

ORIGINAL RESEARCH

Study of surgical management of volar barton's fracture by different methods

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ABSTRACT

Aims: To study the functional outcome of surgical management of volar barton fractures of distal end of radius with various surgical methods. **Materials and methods:** A prospective study conducted on thirty adult patients with volar bartons fractures treated. **Results:** The average age was 40.66 years with the fracture being more common in the 4th and 5th decades. Males were predominant with right wrist affection more than left. All fracture were either due to road traffic accidents or fall on the outstretched hand, with road traffic accidents being more common of the two. With different fracture patterns of both extra-articular and intra-articular type. The average duration from the date of injury to the date of surgery was 3.9 days. Surgery was delayed till the 10th day in 2(3.33%) patients who had hypertension and Diabetes mellitus and associated fractures. 8 (28.33%) patients had residual deformities which included prominent ulnar styloid, radial deviation and dinner fork deformity. There were no instances of delayed union or nonunion. Malunion was found to be within acceptable limits in all cases except 2(8.33%). Percentage of complications were more in patients who underwent K-wires fixation, external fixation with K wire augmentation compared to open reduction and internal fixation with plating. Using the Demerit score system of Gartland and Werley, we had 9(30%) excellent results, 16(53.33%) good results, 4(13.33%) fair results and 1(3.33%) poor results. **Conclusions:** Surgical management of volar bartons 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: Volar bartons fractures, Pre-operative evaluation, Gartland and Werley, K wire

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INTRODUCTION

The distal end of radius fractures continue to pose a therapeutic challenge intraarticular and extraarticular malalignment can lead to various complications like Post-traumatic osteoarthritis decreased grip strength, and endurance, as well as limited motion and carpal instability. Open reduction and internal fixation is indicated to address the unstable distal radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through external manipulation and ligamentotaxis, provided sufficient bone stock is present to permit early range of motion. Barton's fracture, named after the American surgeon John Rhea Barton, is a fracture of the distal end of the radius that involves the articular surface and is usually accompanied by subluxation or luxation of the radiocarpal joint. These fractures may result from high- or low-energy injuries, and they account for approximately 1.2% to 4.2% of distal radial fractures. On the basis of the site and shifting direction of fragments, Barton's fractures are classified into volar

or dorsal Barton's fractures. According to AO classification, volar Barton's fractures are type B3 fractures of the distal radius. Conservative treatment is usually unsuccessful and fraught with complications, such as early osteoarthritis, deformity, subluxation and instability. Various surgical techniques have been reported in literature but open reduction and internal fixation with a volar plate system is currently advocated for the treatment of volar barton fracture resulting in good reduction and providing immediate stability. Introduction 2 Moreover the patients can be mobilized early and quickly potentially reducing wrist stiffness. Internal fixation of metaphyseal bending fractures has become increasingly popular due primarily to (a) directly control and maintain physiologic palmar tilt, (b) prevent collapse with external fixation, and (c) avoid bridging the radiocarpal joint. The distal fragment typically has sufficient size and integrity to provide adequate purchase and may be approached from either a dorsal or a volar approach. Palmar

plating is preferred, as the screws directly buttress against collapse and loss of palmar tilt. With smaller and more distal fragments, a dorsal plate has to be positioned distally on the dorsum of the radius making extensor tendon injury more likely.

There are two types of plates for fractures of distal radius (a) Conventional plates and (b) Fixed angle locking compression plates. When using conventional plates comminution must be less, they poorly hold the cancellous bone fragments, toggle of screws in the distal holes of the plate leads to settling and loss of reduction. With conventional plates and screws stability is achieved by compression of plate to bone by bicortical screws. With fixed angle locking plates the locking screws support subchondral bone and resist axial forces. Compression of locking compression plate to bone is unnecessary and preserves periosteal blood supply. Fixed angle construct provides additional strength to fixation by constructing a scaffold under the distal radial articular surface⁵. Volar fixed angle locking plates are an effective treatment for unstable extra articular distal radius fractures allowing early post operative rehabilitation.

