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Sanjeev Kumar Singhal
Senior Consultant, Maharaja Agrasen Hospital, Punjabi Bagh, Delhi, India

Atul Garg
Consultant, Maharaja Agrasen Hospital, Punjabi Bagh, Delhi, India

Yogesh Kumar
Resident Doctor, Maharaja Agrasen Hospital, Punjabi Bagh, Delhi, India

Correspondence
Sanjeev Kumar Singhal
Senior Consultant, Maharaja Agrasen Hospital, Punjabi Bagh, Delhi, India

Comparison of volar plate with K-wire fixation of distal radius fractures: A prospective study

Sanjeev Kumar Singhal, Atul Garg and Yogesh Kumar

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Abstract
Introduction: The optimal management of distal radius fractures remains controversial. The aim of this study was to compare the functional outcomes of patients who underwent k-wire fixation or volar plating for fractures of the distal radius.
Methods: This prospective study was conducted at a tertiary care private hospital. We recruited sixty patients of fracture distal end radius treated with either volar plate or K-wires fixation between July 2014 to June 2015 and followed for minimum six months.
Results: The study consists of sixty patients of fracture distal end radius divided into two groups. Thirty patients (Group A) treated with closed reduction and percutaneous pinning and other 30 patients (Group B) with open reduction and internal fixation (ORIF) with buttress plating. In our study 26 patients (86.6%) in Group A and 27 patients (90%) in Group B had excellent or good score according to the Gartland and Werly score with Sarmiento *et al* modification criteria.
Conclusions: No method of fixation, external or internal, can be said superior to the other. The results of open reduction and internal fixation with volar plating can be better than K- wire fixation in initial months, but in the long run, both the methods can have excellent score, provided the fixation is good and properly indicated.

Keywords: Distal radius, volar, plating, K-wire, fixation

Introduction
Fractures of the distal radius are one of the most common injuries encountered in orthopaedic practise. Two main mechanisms of injury are high-energy trauma, usually related to road accidents or sport injuries, and low-energy trauma such as falls from standing in the elderly [1, 2]. For a long time plaster casts remained the mainstay of treating fractures of distal radius. But due to collapse of the fracture fragments radial shortening, angulation and articular incongruity may result in permanent deformity. This loss of reduction causes an unacceptable deformity and relative ulnar lengthening leading to pain over the medial side of the wrist. Redisplacement after a closed manipulation indicates instability at the fracture site and re-manipulation rarely produces a better radiographic outcome [3] and some suggest a dorsal comminution at the metaphysic is the cause [4]. The management of distal radius fractures has changed during the past two decades, and open reduction and internal fixation has become more popular in an effort to improve the functional and radiographic results and avoid the complications related to non-operative treatment [5, 6]. Plate fixation holds its merit due to its stability, period of immobilization is short, and early return to previous active life. A locking plate fixation has gained popularity in recent years in management of distal radius fractures. Anatomical restoration of articular surface and fragments alignment promote functional return and avoids early osteoarthritic changes [7-10]. There are drawbacks of open reduction like skin scaring, possible injury to tendons, need for a second procedure to remove the plate, a higher cost and requirement of higher technical skills. On the other hand, percutaneous pin or Kirschner wire fixation has the advantage of being cheaper, easier to perform and less invasive [11, 12]. The aim of this study was to compare clinical and functional outcomes of the fracture distal radius in those treated with volar locking plate to those undergoing manipulation and Kirschner wire fixation.

Material and methods

This prospective study was hospital based and was conducted at a tertiary care private hospital. Patients were selected from those who attended the emergency and outpatient department. Written informed consent was obtained from all the patients or their family members for participation in the study. For this study we recruited sixty patients of fracture distal end radius who presented to our hospital between July 2014 to June 2015 and followed for minimum six months. Patients were enrolled based on inclusion and exclusion criteria. Patients of close fracture distal end radius of either side or both sides with or without fracture ulnar styloid of age between 20 to 70 years, history of trauma within two weeks and who was willing for treatment and gave consent were included in the study. Patients were excluded if they presented more than two weeks after injury, if fracture extended more than 3 cm from the radiocarpal joint, compound fracture, who were unfit for surgery due to the associated comorbidities and those who denied consent for the procedure.

On admission to the institution, thorough history about mode of injury, associated injuries were documented for each patient. Clinical examination, neurovascular status and radiological assessment of the fractured limb was done. Patients were investigated further depending on the general condition and co-morbity of the patient and routine pre-operative protocol was followed as per our hospital guidelines. Preoperatively, all patients had radiographic examinations including antero-posterior and lateral view of wrist with forearm of the affected and normal limb. Fractures were classified according to AO classification for distal end radius fractures.

After Pre-anaesthetic evaluation patients were taken up for either closed reduction and percutaneous pinning or open reduction and internal fixation with volar plate. All patients were divided in two groups, patients operated by percutaneous pinning were classified as Group A and those operated by volar plating were classified as Group B. Similar plaster splints, antibiotic (cephalosporins) and analgesic regimens were used in both groups. Stitches were removed in Group B after 14 days and a gentle physiotherapy plan was instituted. Casts were removed at 4-6 weeks in the other group and wires were extracted after 5-6 weeks. A similar rehabilitation program consisting of assisted and active range of motion exercises was done in both the groups for three months or more.

