients with 55 DRFs were included. Out of those 55 patients, group A included 35 patients and group B included 20 patients.

In group A, patients' age ranged from 13 to 70 years (average, 47.6 years). Sex (M/F) ratio was 13:22. Mechanism of injury included low energy trauma (i.e. fall from lower heights) in 15 patients and high energy trauma (i.e. RTA, sports injuries and fall from greater heights) in 20 patients. AO fracture classification distributed as type A (15 patients), type B (5 patients) and type C (15 patients) fractures. Right and left (R/L) wrist involvement ratio was 19:16. There was associated ulnar styloid avulsion fracture in 14 patients and median nerve compression in 6 patients.

In group B, patients' age ranged from 29 to 71 years (average, 58.1 years). Sex (M/F) ratio was 6:14. Mechanism of injury included low energy trauma (i.e. fall from lower heights) in 9 patients and high energy trauma (i.e. RTA, sports injuries and fall from greater heights) in 11 patients. AO fracture classification distributed as type A (5 patients), type B (5 patients) and type C (10 patients) fractures. Right and left (R/L) wrist involvement ratio was 14:6. There was associated ulnar styloid avulsion fracture in 8 patients and median nerve compression in 3 patients.

3.2 Outcome Evaluation

In group A, the mean duration of operation was 67.3 minutes (range, 53 to 135 minutes). The mean duration of hospital stay was 8.7 days (range, 5 to 20 days). The mean duration of follow up was 8.9 months (range, 6 to 12 months). There was no prevalence of complications such as, wound infection, implant mal-position or failure, and tendon rupture. At 6th post-operative month, the average quick DASH score (QD) was 11.9 (range, 6.8 to 18.2). At final follow up visits, the average ROM of wrist joint included, flexion 53.7 degrees (range, 30 to 70 degrees), extension 58.4 degrees (range, 45 to 80 degrees), and pronation-supination 70.7 degrees (range, 60 to 90 degrees).

In group B, the mean duration of operation was 43.5 minutes (range, 30 to 60 minutes). The mean duration of hospital stay was 6.5 days (range, 5 to 9 days). The mean duration of follow up was 8.8 months (range, 6 to 12 months). There was no prevalence of complications such as, wound infection, pin tract infection, and implant mal-position or failure. At 6th post-operative month, the average quick DASH score (QD) was 17.9 (range, 9.1 to 29.5). At final follow up visits, the average ROM of wrist joint included, flexion 48.8 degrees (range, 30 to 70 degrees), extension 62.3 degrees (range, 35 to 75 degrees), and pronation-supination 53.5 degrees (range, 40 to 75 degrees).

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 3]

IV. Discussion

Treatment options for distal radius fractures differ greatly throughout the world but mainly include internal (IF) and external (EF) fixation [24]. EF is versatile in managing both intra- and extra-articular fractures with acceptable functional results. Reasons for using external fixation include the continuity of reduction under fluoroscopic control, improved reduction by ligamentotaxis, and the ability to protect the reduction until healing occurs. 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. [25-29]

Cui et al. (in 2011) [16] and Wei et al. (in 2012) [17], in their respective meta-analyses comparing IF versus EF, have concluded that there is only some evidence available to support IF over EF. Similarly, Grewal et al. (in 2011) [19, 20] and Wilcke et al. (in 2011)[25] recommended IF over EF in unstable fractures through their RCT and comparative study, respectively. Recently, Xie et al (in 2013) [18], in his meta-analysis comparing IF versus EF, concluded that the IF yields better functional outcomes and forearm supination-pronation and provides quick recovery than EF. However, the doubts still remain and EF is equally popular among modern day surgeons. In addition, developments in new generations of implants and availability of high facility surgical care centers with innovative orthopedic experts surgical trends keeps changing, in this scenario, a comparative study of outcomes of IF and EF will always be helpful to stay vigilant to provide better treatment to the patients.

In this study, 35 patients who received IF were compared with 20 patients who received EF. This clearly suggests that, despite increasing popularity of IF with fourth generation fixed angle volar plates, the usage of EF devices have not been reduced significantly. Due to the development of high facility surgical care centers and better treatment protocols combined with highly trained orthopedic surgeons, the prevalence of complications such as wound infections, pintract infections, implant failure and tendon rupture have reduced significantly. So, at present, only the functional outcomes remain the major tool to compare the outcomes of these two fixation methods.

Our results showed that, the patient treated with EF had greater functional disability (greater QD, $P<0.05$) than those treated with IF. The supination-pronation function was also weak (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 requires shorter operation time and shorter duration of hospital stay ($P <0.05$).