Various forms of treatment have been described in literature. These include percutaneous pinning, external fixation, open reduction and internal fixation (ORIF) with Kirschner wires, and ORIF with a buttress plates and screws. These options are differentiated based on their ability to reinforce and stabilize the three columns of the distal radius and ulna. Closed reduction is usually easy to achieve but difficult to maintain, usually unsuccessful and fraught with complications, such as early osteoarthritis, deformity, subluxation, and instability. Plating allows direct restoration of the anatomy, stable internal fixation, a decreased period of immobilization, and early return of wrist function. Buttress plates reduce and stabilize vertical shear intra-articular fractures through an antiglide effect, whereas modern locking plates address metaphyseal comminution and preserve articular congruity. With locking plates, intraarticular fractures are directly reduced; with buttress plates, the plate itself helps reduce the intra-articular fracture. Complications associated with plating include tendon irritation or rupture and the need for plate removal. (Restoration of the distal radius anatomy within established guidelines yields the best short- and long-term results. Guidelines for acceptable reduction are (1) radial shortening 15°, (3) sagittal tilt on lateral projection between 15° dorsal tilt and 20° volar tilt, (4) intra-articular step-off)

Percutaneous K-wire fixation and volar locking plates are two of the most commonly used surgical treatments for unstable, displaced distal radius fractures. However, there is uncertainty regarding which of these treatments is superior. ORIF with a volar Ellis plate system is currently practiced for the treatment of volar Barton's fracture as it results in good reduction and provides immediate stability.

Moreover, the patients can be mobilized early and quickly potentially reducing wrist stiffness.

Among various factors, including the radiographic fracture pattern, quality of bone, fracture displacement, comminution and energy of the injury of bone, fracture displacement, comminution and energy of the injury influence the preferred choice for treatment of these injuries. Although anatomic reduction remains the goal, surgical techniques are evolving in an attempt to minimize postoperative stiffness, decrease surgical risk, and reduce the quantity of internal and external fixation hardware. Several treatment methods including pins and plaster technique, closed reduction and percutaneous pinning, closed reduction and external fixation, limited open reduction, and open reduction and internal fixation with or without bone grafting are available. Augmentation of the external fixation using percutaneous Kirschner (K) wires and arthroscopically assisted reduction of intra articular fractures have also been shown to be useful. Published clinical trials directly comparing treatment regimens of 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 inconsistent outcome tools, especially in regard to comminuted fractures with joint incongruity.[1,2]

The purpose of this study was to evaluate the functional outcome of volar barton's fractures in adults using various methods such as Closed Reduction and K-wire fixation, External Fixation with or without K-wire augmentation and Open Reduction and Internal Fixation with plate and screws with or without K-wire. Present study consists of 30 cases of volar barton's fractures treated by various methods.

METHODOLOGY

A prospective study conducted on thirty adult patients with volar bartons fractures treated at Prathima Institute of Medical Sciences, Karimnagar between December 2018 to November 2020 under the Department of Orthopaedics, Prathima Institute of Medical Sciences, Karimnagar.

Inclusion Criteria: Adult patients with volar bartons fracture

Exclusion Criteria: Elderly patients and children, with neurovascular deficiency and pathological fractures

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 the 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 fillings, 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 haemoglobin percentage, total and differential WBC counts, fasting blood sugar, blood urea, serum creatinine, bleeding and clotting time, and HIV and HbsAg. Examination of urine was done for presence of albumin and sugar, blood pressure and ECG were recorded in all patients. Preparation of the part was done just before 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 analysed and involvement of radiocarpal and distal radioulnar joints were assessed and classified according to the Frykman's classification.

Out of 30 fractures.6 of the fractures were of type – III, 4 of type – IV, 2 of type – V, 3 of type – VI, 9 of type – VII and 6 of type – VIII frykman's classification. Out of 30 patients 5 patients underwent closed reduction and K-wires fixation, 3 patients closed reduction external fixation with K-wires, 2 patient closed reduction and external fixation. 12 patients underwent open reduction and 60 internal fixation with volar plating, 8 patients open reduction internal fixation with plate and K-wire. Associated ulnar styloid fractures did not alter the surgical management in present study. The duration from the date of injury to date of operation ranged from 2-10 days (Average 3.9 days)

The choice of a particular procedure for each case depended on the fracture pattern, reducibility, stability and quality of bone. Closed reduction and external fixation was done for comminuted, unstable and impacted fractures. Distal radius fractures with

metaphysal instability or simple intra articular displaced fractures treated with percutaneous pinning. Open reduction and internal fixation with volar Ellis T buttress plate and screws 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. In cases which had a displaced radial styloid or fragments too small for other means of fixation, plating and external fixation was augmented with kirschner wires, inserted either percutaneously or through limited dorsal approach.