Patients were followed at 2 weeks of surgery, at one month and then at monthly interval till minimum 6 months. During follow up clinical and functional status of patients assessed by using Gartland and Werley score with Sarmiento *et al* modification [13]. Assessment and analysis of any complication observed.

Results

The study consists of sixty patients of fracture distal end radius divided into two groups. Thirty patients (Group A) treated with closed reduction and percutaneous pinning and other 30 patients (Group B) with open reduction and internal fixation with volar plating.

Most of the patients in Group A were of older age while Group B consists of mostly younger age patients. Majority of the patients in our study were males in both the groups. Right side more commonly involved than left side (Table 1).

Table 1: Demographic profile of patients

	Groups			
	A		**B**	
Age Groups	Frequency	%	Frequency	%
20-30 yrs	4	13%	6	20%
31-40 yrs	5	17%	9	30%
41-50 yrs	6	20%	10	33%
51-60 yrs	5	17%	3	10%
61-70 yrs	10	33%	2	7%
Gender				
Female	18	60%	22	73%
Male	12	40%	8	27%
Laterality				
Right	17	57%	18	60%
Left	13	43%	12	40%

Out of sixty patients, 23 were due to fall on stretched hand, 20 due to road traffic accident and rest 17 got injured with other modes.

Patients were classified according to AO classification for fracture distal radius. Most of the patients in Group A fell in A2 or A3 while in Group B majority were B3 type (Table 2).

Table 2: Distribution of patients according to AO classification

Group	**A1**	**A2**	**A3**	**B1**	**B2**	**B3**	**C1**	**C2**	**C3**
A	0	7	9	4	3	0	5	2	0
B	0	3	4	2	0	14	4	3	0

Clinical and functional status of patients assessed by using Gartland and Werley score with Sarmiento *et al* modification (Table 3). 37 patients were having intra articular fracture and 23 were extra articular.

Table 3: Results as evaluated by Gartland and Werley score with Sarmiento *et al* modification

	A	**B**
Excellent	9 (30%)	12 (40%)
Good	17 (56%)	15 (50%)
Fair	3 (10%)	2 (6%)
Poor	1 (3%)	1 (3%)

Discussion

Following a distal radial fracture, the attainment and maintenance of anatomical reduction of the articular surface is crucial to the preservation of wrist function. K-wire fixation is relatively cheap, minimally invasive, takes less operative time and requires less skill compared to volar plating techniques. The potential disadvantages lie in the fact that the hardware is not rigid and in patients with poor bone stock the fracture may be liable to collapse into an unacceptable position with time.

Another disadvantage is that patients will usually require 4-6 weeks of cast immobilization. In contrast volar plating is expensive, invasive, consumes more operating theatre time and requires more operative skill. It does however create a rigid construct and patients are usually allowed to mobilize earlier, potentially leading to less post-operative stiffness [14].

Over the last decade, there has been a shift in the surgical approach for the treatment of distal radial fractures in favour of open reduction and internal fixation. Koval *et al*. recently documented the increasing popularity of open reduction and internal fixation, especially since the introduction of volar locking plates [15].

Whilst a prospective randomized study shows that there are short term advantages to using volar plates compared to K-wires there is no evidence to suggest that these advantages are maintained in the medium and long term. The study done at our institute was a prospective design comprising of 60 patients with average age of 48.8 years in Group A and 40.5 years in Group B. There was male predominance which constituted 66.6% and rest 33.3% were female, which can be explained by the fact that male are more prone to trauma as compare to female. 58% of our patients had fracture on the right side and 42% on left side. Road traffic accident and fall on out stretched hand were the most common modes of injury.

In 4 patients of Group A reduction of fracture was inadequate, of which 3 patients (2 AO type 23C1 and 1 of 23C2) had residual dorsal tilt. In these three patients results were fair. While in 1 patient (Type 23C2) had a loss of three parameters (radial length, radial inclination and dorsal tilt) which affected the anatomical and functional results. This patient had poor result. Three patients had pin tract infection which healed subsequently following removal of K wire and oral antimicrobial therapy.

In Group B three patients had superficial infection which got subsided by dressing. One patient in this group had poor result which can be attributed to old age female with poor compliance and lack of physiotherapy.

In our study 26 patients (86.6%) in Group A and 27 patients (90%) in Group B had excellent or good score according to the Gartland and Werly score with Sarmiento *et al* modification criteria. This explain no consistent benefit of one treatment over the other. This result was also obtained in randomized controlled trial studies done by Grewal *et al*, Kreder *et al* and Leung *et al*. [16-18]

Several limitations in this study must be acknowledged. Sample size and duration of the study was very small. Different types of distal radius fracture included in study, which limit the power of the study to detect a clinically significant difference.

Conclusion

No method of fixation, external or internal, can be said superior to the other. Each method has fracture specific indication. The results of volar plating can be better than K-wire fixation in initial months, but in the long run both the methods can have excellent score, provided the fixation is good and properly indicated. New era of locking plates has extended the indications of open reduction and internal fixation in comminuted intraarticular fractures. Post-operative radiological alignment and mobilization are important considerations for better functional results.

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