V. Tables

5.1 Table 1 Inclusion and Exclusion Criteria

Demographics	**Pre-operative**	**Intra-operative**	**Post-operative**	**Follow-up**
Age	Fracture classification	Treatment	Duration of hospital stay	Duration of follow-up
Sex	Associated injuries	method	Complications	Functional outcome
Mechanism of	Ulnar styloid fracture	Operation time	Wound infection	ROM
injury	Median nerve compression		Compartment syndrome	Quick DASH
Site of injury			Implant failure	
			Pin tract infection (for EF)	
			Tendon rupture	
			Others	

ROM: Range of motion; DASH: Disability of arm shoulder and hand; VAS: visual analogue scale

5.2 Table 2 Data extraction

Inclusion criteria
Patients treated with internal fixation (volar plates) and external fixation (OREF with pin augmentation)
Patients operated within the week after injury
Exclusion criteria
Patients treated conservatively
Patients treated with dorsal plates or fragment specific fixation
Patients treated with closed reduction and external fixation with/without pin augmentation
Patients treated with “pin and plaster technique”
Patients treated with combined volar plates and external fixation
Patients presented with open distal radius fractures or exctensive soft tissue trauma
Patients presented with multiple fractures (except distal ulnar fracture)
Patients adimitted for implant removal
Patients presented with special scinario: eg. Wound infection, malunion, and non-union

5.3 Table 3 Outcome evaluations

Characteristics	Group A (n=35)	Group B (n=20)	P value*
Demographics			
Age (years)	48±17	58±13	N/A
Sex (M/F)	13/22	6/14	N/A
Right hand/left hand	19/16	14/6	N/A
Fracture classification (AO)			
A (A1,A2,A3)	15(0, 3,12)	5(0,1,4)	N/A
B (B1,B2,B3)	5(2,2,1)	5 (2,0,3)	
C (C1,C2,C3)	15(6,5,4)	10(4,4,2)	
Mechanism of energy			
Low energy	15	9	N/A
High engery	20	11	
Ulnar styloid	14	8	N/A
Median nerve compression	6	3	N/A
Surgical outcomes			
Operation time (min)	67.3±17.2	44±8.1	0.000
Hospital stay (days)	8.7±3.2	6.5±1.7	0.005
Follow-up (months)	8.9±2.6	8.8±2.64	0.81
Quich DASH (6th month)	11.9±4.4	17.9±8.6	0.001
ROM (degrees)			
Flexion	53.7±10.6	48.8±10.4	0.13
Extension	58.4±12.5	62.3±13.2	0.28
Supination/pronation	70.7±7.9	53.5±9.2	0.000

*student t-test, level of significance 0.05

VI. Conclusion

IF certainly is superior compared to EF regarding post-operative functional recovery. However, the usage of EF could not be neglected because of similar flexion/extension ROM, and requirement of shorter operation time and hospital stay. Specially, among elderly patients with co-morbid conditions and relatively lower functional demands, EF would be the treatment of choice.

References

[1]. Jupiter JB, Fernandez DL, Toh CL, Fellmann T, Ring D. The operative management of volar articular fractures of the distal end of the radius. J Bone Joint Surg Am 1996; 78: 1817–27.

[2]. R. M. Szabo. Fractures of the distal radius. Chapman's orthopedic surgery; Lippincott williams and Wilkins; 3rd edition; p1414-1435

[3]. Fernandez DL. Fractures of the distal radius: Operative treatment. Instr Course Lect. 1993;42: 73–88.

[4]. Kaempffe FA, Wheeler DR, Peimer CA, et al: Severe fractures of the distal radius: effect of amount and duration of external fixator distraction on outcome, J Hand Surg [Am]. 1993; 18:33-41.

[5]. McQueen MM, Michie M, Court-Brown CM: Hand and wrist function after external fixation of unstable distal radial fractures, Clin Orthop Relat Res. 1992; 285:200-204.

[6]. Jakim I, Pieterse HS, Sweet MB: External fixation for intra-articular fractures of the distal radius, J Bone Joint Surg [Br]. 1991; 73:302-306.

[7]. Weber SC, Szabo RM: Severely comminuted distal radial fracture as an unsolved problem: complications associated with external fixation and pins and plaster techniques, J Hand Surg [Am]. 1986; 11:157-165

[8]. Vidal J, Adrey J, Connes H, et al: A biomechanical study and clinical application of the use of Hoffman's external fixator. In Brooker AF, Edwards CC (eds): External Fixation: Current State of the Art, Baltimore, Williams & Wilkins. 1979:327-343.

