

# A STUDY OF SURGICAL MANAGEMENT OF DISTAL RADIUS FRACTURES

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## ABSTRACT

**Aim:** To study the functional outcome of operative management of fractures of distal end of radius in adults using various methods like closed reduction and percutaneous K-wire fixation, Open reduction and internal fixation with plate and screws and external fixation.

**Methodology:** The present, “STUDY OF SURGICAL MANAGEMENT OF DISTAL RADIUS FRACTURES IN ADULTS”, which is a prospective study, was carried out in the Department of Orthopedics, SVS Medical College & Hospital, during August’ 2018 to August’ 2019.

**Results:** The total number of cases of fractures of the distal end radius in this prospective study are 20, of which 17 (85%) were Male and 3 cases (15%) were females. The age group of the patients is between 20 to 80 years. The commonest age groups of the cases were in 3rd and 4th decade. The youngest patient is 21 years old and the oldest patient is 65 years old. Mean age is 38.8 yrs. There is a predominant right side involvement.

The mode of injury in most cases is road traffic accidents (55%) followed by fall on outstretched hand (45%). Commonest radiological types of fracture are Frykman type IV, III, II and VII. Intra articular fractures were more than extra articular fractures.

ORIF with plate and screws was done for 11 cases. 7 cases were fixed with ellis plate and 4 cases with LCP through volar approach. Volar Barton fractures were treated with Ellis plate. Closed reduction and K – wire fixation was done for 7 cases. External Fixation was done for 2 cases with Frykman VII and VIII type fractures. There were 2 complications (10%). 1 case landed in malunion and 1 case had superficial infection. Follow –up period was between 3 – 15 months. Results were Excellent in 35% patients, good in 45% patients, fair in 15% cases. 5% (1 case) had poor result.

**Conclusion:** Operative management of distal radial fractures, regardless of the type of fixation, produces excellent to good results with proper pre- operative evaluation, selection of the method based on fracture pattern, reducibility, stability and quality of bone, early fixation, proper wound and pin site care, early post-operative rehabilitation and patient education.

**Keywords:** K-wire fixation, Frykman type, Intra articular fracture, Volar Barton Fracture, Post-operative

## INTRODUCTION

Whenever a person falls, instinctly it is the hand that comes for protection, hence it is the bones of wrist joint and upper limb bones in general that are prone to fracture.

Fractures of the distal radius are the most common fractures of the upper extremity and account for 17% (one-sixth) of all fractures treated in the emergency room. Initially thought to be simple fractures, they are now recognized as complex injuries with a high percentage of long term complications. Fractures of the distal aspect of the radius continue to pose a therapeutic challenge. These fractures often are unstable, are difficult to reduce anatomically, and are associated with a high prevalence of complications of post-traumatic osteoarthritis after intraarticular fracture of the distal aspect of the radius.

The optimal management of distal radius fractures has changed dramatically over the previous two decades from almost universal use of cast immobilization to a variety of highly sophisticated operative interventions. Few prospective studies confirm the benefit of this increasingly aggressive operative approach, however. The results of closed reduction, percutaneous pin fixation, pins and plaster, and internal and external fixation have been variable and have been determined largely by the pattern of the fracture.

Surgeons are increasingly faced with the dilemma of when to consider operative management and when cast immobilization is the optimal treatment. Although some patients still seem to confirm Abraham Colles' famous remarks that, "the casted wrist will at some remote period again enjoy perfect freedom in all of its motions and be completely exempt from pain<sup>1</sup>", an increasing preponderance of published studies supports the need for operative intervention in a growing number of patients. In addition to apparent discrepancies regarding surgical interventions, there are other equally disparate studies regarding multiple facets of this fracture.

Many things are subject to trend and fashion, and the treatment of distal radial fractures is no exception. Pins and plasters gave way to external fixation, and now internal fixation has begun to supplant all other treatment modalities. Published clinical trials directly comparing treatment regimens of closed reduction, external fixation and percutaneous pinning with open reduction and internal fixation are lacking. The results of the currently published data are difficult to compare. Most studies are retrospective in nature and use various classifications and inconsistent outcome tools, especially in regard to comminuted fractures with joint incongruity.