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. Fractures, which healed by 4-6 months, without an additional operative procedure were considered as delayed union. Fractures, which did not unite after 6 months, or those that needed additional operative procedure to unite was considered as non union. Malunion was defined as more than 5mm radial shortening, more than 15° of volar tilt or more than 10° dorsal tilt, and more than 4mm of radial shift. Arthritic changes were graded according to the system described by Knirk and Jupiter.

The present study surgical management of volar Barton's fracture by different methods . thirty cases of volar Barton's fractures in adult with different modalities of treatment like Closed reduction with K-wires fixation , external fixation with or without percutaneous k-wire augmentation ,and open reduction and internal fixation with volar plating and screws with or without augmented k-wires was done in thirty patients. The follow up ranged from 5 months to 12 months (average 8.25 months.). The results were assessed at 3 months after the procedures using the demerit point system of Gartland and Werley[3] based on objective and subjective criteria, residual deformity and complications. The objective evaluation is based on the following ranges of motion as being the minimum for normal function: dorsiflexion 45degrees; palmar flexion, 30degrees; radial deviation, 15 degrees; pronation, 50 degrees; and supination, 50degrees.

Statistical Analysis

Data were analyzed using simple statistical analysis for percentage calculation , Microsoft office (Word and Excel) professional 2007 software has been used to generate graphs and tables etc.

RESULTS

In this series 3(10%) patients were between 21 – 30 Years, 11 (36.6%) between 31 -40 Years, 13 (43.4%) between 41 -50 years, 3 (10%) between 51-60 years. The age of the patients ranged from 22 – 60 years with an average of 40.66years.

Table-1: Demographic distribution in present study

Age in years	No. of cases	Percentage
21-30	3	10
31 – 40	11	36.6
41 – 50	13	43.4
51 – 60	3	10
Gender		
Male	21	70
Female	9	30
Side effect		
Right	16	53.3
Left	14	46.7
Type of injury		
Road traffic accident	18	60
Fall on outstretched hand	12	40
Type of fracture (Frykman's classification)		
III	6	10%
IV	4	6.66%
V	2	3.33%
VI	3	5%
VII	9	15%
VIII	6	10%
Associated Injuries:		
Tibia shaft Fractures	2	5
Fracture shaft femur	1	1.66
Trochanteric Fracture	4	13.33
Intracapsular Fracture	1	3.33
Duration		
1 – 7 Days	29	96.67
10 Days	1	3.33
Time of Union		
2-3 Months	18	60
3-4 Months	12	40

Out of 60 patients, 21 (70%) were male and 9 (30%) were females, Male preponderance with the ratio being M:F 4 :1. Right side (dominant wrist) was involved in 16 (53.3%) patients and the left side involved in 14 (46.7%) patients. Of the cases 6(10%) of Type III, 4(6.66%) of Type IV, 2(3.33%) of Type V, 3(5%) of Type VI, 9 (15%) of Type VII and 6

(10%) of Type VIII. 14 (23.3%) patients had associated injuries. Surgery was delayed upto 10th day in 1 (3.33%) patients who had hypertension and diabetes. In the present 18 (60%) patients had union within 2-3 months and 12 (40%) patients had union in 3-4months There were no cases of delayed union or nonunion.

Table-2: Type of Fixation in patients of present study.

Type of fixation	No. of Cases	Percentage
Closed Reduction and K- Wire fixation	5	8.33%
Closed Reduction, External fixation	2	3.33%
Open Reduction and Internal Fixation with plating	12	20%
Closed Reduction, External fixation with k	3	5%
WireOpen Reduction and Internal Fixation with plate and K-Wires	8	13.33%

Out of 60 patients, 5 (8.33%) patients underwent closed reduction and K-Wire fixation, 2(3.33%) patient underwent closed reduction and external fixation ,12 (20%) patients underwent open reduction and internal fixation with volar plate and screws, 3

(5%) patients underwent closed reduction external fixation with K-wires, 8(13.33%) patients underwent open reduction and internal fixation with plate and K-wires.

Table-3: Deformity in patients of present study.