[9]. Cherubino P, Bini A, Marcolli D. Management of distal radius fractures: treatment protocol and functional results. Injury 2010; 41: 1120-6.

[10]. Schnall SB, Kim BJ, Abramo A, Kopylov P. Fixation of distal radius fractures using a fragment-specific system. Clin Orthop. 2007; 445:51–57

[11]. Axelrod TS, McMurtry RY: Open reduction and internal fixation of comminuted, intraarticular fractures of the distal radius, J Hand Surg [Am]. 1990; 15:1-11.

[12]. Rikli DA, Regazzoni P: Fractures of the distal end of the radius treated by internal fixation and early function. A preliminary report of 20 cases, J Bone Joint Surg Br. 1996; 78:588-592.

[13]. Drobetz H, Kutscha-Lissberg E. Osteosynthesis of distal radial fractures with a volar locking screw plate system. Int Orthop . 2003; 27:1–6

[14]. Orbay JL, Fernandez DL: Volar fixation for dorsally displaced fractures of the distal radius: a preliminary report, J Hand Surg [Am]. 2001; 27:205-215.

[15]. Nana AD, Joshi A, Lichtman DM. Plating of the distal radius. J Am Acad Orthop Surg. 2005; 13:159–171

[16]. Cui Z, Pan J, Yu B, Zhang K, Xiong X. Internal versus external fixation for unstable distal radius fractures: an up-to-date meta-analysis. Int Orthop 2011; 35: 1333-41.

[17]. Wei DH, Poolman RW, Bhandari M, Wolfe VM, Rosenwasser MP. External fixation versus internal fixation for unstable distal radius fractures: a systematic review and meta-analysis of comparative clinical trials. J Orthop Trauma. 2012; 26:386–9

[18]. Xuetao Xie, Xiaoxing Xie, Hui Qin, Longxiang Shen, Changqing Zhang. Comparison of internal and external fixation of distal radius fractures: A meta-analysis of randomized controlled trials Acta Orthop. 2013; 84: 286–291

[19]. Grewal R, Macdermid J C, King G J, Faber K J. Open reduction internal fixation versus percutaneous pinning with external fixation of distal radius fractures: a prospective, randomized clinical trial. J Hand Surg Am 2011; 36 : 1899-906.

[20]. Grewal R, Perey B, Wilmink M, Stothers K. A randomized prospective study on the treatment of intra-articular distal radius fractures: open reduction and internal fixation with dorsal plating versus mini open reduction, percutaneous fixation, and external fixation. J Hand Surg Am 2005; 30 (4): 764-72
[21]. Rozental TD, Blazar PE, Franko OI, Chacko AT, Earp BE, Day CS. Functional outcomes for unstable distal radial fractures treated with open reduction and internal fixation or closed reduction and percutaneous fixation. A prospective randomized trial. J Bone Joint Surg Am. 2009; 91:1837–46.
[22]. Abramo A, Kopylov P, Geijer M, Tägil M. Open reduction and internal fixation compared to closed reduction and external fixation in distal radial fractures: a randomized study of 50 patients. Acta Orthop 2009; 80 (4): 478-85.
[23]. Mueller ME, Nazarian S, Koch P. Berlin: Springer-Verlag; 1987. AO classification of fractures.
[24]. Sanjay Meena, Pankaj Sharma, Abhishek Kumar Sambharia, Ashok Dawar. Fractures of Distal Radius: An Overview J Family Med Prim Care. 2014; 3: 325–332.
[25]. Wilcke MK, Abbaszadegan H, Adolphson PY. Wrist function recovers more rapidly after volar locked plating than after external fixation but the outcomes are similar after 1 year.Acta Orthop. 2011;82: 76–81.
[26]. Beharrie AW, Beredjiklian PK, Bozentka DJ. Functional outcomes after open reduction and internal fixation for treatment of displaced distal radius fractures in patients over 60 years of age. J Orthop Trauma. 2004;18:680–6.
[27]. Orbay JL, Touhami A. Current concepts in volar fixed angle fixation of unstable distal radius fractures. Clin Orthop Relat Res. 2006; 445:58–67
[28]. Arora R, Lutz M, Hennerbichler A, Krappinger D, Espen D, Gabl M (2007) Complications following internal fixation of unstable distal radius fracture with a palmar locking-plate. J Orthop Trauma 21:316–322
[29]. Slutsky DJ. External fixation of distal radius fractures. J Hand Surg Am 2007; 32:1624–1637