



Functional Outcomes of Fracture Distal Radius after Fixation with Two Different Plates: A Retrospective Comparative Study

Zahoor Illahi Soomro¹, Farukh Hussain², Khurram Shahzad Shahwani³, Hassan Amir Us Saqlain⁴, Abdul Rehman Khan⁵, Niaz Hussain Keerio⁶, Syed Shahid Noor⁷

¹Associate Professor Orthopaedic, Peoples University of Medical & Health Sciences Nawabshah, Pakistan; ²Senior Registrar Orthopaedic, Jinnah Hospital Karachi Pakistan; ³Consultant Orthopaedic Surgeon, Bolan Medical Complex Hospital Quetta Pakistan; ⁴Specialist Orthopaedic, Al Qassimi Hospital, Sharjah United Arab Emirates; ⁵Assistant Professor Orthopaedic, DIMC, Dow University of Health sciences Karachi Pakistan; ⁶Assistant Professor Orthopaedic, Muhammad Medical College and Hospital Mirpurkhas, Pakistan; ⁷Professor, Liaquat National Hospital and Medical College Karachi, Pakistan.

ABSTRACT

Introduction: In adults, many types of injuries take place, but distal radius fractures frequently occur with a 15 to 19% of ratio. There are many techniques to treat these fractures such as fixation and percutaneous Kirschner wire and ORIF with dorsal or volar plates.

Aim: To assess the functional outcomes following fixation of a marginal distal radius fracture with two commonly used volar locking plates

Methodology: The study was conducted which is retrospective in nature. Patients were divided into two groups each with one of the two designs of VLP. The initial results reported by patients were pain scores and range of movements. The final results were based on the satisfaction of patients while performing physical activities. A retrospective comparative study. This study was conducted at Peoples University of Medical & Health Sciences Nawabshah, Pakistan from February 2019 to March 2020.

Results: A total of 41 patients were included in the study. Twenty-two patients were in the Synthes LCP group and 19 in the Acumed Acu-Loc group. By observing the patients, it was concluded that Acumed Acu-Loc group patients gave better results.

Conclusions: Despite various surgical techniques, tendon rupture and complexities is still an issue unresolved. This study shows that the Acumed Acu-Loc system gives better results than Synthes LCP when placed accordingly with watershed line.

Key Words: Acumed Acu-Loc system, Than Synthes LCP, Marginal distal radius fracture, Surgical techniques, Injuries, Patients

INTRODUCTION

In adults, many types of injuries take place, but distal radius fractures frequently occur with a 15 to 19% of ratio.^{1,2} Due to age factors, elderly people are more prone to distal radius fractures. There are many techniques to treat these fractures such as fixation and percutaneous Kirschner wire and ORIF with dorsal or volar plates.³ As there are many techniques in the medical field to treat these fractures the patient should go for the specific one with the best optimal results.³ In recent years surgical techniques have gone through many advancements. VLP ie volar locking plate technique, which was introduced in 2001, this technique was frequently used to treat

distal radius fractures as it has many advantages such as movement after the operation, early movement of wrist and

Safe immobilization.⁴ As it is known that every surgical treatment both has pros and cons VLP also has some negative outcomes like carpal tunnel syndrome, malunion, tendon irritation, and plates malposition. So the complexity rate of VLP is 3 to 25%.⁵ Surgeons should not implant prominence because there have been many studies that describe how flexor tendon irritation is related and the prominence of the volar plate towards the watershed line.⁵ In recent years VLP has gone through many advancements to ensure fewer complexities and more optimal results.⁶ The occurrence of

Corresponding Author:

Niaz Hussain Keerio, Assistant Professor Orthopaedic, Muhammad Medical College and Hospital Mirpurkhas, Pakistan.
Email: niaz_h@hotmail.com

ISSN: 2231-2196 (Print)

ISSN: 0975-5241 (Online)

Received: 11.05.2021

Revised: 06.06.2021

Accepted: 21.08.2021

Published: 01.03.2022

reoperations has decreased in past years from 19.5% in 1999 to 10% in 2015.⁶ Fractures in which the fracture line is near to joint line, are not suitable for VLP. Fracture fragments that are proximal to the watershed line are not supported by standard VLP designs.⁶ Distal fragments can be displaced if there is a poor selection of plates.⁷ To achieve fixation plate should be positioned over the watershed line. There is not enough information about VLP designs that support marginal distal radius fractures.⁸ With the use of two VLP designs such as Synthes and Acumed Acu-Loc wrist plating, this study takes into account pre and post events of surgery in patients with marginal radius fractures.

METHODOLOGY

A study was carried out on patients who received two designs of VLP. The grafting criteria are the same for both designs that are standard VLP was not sufficient to secure the fragments and fracture being extended far off the watershed line. Patients who were going through the treatment of distal radius fracture fixation with one of the two study grafts were included in the study and patients with more than one skeletal fracture were excluded from the study.