	Prominent ulnar styloid	Radial deviation	Dinner fork deformity
Closed Reduction and K-Wire fixation	0	2	1
Closed Reduction, External fixation	1	0	0
Open Reduction and Internal Fixation with plating	1	0	0
Closed Reduction, External fixation with k wire	1	1	0
Open Reduction and Internal Fixation with plate and K-Wires	0	0	0
Total	6	6	5
Percentage	10%	10%	8.33%

In distractor group, 3 patients (60%) had residual clinical deformity. 3(60%) patients with k-wire fixation had residual deformity and only 1(5%) patient had any residual deformity in the plating group.

The deformities with K-wire fixation and external fixation with or without percutaneous pinning compared to open reduction and internal fixation with volar plating.

Table-4: Range of motion in patients of present study.

Movement (within normal functional range)	Closed Reduction and K-Wire fixation	CRE F	ORIF with plating	CRE F with k wire Augmentati on	ORI F with plate and K-Wire s	No. of Case s	%
Dorsiflexion (min. 45°)	4	1	12	1	8	26	86.66 %
Palmar flexion (30°)	5	1	12	1	8	27	93.33 %
Pronation (50°)	4	1	12	1	7	25	80%
Supination (50°)	2	0	11	1	7	21	73.33 %
Radial deviation(1 5°)	1	0	11	0	7	19	63%
Ulnar deviation(1 5°)	5	0	12	1	8	25	96.66 %
Pain in distal radioulnar joint	0	1	0	2	0	3	11.66 %
Grip strength (60 °or less than on opposite side)	0	0	0	1	0	1	3.33%

In our study 26 (86.66 %) patients had dorsiflexion within the normal functional range (minimum 45°), 27 (93.33 %) had palmar flexion within the normal functional range (minimum30°), 25 (80%) had pronation within the normal functional range (minimum 50°), 21 (73.33%) had supination within the normal functional range (minimum 50°), 19 (63%) had radial deviation within the normal functional

range (minimum 15°), and 25 (96.66%) patients had ulnar deviation within the normal functional range (minimum 15°). 58 (96.66%) patients had grip strength more than 60% compared to the opposite side. 1 (3.33%) had significant loss of grip strength (> 60% compared to the opposite side). 3 patients had pain in the distal radioulnar joint. None patients had stiffness of the wrist

Table-5: Complications in patients of present study.

Complications	Superficial infection	Pin tract infection	Finger Stiffness	Malunion	Arthritic changes
Closed Reduction and K-Wire fixation	0	0	2	0	0
Closed Reduction, External fixation	0	1	1	1	1
Open Reduction and Internal Fixation with plating	1	0	2	0	0
Closed Reduction, External fixation with k wire	0	1	2	0	1
Open Reduction and Internal Fixation with plate and K- Wires	0	0	1	0	0

Total	1	2	8	1	2
%	1.66	3.33	30	8.33	6.66

There are, 2(40%) patients in k-wire fixation group, 3(60%) patients with external fixator group and 3(60%) patients in plating group who developed finger stiffness. There are 2(40%) patients with external fixator group and no arthritic changes were observed in plating group. one patient who underwent open

reduction and internal fixation had a superficial wound infection , 2 patients who underwent closed reduction K- wire fixation & external fixation had pin tract infection. 1 patient who underwent closed reduction with K-wire fixation had significant malunion (radial length 4mm).

Table-6: Evaluation of results

Results	Excellent	Good	Fair	Poor
Closed Reduction and K-Wire fixation	0	3	2	0
Closed Reduction, External fixation	0	0	1	1
Open Reduction and Internal Fixation with plating	8	3	1	0
Closed Reduction, External fixation with k wire	0	1	2	0
Open Reduction and Internal Fixation with plate and K-Wires	4	4	0	0
Total	12	11	6	1
	40	36.66	20	3.33

Using the Demerit score system of Gartland and Werley[3], present study had 12 (40%) excellent results, 1(36.66%) good results, 6 (20%) fair results and 1 (3.33%) poor result. In our study 20 patients received ORIF plating and plating with k-wire augmentation. Of them 12(60%) had excellent

results, 7(35%) had good and one(5%) had fair functional recovery. Patients treated by external fixator, with or without pinning, showed a less satisfactory result: 20% being good, 60% fair and 6% poor result.