The purpose of this study was to evaluate the functional outcome of surgical management of distal radial fractures in adults using various methods such as Closed Reduction and Kirschner wire Fixation, External Fixation and Open Reduction and Internal Fixation with plate and screws.

## OBJECTIVES

- To study the functional outcome of operative management of fractures of distal end of radius in adults using various methods like closed reduction and percutaneous K-wire fixation, Open reduction and internal fixation with plate and screws and external fixation.
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- To study the effectiveness and complications of operative management of distal end radius fractures.

## **PATIENTS AND METHODS**

The present, “**STUDY OF SURGICAL MANAGEMENT OF DISTAL RADIUS FRACTURES IN ADULTS**”, which is a prospective study, was carried out in the Department of Orthopedics, SVS Medical College & Hospital, under the guidance of Dr. K. ANJANEYULU, Professor of Orthopedics, during August’ 2018 to August’2019.

### **Inclusion criteria:**

- Fractures distal end radius either side or both, with or without ulnar styloid fracture
- Patients age group between 20 to 80years
- Grade 1 open fractures
- Both males and females
- All closed fractures of distal radius fractures in the above age group
- Patients medically fit for surgery
- Children and patients below the age group of 20years
- Grade 2&3 Open fractures
- Elderly patients with co morbid conditions
- Patients who are medically unfit for surgery
- Patients not willing for surgery

A total of twenty cases of fractures of distal end radius belonging to various groups were treated with internal & external fixation.

There were 17 (85%) males and 3(15%) females between the age group of 20- 80 years with mean of 38.8years. 12 (60%) patients had right side involvement (dominant wrist) and 8(40%) had left side involvement.

Of the 20 cases, injury occurred due to road traffic accident in 11(55%) patients and fall on the out stretched hand in 9 (45%) patients.

### **PRE-OPERATIVE EVALUATION:**

#### **Immediate Management:**

Following admission to the hospital, a careful history was elicited from the patients and / or attendants to reveal the mechanism of injury and severity of trauma. All patients were thoroughly examined. Their general condition associated systemic diseases and associated injuries were noted. All the findings were duly recorded in the patient proforma.

All patients presented with the involved elbow flexed and the wrist supported by the other hand. Careful inspection of the deformity, swelling and ecchymosis were done. Clinically tenderness, bony irregularity, crepitus and the relative position of radial and ulnar styloid process were elicited. Movements of the wrist and forearm were checked and found to be painful and limited. Distal vascularity was assessed by radial artery pulsations, capillary filling, pallor and paraesthesia over finger tips.

The involved forearm was immobilized in a below elbow POP slab and kept elevated. Pain and inflammation were managed using analgesics like diclofenac sodium 50mg twice daily.

### **Pre-operative planning:**

Routine examination of blood was done for hemoglobin percentage, total and differential WBC counts, fasting blood sugar, blood urea, serum creatinine, bleeding and clotting time, HIV and HbsAg. Blood pressure and ECG were recorded in all patients. Preparation of the part was done on the day of surgery. Tetanus toxoid injection and intravenous antibiotic were given to all patients pre-operatively. Physician fitness was obtained for all patients. Consent for surgery was taken and patients were operated after a pre-anaesthetic checkup.

### **RADIOGRAPHIC EXAMINATION:**

Standard radiographs in PA and lateral views were taken for confirmation of the diagnosis and also to know the type of fracture. Oblique views were also taken in a few patients who had complex comminuted fractures. The fracture fragments were analyzed and involvement of radiocarpal and distal radioulnar joints were assessed and classified according to the Frykman's classification.

### **SURGICAL PROCEDURES:**

The duration from the date of injury to date of operation ranged from 1 - 7 days.

### **Criteria for selection of cases:**

All the patients were pre-operatively assessed to classify the type of fracture based on "FRYKMAN Classification" of the distal end Radius and treated by various surgical methods. The choice of a particular procedure for each case depended on the fracture pattern, reducibility and stability and quality of bone.

Closed reduction and percutaneous pinning and cast application done in cases of extra articular distal radius fractures with anticipated late collapse of the fracture fragment. Closed reduction and external fixation was done for comminuted, unstable, impacted fractures. In cases which had a displaced radial styloid or fragments too small for other means of fixation, external fixation was augmented with Kirschner wires; inserted percutaneously.