The operation was carried out with advanced techniques such as 30 to 45mm over the volar of the wrist. Muscles (pronator quadratus) were cut to be exposed for fracture site and then repaired after plate insertion. Patients were asked to show movement across the fracture site just after the surgery. The wrist joint was also disabled for 12 days with the arm splint. After the removal of the arm splint, small wrist movements were made by the patient, and these movements were increased after 5 weeks of surgery.

The fracture site was examined through radiography by an orthopedic and re-examined by a surgeon. The fracture which is distally horizontal with fracture line within 9.5mm of joint line is marginal distal radius fracture. Fracture patterns of volar to dorsal Barton were not examined. Every computer detail such as CT before and after surgery and plan films was recorded and observed.

In initial outcomes, pain scores and movement range of broken wrist were told by patients as compared to the normal wrist after 1 year of surgery. Outcomes include patient satisfaction of movement range of the broken wrist and do it hurt during physical activity. After two years of surgery x-ray of the injured wrist was taken which included radial height, ulnar variance, and Soong grade. Further examinations were made to know about the complexities related to surgery.

Data was translated as to mean and SD. A statistically significant value known as p-value was taken. SPSS Version 22 was used for data analysis.

RESULTS

In our study, there were actual 55 patients with marginal distal radius fracture, 28 were cured with Synthes and among these 28, 6 patients were removed from studies due to other issues. Acumed Acu-Loc VLP took into account 25 patients out of the 6 patients were removed from the study. Total 41 patients were included and they carried out the whole process of treatment. Out of these 41 patients, 23 were male and 18 were females. There was not any open fracture. Age ranges of patients were 25 to 90 with a mean age of 50 years. Nineteen patients were treated with Acu-Loc VLP and twenty with Synthes. There were 25 patients complete articular and 13 patients were extra-articular. From fracture line to lunate fossa the distance was 7.33mm. There were also other injuries like ulnar styloid avulsion fractures which were present in 10 patients. The surgeon also checked the DRUJ stability, and he got to know that DRUJ pinning was needed in 3 patients. Further examinations showed that there are two patients with TFCC and three patients with die-punch fractures. From this study, it was noted that there is no such contrast in fractures based on based concomitant injuries.

Complexities like distal irritation made five patients undergo reoperation to remove graft. Out of these five, three were of Synthes and two patients of Acumed Acu-Loc group. There was no tendon rupture, malunion, or fracture site ailments were observed. Initial results have reported that among the two designs of VLP Acumed Acu-Loc has more advantages. Ten out of twenty patients of the Acumed Acu-Loc group were succeeded in the treatment within 20 months of treatment with 100% efficient results while there were only 3 of 21 patients in the Synthes LCP group. Holding power post-operation efficiency was 65% in Acumed Acu-Loc group patients and only 22% in Synthes LCP group. VAS pain scores, after the operation, were also better in the Acumed Acu-Loc group. Patients of Synthes LCP somehow showed improved outcomes like were more satisfied and comfortable in carrying out their physical activities than patients of the Acumed Acu-Loc group. In the Acumed Acu-Loc group, the performance activity rate was 7.57 vs 7.43 and the overall rate was 7.86 vs 7.62 in comparison to the Synthes LCP group.

Acumed Acu-Loc group patients also showed more MAYO wrist score than Synthes LCP group. There was not a single case of tendon rupture and other ailments related to the fracture site. After the operation within the 1.5 years, the 1.5 years trained in all 41 patients. Patients were categorized as Soong grade 2 due to distal radius fracture pattern. Between groups, there was no ulnar variance and volar angle inclination. Out of 22, 3 patients in Synthes LCP group had articular step off more than 3mm in comparison to Acumed Acu-Loc group with 2 of 19 patients had articular step off 4mm.

Table 1: Patient Demographics

	Overall (N=42)	Plate LCP (N = 21)	Plate VLP (N=21)	P-value
Age	50.2(22-90)	50.5(24-85)	50.9(22-90)	0.88
Male	18	10	7	0.52
Female	22	9	12	
AO fracture type				0.32
A	15	5	7	
B	0	0	0	
C	27	15	11	
Mean marginal distance (±)	8.3mm(±0.95)	8.7mm(±0.85)	8.2mm(±0.85)	0.34
Patient requests remove the implant	5	5	3	0.65

Table 2: Functional Outcome between Groups

	Overall (N=42)	Plate LCP(N=21)	Plate VLP(N=21)	P-value
Range option				0.015
0-23%	0	0	0	
24-49%	0	0	0	
50-75%	2	0	2	
71-99%	24	16	9	
100%	15	5	13	
Gripping power				0.013
0-23%	0	0	0	
24-49%	0	0	0	
50-75%	5	3	4	
71-99%	18	15	6	
100%	18	6	15	
Pain VAS score (± SD)	1.20(±1.32)	1.34(±1.47)	1.05(±1.22)	0.48
Subjective functional score				
Occupation	8.52(±3.44)	8.45(±1.30)	8.55(±1.090)	0.699
Social activity(± SD)	9.30(±0.82)	9.20(±0.88)	9.20(±0.89)	0.465
Overall (± SD)	9.9(±1.06)	8.87(±1.12)	8.85(±1.11)	0.887
MAYO score (± SD)	73.36(±25.66)	75.68(±8.98)	86.20(±12.5)	0.005

