

Original Research Article

Management of distal unstable radius fractures with locking distal radius plates: a retrospective study

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ABSTRACT

Background: Distal radius fractures that are unstable are challenging to treat. The locking distal radius plate screws is a superior alternative to the other forms of treatment (external fixator and K pin). The purpose of this study was to provide the radiographic and functional clinical outcomes of patients who had locking distal radius plate screws treatment. This study's objective was to clinically assess the results of using a locking distal radius plate system to treat radius fractures.

Methods: 31 patients with radius fractures are included in this retrospective clinical trial. They are all treated with a locking distal radius system made by Kaulmed Private Limited in Sonipat, Haryana, India. The patients were treated with variable angle locking distal radius plates that includes 2.4 mm KL-8 variable angle two column volar distal radius plates and 2.4 mm KL-8 variable angle volar rim distal radius plates. There were 31 patients consisting of 24 male and 07 female, with an average age of 44 years. The fractures were categorized based on AO classification and pre-operative fitness was assessed using American society of anaesthesiologist (ASA grade). The patients were assessed clinically, radiologically and functionally using visual analogue scale (VAS), post-operative radiographs and measuring grip strength and weight bearing respectively.

Results: Surgery was performed on 31 patients with at-least three post-operative follow-up visits in 180 days. No patient in any group complained after the final follow up about any major complications or hardware problems, and every patient's bone union was achieved successfully. Radiological outcomes also showed proper union in 6-7 weeks.

Conclusions: Distal radius volar locking plates provide effective results in correcting distal radius anatomy.

Keywords: Locking plate, Unstable fracture, Distal radius fracture, Open reduction, VAS score, Radiographs

INTRODUCTION

Fractures of the distal radius often occur primarily due to falls, vehicles and sports injury. The major goal of treatment is to restore anatomical functioning and integrity. In most cases, it is not possible to use closed techniques to restore the wrist and distal radius joints' integrity and preserve radial length in unstable intra-articular fractures. These situations necessitate open surgical techniques. There are several surgical techniques and fixation options.¹ The indications for surgical approach have been expanded as a result of recent research that has improved our understanding of the anatomy of the

wrist and how it functions, as well as patient expectations that are rising. Additionally, new prospects have been made possible by improvements in fixation materials.²

Distal radius fractures, which were categorised as 2R3B and 2R3C by AO criteria, required surgical treatment because of their intra-articular and/or displaced fracture. One of the typical treatments for these kinds of fractures today is open surgical plate fixation.^{3,4} Traditional support plates have been replaced with locking plates that includes fixed angle construct and variable angle construct. These locking plates provides bio-mechanical endurance against forces applied to the fracture surfaces.⁵ Locking plates are

favoured in osteoporotic and multi-fragmented fractures due to their bio-mechanical endurance. However, there is disagreement on whether to place these plates on the volar or dorsal side.⁶⁻⁸ Therefore, the adoption of a locking distal radius plate and screw technique has become more popular. In order to examine the clinical results and side effects of treatment distal radius fractures with the locking distal radius system made by Kaulmed Private Limited, a retrospective clinical investigation was conducted.

The distal radius plates manufactured by Kaulmed Private Limited are available in 6 and 7 heads in three sizes that are Narrow, standard and wide. The plate design covers the different indication of distal radius. The following figure show the different distal radius volar plate and variable angle locking screws in variable angle construct. These plates are used in the treatment of patients included in this study.

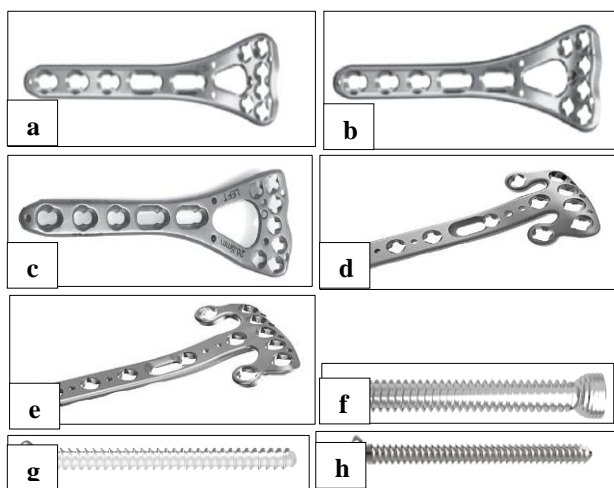


Figure 1: KL-8 distal radius plate system; 2.4 mm KL-8 variable angle two-column volar distal radius plate (a) narrow, 6 head holes (b) standard, 6 head holes, and (c) wide, 7 head holes. 2.4 mm KL-8 variable angle volar rim distal radius plate (d) 6 head holes and (e) 7 head holes; (f) 2.4 mm KL-8 variable angle screw, self-tapping, (star head); (g) 2.4 mm cortical screw, self-tapping, (star head), and (h) 2.7 mm cortical screw, self-tapping, (star head).