Open reduction and internal fixation with buttress plate and screws or locking compression plate was done for volar displaced fractures. It was also indicated for cases which had >2mm residual articular step-off after conservative treatment or closed reduction. All Volar Bartons fractures were treated with open reduction and internal fixation with Ellis 'T' buttress plate.

### **Post – operative care and rehabilitation:**

Post-operative pain and inflammation were managed using anti- inflammatory analgesics, diclofenac sodium 50mg twice daily. All patients were given intravenous Cefotaxime 1gm twice daily for 1-3 days and followed by oral antibiotics like cefixime 200mg or ciprofloxacin 500mg b.d.for 3-5 days. Affected limb was kept elevated and patients were asked to perform active finger movements, elbow and shoulder movements from day one. Dressings were changed on the 2<sup>nd</sup> and 6<sup>th</sup> post- operative day.

After discharge all patients were reviewed bi-weekly for the first 6 weeks. Patients

were assessed subjectively for pain at the fracture site, clinically for tenderness, loosening of pins and any signs of infection. Pronation and supination of the forearm and active movements of elbow and shoulder were advised. Physiotherapy was advised, which included flexion – extension, adduction – abduction and pronation – supination exercises. The range of wrist movements and any deformity were assessed.

### **Radiographic Assesment:**

Check X-rays were taken at 6 weeks to assess consolidation or collapse at the fracture site and to note any displacement. The fracture was considered united when clinically there was no tenderness, subjective complaints, and radiologically when the fracture line was not visible.

Regular follow up was done at an interval of 6 weeks, 3 months, 6 months, and 12months. The follow-up ranged from 5months to 15months (average 9.58months).

<u>ANATOMICAL EVALUATION –</u> <u>SARMIENTO'S MODIFICATION OF LIND STORM CRITERIA</u>				
	<b>DEFORMITY</b>	<b>RESIDUAL DORSAL TILT</b>	<b>RADIAL SHORTENING</b>	<b>LOSS OF RADIAL INCLINATION</b>
<b>EXCELLENT</b>	No or insignificant	0 <sup>0</sup>	< 3 mm	< 5 <sup>0</sup>
<b>GOOD</b>	Slight	1 <sup>0</sup> to 10 <sup>0</sup>	3 to 6 mm	5 <sup>0</sup> to 9 <sup>0</sup>
<b>FAIR</b>	Moderate	11 to 14	7 to 11 mm	10 <sup>0</sup> to 14 <sup>0</sup>
<b>POOR</b>	Severe	Atleast 15 <sup>0</sup>	Atleast 12 mm	>14 <sup>0</sup>

The results were assessed at 6 months after the procedures using the demerit point system of Gartland and Werley based on objective and subjective criteria, residual deformity and complications.

Fig: 1-CASE – 1



Pre \_ OP X- ray

Post OP X-ray



6 months follow – up



6 months follow – up

**RESULTS****TABLE NO.1: AGE INCIDENCE**

In the present study distal radius fractures were common in 3<sup>rd</sup> to 5<sup>th</sup> decade, with 30% cases in 3<sup>rd</sup> and 4<sup>th</sup> decade and 20% cases in 5<sup>th</sup> decade.

<b>Age</b>	<b>Number</b>	<b>Percentage</b>
21 - 30	6	30%
31 - 40	6	30%
41 - 50	4	20%
51 - 60	2	10%
61 - 70	2	10%

**TABLE NO.2:SEX DISTRIBUTION:**

Fractures were more common in males with 85% of cases.

<b>Sex</b>	<b>Number</b>	<b>Percentage</b>
Male	17	85%
Female	3	15%

**Table 3. SIDE INVOLVEMENT:**

Right side is predominantly involved than left with 18 (60%) cases.

<b>SIDE</b>	<b>NUMBER</b>	<b>PERCENTAGE</b>
LEFT	8	40%
RIGHT	12	60%

**Table 4. MODE OF INJURY:**

Common mechanism of injury in this study was RTA (63%). FOOH constituted 37% cases.

MODE	NUMBER	PERCENTAGE
RTA	11	55%
Fall On Outstretched Hand	9	45%

**Table 5. FRYKMAN'S TYPE OF FRACTURE:**

Type IV fractures are seen on 23% cases. Type III and VII constituted 20% cases each.