Table 3: Radiological outcome between groups

	Overall (N=42)	Plate LCP(N=21)	P-value	P-value
Radiological parameters				
Radial height (±SD)	9.50mm (±1.38)	9.42mm (±1.62)	9.55mm (±1.21)	0.77
Radial inclination Angle(±SD)	18.65(±3.69)	19.10(±4.03)	128.22(±3.35)	0.45
Ulnar Variance (± SD)	0.02mm (±1.98)	-0.02mm (±2.15)	0.05mm (±1.83)	0.94
Articular step-of (AP view)				0.80
< 1MM	33	15	17	
< 1-2MM	9	4	5	
>2MM	3	3	2	
Volar Tilt Angle(±SD)	5.22(±5.48)	4.77(±5.70)	5.68(±5.70)	0.60

DISCUSSION

Two designs of VLP were cross analyzed in patients with marginal distal radius fracture in which the fracture line was lying within 8mm of lunate fossa. Both designs are frequently used to treat fractures near the joint line. In 2006 watershed line idea was given by Orbay which was stated as a ridge that minimizes the area of volar radius. This definition was further elaborated as a “line pointing the margins and aspects of volar radius”.^{24,25} Watershed line is also used as a reference point for adjusting the positions of volar plates so that tendons rupture and irritation can be avoided.^{1,10,11,13,15,17}

The point where Tendon is near to bone and plate and the most pointed out area or volar surface is called watershed line, and this was stated by Soong et al.⁶ By adjusting the positions through the “Soong Grading” of plate authors have described in their studies the tendon complexities related to the watershed line. Soong Grade 1 or 2 orientation was observed by examining the fracture site after surgery and this was done by putting the VLP near to watershed line, this also was related to tendon complexities.^{6,12,15,17} It was reported by Mehrzad et al. That 8 of 58 patients with graft-associated complexities need further treatment.¹ For the limitation of complexities, Soong et al. suggested that during surgery graft prominence should be avoided at the watershed line and plate adjustments should be done according to fracture pattern and patient anatomy.^{4,15,16} Adjustments of the plate are difficult during surgery when VLP is placed to the watershed line. To avoid these problems edges of the plates are polished and contoured and a mark is placed on the FPL to decrease the pressure under the FPL tendon.^{4,6,14,16,18,19} The design of the grafts is accordingly made to allow sitting distally to the watershed line and to avoid tendon complexities.^{30,31} The volar plate is pre-adjusted to fit with the cortex of volar in Synthes LCP. Intraoperative shaping of plates is done by the low plate and screw profile.³⁰ Acumed Acu-Loc system is fully developed with pre-shaped plates and with a circular plate edge and low profile.^{30,31} So Acumed Acu-Loc system is designed accordingly with watershed then other volar plates.^{31,32}

FPL iatrogenic injuries have been reported after the use of Acumed Acu-Loc VLP.^{6,12,13,17} The main reason for this is that the plate is pointed towards the radial styloid that leads to tendons complexities.¹² To avoid the FPL iatrogenic injury the Medartis APTUS FPL has developed the plating system to decrease the FPL tendon and plate contact.⁴

In this study, there were no FPL tear complexities. Better holding power, good movement ranges, and Mayo wrist scores were reported by the Acumed Acu-Loc group.

From this data, it was observed that through better Acumed Acu-Loc VLP adjustments tendon complexities can be avoided. When examined it was observed that Acumed Acu-Loc fits better to volar cortex than Synthes LCP. By examining

the bone model, it was noted that if Acumed Acu-Loc was not placed in its design it would increase prominence. So, it is advised to place a locking plate on the watershed line. If Acumed Acu-Loc VLP is placed distally to the watershed line, tendon complexities will arise after surgery. So Acumed Acu-Loc should be placed correctly. In recent literature, it has been reported that there is an association between tendon complexities and graft adjustments.^{6,13,14,17,18} So, it is advised to design the graft accordingly to the watershed line to avoid complexities. So, it is reported in this study that the Acumed Acu-Loc system gives better results than Synthes LCP.

As the nature of the study was retrospective it has many limitations like ordinary surgical techniques and non-randomization of patients. Also, initial results were concluded from patients' reports due to this objectivity was limited. Patients that took part in this study were low in numbers, but a low cohort size also gives precise results. The examination time was between 20 months so the complications that took place after this period were not studied. It was reported by Asadollahi et al. that postponed tendon rupture can take place between 5 to 67 months after surgery.³⁵

CONCLUSION

Tendon complexities are still an issue despite many advancements in graft designs. It is advised to avoid adjusting the VLP distal the watershed line to neglect the volar prominence. More distal fixation is required by marginal fracture patterns. It is believed that Acumed Acu-Loc gives better results than Synthes LCP.

Permission

It was taken from the ethical review committee of the institute

Funding source

None

Conflict of interest

None

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