METHODS

Data were gathered from the patients who were treated with a locking distal radius system, at Jawaharlal Nehru Hospital in the Mauritius from September 2021 to July 2022. The data collected from the hospital includes age, gender, fracture type, ASA grade and operation duration and about 6 months were spent monitoring the included patients. The distal radius Volar locking plate fixation was used on 31 patients with unstable distal radius fractures (24 males, 7 females, mean age 44 years) (Table 1). The average surgical operation duration lasted for 80 minutes. The aetiology of distal radius fractures primarily includes fall from height and Vehicle trauma cases (Table 2). The

included patients in this study had fracture type of 2R3B2 (3 patients), 2R3B3 (3 patients), 2R3C1 (2 patients), 2R3C2 (19 patients) and 2R3C3 (4 patients) as per AO classification (Table 3). About 71% of the patients (22 patients) has fracture in their right hand. No patient has any other accompanying fracture. When the patients were presented in the emergency closed reduction and splinting were performed. Based on the radiographs, for unstable fractures indications, open surgery and plate fixation were planned and operation was performed to stabilize the fracture. Locking plates were preferred because of their bio-mechanical advantages and earlier start of movement. A short splint was applied after the surgery to prevent the motion and any load at the surgical site. It was taken off after two weeks and after the confirmation of bone union initiation, the exercises started to increase the wrist ROM and weight bearing.

Table 1: Demographic data.

Demographics	Percentage (%)
Sample size	31 (100)
Mean age (years)	44
Range (years)	Youngest: 19
	Oldest: 64
Male	24 (74.2)
Female	7 (27.8)

Table 2: Aetiology.

Fracture cause	Percentage (%)
Motor vehicle accidents	13 (41.9)
Fall from height	15 (48.3)
Other (e.g., sports)	3 (9.8)

Table 3: AO fracture classification.

AO fracture type	No. of patient
2R3B2	3
2R3B3	3
2R3C1	2
2R3C2	19
2R3C3	4

In the next follow up visits, bone union was deemed to have taken place if there was no pain and discomfort in the fractured location. Patients were advised to come for post-operative visit at suitable interval. At each post-operative, distal radius AP and lateral radiograph (X-rays) were taken to assess the bone union and to measure the ulnar variance, radial height, and radial inclination angle. The clinical outcome was assessed using VAS scale (Figure 2).

The American society of anesthesiologists (ASA) classified the patient's clinical state into two groups: 11 (9 M and 2 F) were classified under grade 2, which denotes patients with moderate systemic illness, and 20 (15 M and 5 F) were classified under grade 1, which indicates a

normal healthy patient. Patients classified as grade 3 by ASA were not included in the study.

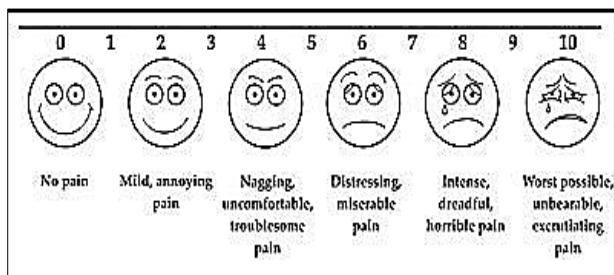


Figure 2: VAS scale.

The procedure was carried out utilising a locking distal radius system plates made of titanium alloy (Ti-6Al-4V) and stainless steel (316LRM) which were manufactured by Kaulmed Private Limited in Sonipat, Haryana, India. The same surgeon who performed the operation also analysed all of the radiological readings. At last visit, there were no problems with any patient.

Inclusion criteria

Male or female participants who were at least 18 years old and had recently suffered a distal radius fracture with an injury time of between 12 and 72 hours were included in the research.

Exclusion criteria

Patient age greater than 65, mortality before to surgery, and non-surgical therapy were exclusion criteria. Subjects who had problems with alcohol abuse, those who were detained or were in the process of being detained, those who had an infection at the site of the operation, patients who had any active local infections, those who had an allergy to the metal used in the nailing system, and patients who had problems with neuromuscular diseases were also excluded from this study.