TYPE	NUMBER	PERCENTAGE
I	1	5%
II	4	20%
III	4	20%
IV	4	20%
V	0	0
VI	1	5%
VII	5	25%
VIII	1	5%

**Table 6. TYPE OF FIXATION:**

7 cases (35%) were treated with CR and k -wires, 2 cases underwent CREF and 11 (55%) underwent ORIF.

Type of Fixation	No. of Cases	Percentage
Closed reduction and K-wire fixation	7	35%
Closed Reduction and External Fixation	2	10%
Open Reduction and Internal Fixation with plate and screws	11	55%

**Table 7. COMPLICATIONS:**

Complication rate was 10%. 1 case (5%) landed in malunion and 1 case developed superficial pin site infection.

COMPLICATION	NO.OF CASES	PERCENTAGE
Malunion	1	5%
Carpal tunnel syndrome	-	-
Tendon rupture	-	-
Secondary radio-carpal arthritis	-	-
Infection	1	5%
Sudeck's osteodystrophy	-	-

**Table 8. SARMIENTO'S RADIOGRAPHIC CRITERIA:**

According to sarmiento's radiographic criteria, 10 cases (50%) achieved excellent results, 7 cases (35%) achieved good results and 3 cases (15%) got fair result.

SARMIENTO GRADING	No. Of Cases
EXCELLENT	10
GOOD	7
FAIR	3
POOR	-

**Table 9. MEAN GARTLAND AND WERLEY SCORES:**

Mean G&W score in ORIF group was 2, CREF group is 9 and CRIF group was 7.

Type of fixation	Gartland and Werley MEAN score
Closed Reduction and K-Wire fixation	7
Closed Reduction and External Fixation	9
Open Reduction and Internal Fixation	2

**Table 10. RESULTS:**

Results were excellent in 35% cases, good in 50% cases, fair in 10% cases and poor in one case (5%).

<b>RESULT</b>	<b>No.of cases</b>	<b>percentage</b>
EXCELLENT	7	35%
GOOD	10	50%
FAIR	2	10%
POOR	1	5%

**DISCUSSION**

More than 190 years have passed since Colles described the fracture of the distal end of the radius. It is remarkable that this common fracture remains one of the most challenging of the fractures to treat. There is no consensus regarding the description of the condition and the appropriate outcome.

The operative method selected to achieve the treatment objectives requires a careful study of the individual fracture pattern, level of activity, quality of bone and general medical condition.

The present study was undertaken to assess the functional outcome of operative management of distal radial fractures using various methods such as closed reduction & percutaneous pinning with K wire, closed reduction and external fixation, and open reduction and internal fixation with plate and screws.

We evaluated our results and compared them with those obtained by various other studies utilizing different modalities of treatment. Our analysis is as follows.

**Table 11. AGE DISTRIBUTION:**

<b>SERIES</b>	<b>AVERAGE AGE</b>
Jesse B. Jupiter et al <sup>16</sup>	40
Louis Catalano III et al <sup>17</sup>	32
Harish Kapoor et al <sup>18</sup>	39
<i>Das et al.</i> <sup>27</sup>	41.4
Present study	38.8

In the present study, distal radial fracture was more common in the 3<sup>rd</sup> to 5<sup>th</sup> decade with an average of 38.8 years. 6 cases (30%) are in 3<sup>rd</sup> and 4<sup>th</sup> decade and 4 cases (20%) are in 5<sup>th</sup> decade. Least no. of cases are in 6<sup>th</sup> and 7<sup>th</sup> decade (10%).

Most of the intra articular, comminuted and unstable fractures requiring operative management occurred in young individuals are due to high energy trauma such as road traffic accident. Fractures occurring in old individuals are due to trivial fall and usually will be extra articular which in most cases can be treated with percutaneous pinning.

Average age of the patients in previous studies was comparable. Average age of incidence in the present study is 38.8 yrs. Average ages in study by Jupiter et al. were 40 where as in studies by Catalano et al. and Harish kapooret al it was 32 and 39 respectively. Abhishek et al.'s study also has similar age distribution with mean age 41.4years.