PRE-OP X-RAY IMMEDIATE POST-OP



AFTER 16 WEEKS POST-OP AFTER 28 WEEKS POST-OP



DORSIFLEXION PALMARFLEXION PRONATION SUPINATION



PRE-OP



IMMEDIATE POST-OP



AFTER 4 WEEKS POST-OP



AFTER 16 WEEKS POST-OP



DORSIFLEXION

PALMARFLEXION

PRONATION

SUPINATION



PRE-OP IMMEDIATE POST-OP



POST-OP AFTER 4 WEEKS POST-OP AFTER 6 WEEKS POST-OP AFTER 28 WEEKS



Dorsiflexion

Palmarflexion

Pronation

Supination



After 4 weeks

After 12 weeks

After 28 weeks



DORSIFLEXION

PALMARFLEXION

PRONATION

SUPINATION



PRE-OP

IMMEDIATE POST-OP



AFTER 4 WEEKS POST-OP

AFTER 8 WEEKS POST-OP

AFTER 16 WEEKS POST-OP

Dorsiflexion

Palmarflexion

Pronation

supination



DISCUSSION

Intra-articular distal radius fractures are extremely common injuries and tend to occur in a bimodal age distribution. They are seen most frequently in young patients due to RTA and in old osteopaenic patients due to accidental fall on outstretched hand. More than 190 years have passed since Colle’s 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 consensus regarding the description of the condition

and the appropriate outcome. However, most authors agree that fundamental principle of treatment is the restoration of articular congruity with the goal of restoring functional, painless motion of the wrist and fingers.

Numerous studies have shown that extra-articular fractures as well as impacted stable fractures with minimal shortening can be managed conservatively. However, more often than not, distal radius fractures involve the radio carpal joint and / or the distal radioulnar joint. These require an anatomical

reduction of the joint surface to reduce the incidence of post – traumatic arthritis and to guarantee a successful treatment outcome. In contrast, the results of conservative treatment of intra – articular fractures, especially in young individuals have been poor. Thus, intra – articular fractures that cannot be reduced by conservative methods and also comminuted, displaced and unstable require operative treatment.

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 management of volar barton's fractures using various methods such as closed reduction and k-wire fixation, external fixation with or without 'K' wire augmentation and open reduction and internal fixation with plate and screws with or without augmentation of K-wires.

In present study results are compared them with those obtained by various other studies utilizing different modalities of treatment. Present study analysis is as follows. In present study, volar bartons fractures was more common in the 4th and 5th decade with an average of 40.66 years.

Table-7: Average age in present study is comparable to the studies

Series	Minimum age in years	Maximum age in years	Average in Years
John K. Bradway et al[4]	18	75	40
Jesse B. Jupiter et al[5]	16	76	42
Vargaonkar Gauresh et al[6]	20	70	46.45
Harish Kapoor et al[7]	-	-	39
Pattana Shetty et al [8]	20	69	39.37
Present study	22	53	40.66

The average age in present study is comparable to the studies of John K. Bradway et al [4], Jesse B. Jupiter et al[5], Harish Kapoor et al [7] Vargaonkar Gauresh et al[6] and Pattana shetty et al [8] who had an average age of 40 Years, 42 Years, 39years, 46.45 years and 39.37 Years respectively. Majority of injuries in

younger patients are secondary to motor vehicle accidents, increased outdoor activity , alcohol intake , heavy manual labour , youth involved in sports, who sustained a relatively high energy fall due to foot ball, dancing. Present study had a male preponderance with 70% male patient and 30% female patients.

Table-8: Gender comparison with previous studies.

Series	Males%	Females%
John K. Bradway et al[4]	56	44
Jesse B. Jupiter et al[5]	60	40
Vargaonkar Gauresh et al[6]	41	59
Harish Kapoor et al[7]	72	28
Pattana Shetty et al [8]	53.1	46.9
Present study	70	30

John K. Bradway et al , Jesse B. Jupiter et al[5]and Harish Kapoor et al[7], who had also male preponderance compared to female. Pattana Shetty et al [8] who had also male preponderance compared to female. Increased incidence in males is probably due to their involvement in out door activities and heavy manual labour.

Incidence of distal radius fracture in male is more due to high energy injuries and in female (more in elderly) is due to low energy injuries. The right side (dominant wrist) was involved in 53.33% of the cases in our study.

Table-9: Side involvement comparison with previous studies.