RESULTS

The average duration to heal the fracture was 7 weeks (6-8 weeks). Radiographs at each visit were evaluated to assess the progress of bone union and based on the last visit radiographs (X-ray) the distal radius measurement are as follows, the average negative ulnar variance was about -0.3mm in 18 patients, the average positive ulnar variance was about 0.4 mm in 8 patients and neutral ulnar variance was found in 5 patients. The radial inclination angle was equal to the uninjured distal radius in 10 patients where as it was on average its was 6° towards volar direction in the other patients. There was loss of approximately 1.2 mm radial height on the that went under surgery.

On the final visit of patients, the average ROM data of the wrist is as follows: average angle of flexion was 58°, average extension angle was 42°, average radial and ulnar deviation found out to be 17° and 18° respectively, average pronation was 88° and supination angle was 85°. There was no loss of forearm rotation is observed in the patients.

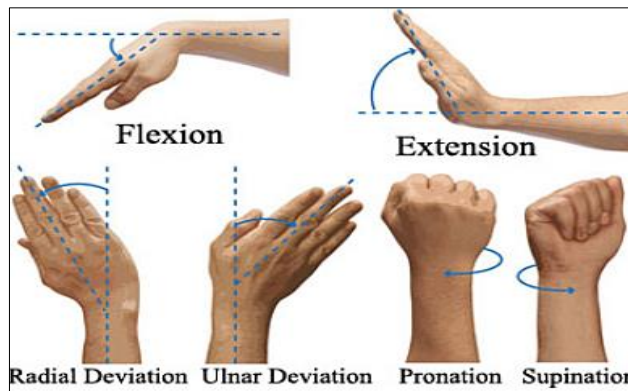


Figure 3: Wrist ROM.



Figure 4: Distal radius measurements.

Clinical assessment was done using a VAS score (the most extreme score, 10 focuses). The early activation of treated distal radius fractures was made possible by a variety of painkiller approaches. According to the visual analogue scale, the average VAS score decreases as the time elapsed, on average after one month the VAS score was 3.5 which reduced to 1.9 after three months and further decreased to 0.2 after six months later (Table 4). At the initial check-up, 4 patients complained of irritation and infection, but at the future check-ups, no patient complained of any health-related issues. At the final check-up, there were no complications to be found, and the bones had properly united in each case.

The patient satisfaction based on pain, weight bearing and aesthetics was also collected at their last visit (Table 5).

Table 4: Result of VAS score.

Visit time	Pain scale					
	No pain	Mild pain	Nagging	Distress	Intense	Worst possible
Pre-surgery	-	-	-	-	-	9.2
Post-surgery (after anaesthesia effect wear off)	-	-	-	6.5	-	-
30 days±15 days	-	-	3.5	-	-	-
90 days±30 days	-	1.9	-	-	-	-
180 days±30 days	0.2	-	-	-	-	-

Table 5: Patient satisfaction.

Evaluation parameter	Satisfied (%)	Un-satisfied (%)
Permanent pain reduction	30 (96.77)	1 (3.22)
Full weight bearing	16 (31.61)	15 (48.39)
Aesthetics	30 (96.77)	1 (3.22)

DISCUSSION

The distal radius fractures are widespread but complex fractures of distal radius are difficult to treat and practically impossible to re-establish the normal joint anatomy post-operatively. Although reduction using distal radius locking plates is the best treatment available for complex distal radius fractures.⁹⁻¹¹ Based on the radiological outcomes, anatomical restoration was obtained in this retrospective study for complex distal radius fractures. On the sixth month visit approximately 80% recovery in the wrist's ROM and around 60% in 70% weight bearing as compared to capacity before traumatic event.

Locking plates provides better results particularly in case of intra-articular complex fracture.^{1,3,6,10} Early joint movement can be made possible due to such treatment that offer fixation strength. The bio-mechanical advantage of such system is the placement of screw close to joint surface in the different directions.¹² In this study, volar plates are used for fracture restoration and patient returns to ADL with 95% recovery. Although, there is a direct correlation between functional and clinical outcome, it is seen functional results are satisfactory as compared to clinical in the elderly population. The more advance variable angle locking plate provides better result in such complex fracture due to the fact the screw can be rotated at the conical angle of 30° around the hole, which provide better strength and restoration. In this study the Locking plates for distal radius were manufactured by Kaulmed Pvt. Ltd., India were variable angle plates.

The limitation of the present study is the small sample size, retrospective design and no statistical significance considered data analysis. Only descriptive data with mean, range and frequency is shown. These limitations can be

avoided using different study design with large sample size.

CONCLUSION

Locking plates are effective in the restoration and protection of the distal radius anatomy. Joint movement and daily functions are regained by using locking plates in distal radius unstable fractures within a shorter period.

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Ethical approval: The study was approved by the institutional ethics committee

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