**Table 12. SEX DISTRIBUTION:**

Study	Males %	Females %
Jesse B. Jupiter et al <sup>16</sup>	60	40
Louis Catalano III et al <sup>17</sup>	67	33
Harish Kapoor et al <sup>18</sup>	72	28
<i>Das etal</i> <sup>27</sup> .	56	44
Present study	85	15

In this study there is a male preponderance with 17(85%) males and 3(15%) females. Increased incidence in males is probably due to their involvement in outdoor activities, riding vehicles and heavy manual labour. It is comparable with previous studies as shown in the table below. Harish kapooret. Al and Catalano et. al reported similar sex distribution with male predominance.

**Table 13. SIDE INVOLVEMENT:**

Series	Right %	Left %
Jesse B. Jupiter et al	61	39
Louis Catalano III et al	48	52
Harish Kapoor et al	65	35
<i>Das etal</i>	66	34
Present study	60	40

The right side is commonly involved with 60% cases in this study which is dominant hand in most of the cases. The series of Jesse B. Jupiter et al (1996) and Harish Kapoor et al (2000) had increased involvement of the right wrist. Louis Catalano III et al (1997) had increased involvement of the left wrist in their series. Matthew L Costa et al (2013) reported almost equal involvement, Abhishek das et

al. (2014) reported right sided predominance. The present study is comparable with previous studies, which reported similar involvement.

Series	RTA %	FALL %
Jesse B. Jupiter et al	67	33
Louis Catalano III et al	24	76
Harish Kapoor et al	70	30
<i>Das et al.</i>	34	66
Present study	55	45

**Table 14. MODE OF INJURY:**

Predominant mode of injury in the present study is RTA which constituted 55% cases. Fall on outstretched hand accounted for 45% cases.

RTA was common in younger age group. Whereas, fall on outstretched hand was predominantly seen in 4<sup>th</sup>, 5<sup>th</sup> & 6<sup>th</sup> decades. Studies by Jupiter et al and Kapoor et al reported similar mode of injury predominance. Das et al reported predominance of fall on outstretched hand.

#### **TYPE OF FRACTURES:**

Intra articular fractures were more than extra articular fractures. There were 6(30%) Extra articular and 14 Intra articular fractures (70%). Of the intra articular fractures most were volar barton fractures. Frykman type IV and type III constituted 20% of cases. Type VII fractures were 25% of cases. 1 case was severely comminuted (Frykman type VIII). 3 of the 6 extra articular cases were seen in patients with age group between 40 – 70 years. Intra articular fractures were common in 3<sup>rd</sup> & 4<sup>th</sup> decade. 8 out of 14 cases (57%) with intra articular fractures were due to RTA, which shows high energy injuries lead to intra articular fractures.

In our study 11 patients (55%) underwent ORIF and plating, 7 patients (35%) underwent CRIF with K-wires and 2 patients were treated with External Fixation (10%). In other series, 71 patients underwent ORIF in Catalano et al. study and 32 patients underwent ORIF in Harish Kapoor et al study. In ORIF group, 7 patients underwent Ellis plating and 4 patients underwent LCP fixation. All cases were done using volar approach. Volar Barton's were fixed with Ellis plates. 4 cases were Frykman type III, 3 cases were Frykman type IV. In CRIF with pinning group, 6 cases were Extra articular fractures, Frykman types I & II. 1 case was intra articular fracture. External fixation was done in 2 cases of which 1 was Frykman type VIII and 1 case is Type VII fracture.

Series	CR and K wires	CREF	ORIF
Louis Catalano III et al		29	71
Harish Kapoor et al		30	32
Abhishek das et al	21%		
Present study	7	2	11

**Table 15. TYPE OF FIXATION:****COMPLICATIONS:**

We encountered a complication rate of 10%, out of which 5%(1 case) was due to malunion.5%(1 patient) had pin site infection. We did not have nonunion or median nerve related complications. Malunion was seen in 1case which underwent K-wire fixation. One patient who was treated with K - wires developed superficial pin site infection in one of the pins at 2<sup>nd</sup>week. Infection was subsided with antibiotics and subsequently, K – wires were removed after 6weeks.

John K.Bradway et al (1989) and Jesse B. Jupiter et al (1996) reported a complication rate of 30% and 36% respectively. However, Harish Kapoor et al (2000) reported a complication rate of just 4% in their series.Abhishek Das et al.(2014) reported 21% complication rate.