Series	Right (%)	Left (%)
John K. Bradway et al[4]	50	50
Jesse B. Jupiter et al[5]	61	39
Harish Kapoor et al[7]	65	35
Pattana Shetty et al [8]	71.8	28.2
Present study	53.3	46.7

John k. Bradway et al[4] had equal involvement of both wrists in their study. But the series of Jesse B.

Jupiter et al[5]and Harish Kapoor et al[7], Pattana Shetty et al [8] had increased involvement of the right

wrist which was also the same in present series. Right side is more common may be because of more number of right handed persons using right hand first for

protecting themselves while fall on the ground. In present study 60% of the patients had road traffic accident and 40% had a fall on the out stretched hand.

Table-10: Injury comparison with previous studies.

Series	Road traffic accident (%)	Fall on the out stretched hand (%)	Direct blow (%)	Fall from height (%)
John K. Bradway et al[4]	31	69	-	-
Jesse B. Jupiter et al[5]	67	33	-	-
Vargaonkar Gauresh et al[6]	42	58	-	-
Harish Kapoor et al[7]	70	30	-	-
Pattana Shetty et al [8]	40.7	25	12.5	21.8
Present study	60	40	-	-

John K. Bradway et al[4] and Vargaonkar Gauresh et al[6] reported fall on the outstretched hand as the most common mode of injury. Present study reported road traffic accident as the most common mode of injury. Jesse B. Jupiter et al[5], Harish Kapoor et al[7] and Pattana Shetty et al [8] also reported similar findings in their series. Present series is comparable to that of Harish Kapoor et al[7], Pattana Shetty et al [8] as it

was also done in the Indian subcontinent and in a similar setup.

In present study 16.66% of the patients underwent closed reduction and K- wire fixation, 6.66% external fixator, and 40% underwent open reduction and internal fixation with volar plating, 26.33% plating with K-wires augmentation and 10% external fixation with percutaneous 'K' wire augmentation.

Table-11: Open reduction and internal fixation comparison with previous studies.

Series	Closed reduction and percutaneous pinning	Closed Reduction External fixatio	OR& IF with plating	OR & IF with plating +Kwires	Closed reduction with External Fixator+ K-Wire
John K. Bradway et al[4]	0	0	69	0	31
Vargaonkar Gauresh et al[6]	0	25%	25%	0	0
Harish Kapoor et al[7]	0	0	32	0	31
Pattana Shetty et al [8]	0	0	100	0	0
Present study	8.33	3.33	20	13.33	5

In the series of John K. Bradway et al[4] more cases underwent open reduction and internal fixation compare to external fixation with percutaneous pinning. Pattana Shetty et al [8] who has done 100% of open reduction and internal fixation with buttress plates and screws. Pattana Shetty et al [8] has used bone graft for six patients in their study over 40yrs age group. None of these had excellent results. 3 patients had good, 2 patients had fair and 1 patient had poor results. But the series of Harish Kapoor et al[7] had almost equal distribution of cases that underwent closed reduction and external fixation and open reduction and internal fixation.

Present study more cases of open reduction internal fixation with volar plating compared to other methods- Closed reduction percutaneous pinning with K- wires, closed reduction external fixation with or without augmentation of K- wires, plating with K-wires fixation. Present series is comparable to Harish Kapoor et al[7] and Vargaonkar Gauresh et al[6]

series as they have done management with different modalities of treatment for volar bartons fracture by analyzing the fracture pattern and considering the needs of the patient in the same region and in a similar setup.

Present study encountered a complications, out of which 3.33% was due to pin tract infection, 1.66% due to superficial wound infection, 30% of patients had finger stiffness, and 6.66% had arthritic changes. The incidence of malunion was 8.33%. Present study did not have nonunion or nerve related complications. One Patient underwent open reduction with internal fixation had superficial infection treated with appropriate antibiotics and regular sterile dressings. Two patients had pintract infection which was also controlled with appropriate antibiotics and sterile dressings, four patients had malunion may be due to delayed intervention, non compliant patient, lack of regular follow up, physiotherapy.

Pintract infections can be prevented by subcutaneous incorporation of K-wire appropriate time of removal

necessary usually 4-6weeks,regular Sterile dressings. Deep infections can be controlled by debridement , regular sterile dressings , appropriate intravenous antibiotics, pin removal. John K. Bradway et al[4] andJesse B. Jupiter et al[5]reported a complication rate of 30% and 36% respectively. Pattana Shetty et al [8] who had complications in 3 patients (9.3%) malunion, 7 patients (21.8%) finger and wrist stiffness.

Vargaonkar Gauresh et al[6]reported 8(32%) patients in distractor group and 2(8%) patients in plating group who developed finger stiffness. The number of patients with arthritic change in three groups was respectively 6(20%), 5 (20%)and 4(16%). Only 1 patient in distractor group had paresthesia along median nerve. However, Harish Kapoor et al[7] reported 14.28% complication rate in 28 patients treated with ex.fix, 3.44% complication rate in 29 patients treated with open reduction with internal fixation in their series.

In present series had 30% excellent, 53.3% good, 13.33% fair and 3.33% poor result. In our study 20 patients received ORIF with plating and plating with k-wire augmentation. Of them 12(60%) had excellent results, 7(35%) had good and 1(5%) had fair functional recovery. Patients treated by external fixator, with or without pinning, showed a less satisfactory result: 20% being good, 60% fair and 20% poor result patients with k-wire fixation 60% had good results and 40% had poor results.

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. They were operated within 4days after injury. Radial length, volar tilt and articular step –off were within acceptable limits. They were co-operative to physiotherapy.

Patients with good results had minimal residual deformities, pain and slight limitations. Results of their findings were within acceptable parameters. Patients with fair results : along with residual deformity, pain and limitation also had pain in the distal radio – ulnar joint and minimal complications. Few of their movement complications. Few of their movement were less than that required for normal function.

One of the patient of 2 patients with poor result presented after 10 days of injury, and the other patient had hypertension and diabetes mellitus, associated fractures, anaemia. After controlling hypertension, blood sugar levels with physician advice and treatment, anaemic status also improved with blood transfusions then undertaken the procedures – open reduction and internal fixation with plating.

Because of soft tissue adaptations during these ten days ,radial length could not be restored to acceptable measurement. They had pain, limitation, disability and weakness. Most of the movements were not within the range required for normal function. They were non-compliant with regard to post- operative physiotherapy. And had malunion due to radial shortening.

Table-12: Gartland and Werley comparison with previous studies.

Series	G & W scoring system			
	Excellent	Good	Fair	poor
John K. Bradway et al[4]	56	25	19	0
Jesse B. Jupiter et al[5]	63	20	17	0
Pattana Shetty et al [8]	18.75	46.88	18.72	15.65
Present study	30	53.3	13.33	3.33

Present series is comparable to those of John k. Brad way et al[4], Jesse B. Jupiter et al[5]and Pattana Shetty et al [8] who had more percentage of excellent and good results. Harish Kapoor et al[7] functional assessment (Sarmiento) the results were more percentage of excellent and good (80%) , fair and poor (20%) results in external fixation group, In open reduction internal fixation group had good and excellent (63%) , fair (26%) and poor (11%) results in their study. Vargaonkar Gauresh et al[6]reported as 67% had excellent results, 33% had good and no one had fair/poor functional recovery by ORIF with plating. Present study had more percentage of excellent , good results in volar bartons fractures treated with plating compare to other methods of fixation, this means plating gives relatively better results in intra articular fractures of distal radius. This does not mean that plating is the gold standard in

treatment of volar barton's fractures, this is the only alternative methods in treating these injuries. [9,10,11]

CONCLUSION

Intervention is required in distal radius fractures to prevent complications and to improve functional outcome. Extra-articular fractures can be immobilized with POP casting but with regular follow ups. Fractures with extreme comminution are best fixed with distraction and external fixation. Radial length, which is the most important radiological parameter, is best maintained by external fixation due to sustained counter traction utilizing the principle of ligamentotaxis. However, joint congruity and volar tilt may not be fully restored with external fixation.

Volar displaced fractures with subluxation or dislocation of the carpus on the radius (volar

Barton's) best treated by fixation with volar plate and screws. Open reduction and internal fixation provides the best chance for restoring joint congruity and therefore patients treated by this method have a lesser chance of developing secondary osteoarthritis.

Union is not problem as these fractures occur in the metaphyseal region. But malunion should be avoided by proper selection of implant and procedure, early reduction and fixation, better surgical skills. Surgical management of volar bartons 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.

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