**Table 16. LINDSTORM CRITERIA:**

SERIES	EXCELLENT	GOOD	FAIR
Abhishek Das et al.	66%	28%	6%
Present study	50%	35%	15%

Anatomical and radiological evaluation by Sarmiento's modification of lindstorm criteria showed excellent results with very insignificant deformity and insignificant radial shortening in 10 cases. i.e., 50% of cases. These cases have no residual dorsal tilt. 10 of these cases were treated with ORIF and plating. 7 cases showed good results (35%). These cases have 3 -5 mm radial shortening. These cases have slight dorsal tilt ( upto 100 dorsal tilt) which did not alter the functional outcome.

3 cases showed fair results with moderate deformity (15%). These cases have residual dorsal tilt and functional limitation. Abhishek Das et al. who compared with similar radiological criteria reported 66 % excellent results and 28% good results. Most of the cases that have excellent results were treated with ORIF.

**Table 17. RESULTS:**

<b>SERIES</b>	<b>EXCELLENT</b>	<b>GOOD</b>	<b>FAIR</b>	<b>POOR</b>
John K. Bradway et al	44 (44%)	12 (12%)	44 (44%)	0
Jesse B. Jupiter et al	63 (63%)	20 (20%)	17(17%)	0
Harish Kapoor et al	15 (36%)	15(36%)	8 (19%)	4 (9%)
Das et al.	26 (81%)	4(12%)	2(7%)	0
Present study	7(35%)	9(45%)	3(15%)	1(5%)

Results were calculated using Gartland and Werly Demerit point system. In our study, we got 35% excellent results, 45% good results and 15% fair result. 1 patient had poor outcome. (5%).

Patients, who obtained excellent results, had no residual deformities or pain. Range of motion was within the normal functional range. They had no arthritic changes or other complications. Radial length, volar tilt and articular step-off were within acceptable limits.

Patients with good results had minimal residual deformities, pain and slight limitation of movements. Rest of their findings was within acceptable parameters.

Patients with fair results, along with residual deformity, pain and limitation also had minimal complications. Few of their movements were less than that required for normal function.

Patient, who had poor result, had limitation, disability and weakness. Most of his movements were not within the range required for normal function. He also had pin tract infection. He was non-compliant with regard to post-operative physiotherapy.

Our series is comparable to other studies, Harish Kapoor et al. Who had similar results.

They reported 36% excellent and good results in their study. Jupiter et al. reported 63% excellent results and 20% good results. Abhishek das et al reported 81% excellent results. There were no poor results in their study.

In one patient (case no.3) dorsal comminution was observed intra-operatively during ORIF. He developed mild dorsal tilt. On functional evaluation using G&W score, his outcome was excellent. A patient (case no. 8) with severe comminution (Type VIII) was treated with external fixation and ligamentotaxis.

**ORIF vs CR and K-wires vs External fixation:**

7 cases out-of 11 treated with ORIF and plating (63%) achieved excellent results and 37 % cases achieved good results. On the contrary, with closed reduction and K-wire fixation, 4cases 57% achieved good results and 1 case (14%) landed in malunion with poor results. He was non-compliant to post-operative physiotherapy. There were none excellent results with K-wires. Mean G&W score in ORIF is 2 whereas it is 9 in K-wire group.

Patients attained early functional mobility in ORIF group. Their ranges of motion were within acceptable limits without any pain and disability. 1 case treated with K- wires had arthritic changes. They had deformity and limitation of movements. One patient who developed superficial infection had significant deformity also.

Out of two cases treated with external fixation, 1 achieved fair result and 1 patient achieved good results, with mean G & W score being 9. Those with Fair results developed arthritic changes in radio carpal joint. Among all the cases, those treated with ORIF with plating attained better results than K – wire fixation and External fixation. Patient compliance was better in ORIF group.

**CONCLUSION**

The present study was undertaken to assess the functional outcome of operative management of distal radial fractures in adults by various methods and the following conclusions were drawn. Operative management of distal radial fractures, regardless of the type of fixation, produces excellent to good results with proper pre- operative evaluation, selection of the method based on fracture pattern, reducibility, stability and quality of bone, early fixation, proper wound and pin site care, early post-operative rehabilitation and patient education.

Conflict of Interest: None

Finding Support: Nil

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