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Functional outcome of volar barton fracture distal end radius treated with plating

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Abstract

Background: More than 206 years have passed since Colles described the fracture of the distal end of the radius. Barton's fracture, named after the American surgeon John Rhea Barton is a fracture of the distal end of the radius that involves the dorsal or volar rim and extends into the intra-articular region. As far as the treatments of volar Barton fractures are concerned, it is one of the most challenging types. The main objective of treatment is to re-establish anatomic integrity and joint function. The purpose of the study is to evaluate the functional outcome of volar Barton fracture of distal end radius treated with plating using Mayo wrist score.

Materials and Methods: The study was conducted in the department of orthopedics, Geetanjali medical college and hospital, Udaipur. 25 patients with volar Barton fracture of distal end radius were included in study. The period of study was between January 2019 to June 2020. Minimal period of follow-up was 6 months and Functional outcome was evaluated using Mayo wrist score.

Results: In our series, we had 64% excellent, 32% good, 4%, fair and no poor results using Mayo wrist score. Patients, who obtained excellent results, had normal regular activities and no pain. Range of motion was within the normal functional range. 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 function. 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 movements were less than that required for normal function.

Conclusion: Our study concludes that fixation of volar Barton fracture of distal end radius treated with plating showed excellent functional outcome with early ROM and good grip strength without any major complications.

Keywords: Volar barton fracture, distal end radius, volar plating, Mayo wrist score

Introduction

A volar Barton fracture is a compression injury with an intra-articular marginal volar shearing fracture of the distal radius. The most common cause of this injury is a fall on an outstretched, pronated wrist.

Distal radial fractures are the most common fractures of the upper extremity and account for more than one sixth of all fractures treated in the emergency department. It is relatively more common in osteoporotic elderly population (18% of all fractures) and usually caused by low energy falls. DRFs also have a significant impact on the health of young adults, which is most frequently due to a fall on a hyperextended wrist or high energy trauma.

Internal fixation using a dorsal plate, which is greatly advocated, achieves anatomical reduction with good stability. But a variety of complications have been documented, including irritation of the subcutaneous tissue, tenosynovitis of the extensor muscles, rupture of the extensor tendons and even chronic pain [1].

Despite the frequency of distal radius fractures, a concurrence has not been reached on the optimal approach to treatment. Volar plating systems have changed the ease by which fractures can be treated compared with traditional methods such as fracture specific fixation, pinning, and external fixation [2]. The functional outcome of treatment of fracture of the distal aspect of the radius is influenced by the anatomical reduction of the articular surface and the extra-articular alignment of the distal part of the radius.

By directly restoring the anatomy, plating allows secure internal fixation with resultant early return of wrist function. Furthermore, antiglide effects of buttress plates help reduce and stabilize intra articular fractures. The increase in the incidence of sympathetic dystrophy with immobilization over long durations is circumvented by this novel method of fixation [3].

The purpose of the study is to evaluate the functional outcome of volar barton fracture of distal end radius treated with plating using mayo wrist score.

Aims & Objectives

- Evaluation of functional outcomes of volar barton fractures treated with volar plating.
- To study the intra-operative and post-operative Complications associated with volar barton fracture treated with volar plating.

Materials and Method

The prospective study was conducted in the department of orthopedics, Geetanjali medical college and hospital, Udaipur. In this study, 25 patients with volar barton fracture of distal end radius were included. The period of study was between January 2019 to June 2020. The minimal period of follow-up was 6 months and Functional outcome was evaluated using a mayo wrist score.

Inclusion and Exclusion Criteria

Patients over the age of 18 years with volar barton fracture of the distal radius (closed or open up to grade III B) who give informed consent and fit for surgery were included in this study.

Patients with poor local soft tissue condition like compartment syndrome and grade III C open fractures were excluded from this study.

Surgical procedure (Modified Henry approach)

Surgery was performed under appropriate anaesthesia i.e. either general anaesthesia or axillary or supra clavicular block under tourniquet control.

Incision– The modified Henry approach uses the plane between the flexor Carpi radialis tendon and the radial artery. The flexor Carpi radialis tendon was palpated, before making the skin incision to the radial side. The flexor Carpi radialis tendon retracted medially and the radial artery retracted laterally to expose the pronator quadratus muscle.

The Pronator quadratus was sharply taken off using an L-shaped incision to facilitate exposure of the fracture. The horizontal limb (of L shaped incision) was placed at the watershed line. This lies a few mm proximal to the joint line; the position of the joint line was determined by a hypodermic needle placed in the joint.

Under direct visualization and the aid of fluoroscopy, the fracture was then reduced. Depending on the difficulty in achieving the reduction, provisional fixation with k-wires were occasionally utilized. The plate will be initially secured proximally with a cortical screw. Upon confirming the adequate placement of the plate, a second screw proximal to the fracture was used to firmly secure the hardware. Distal fixation with locking screws were performed while maintaining the fracture reduction. The remaining proximal fixation was completed. After fixation, saline wash given and

closure done. After sterile dressing below elbow slab was applied.

Post-operative protocol

Patients will be followed up at 2weeks, 6 weeks, 3 month and 6 month interval.

Around 2 weeks after surgery, sutures and slab were removed and range of motion exercises were started. Patients were advised to apply crape bandage for next 2 to 4 weeks.

Then patients were examined both radiologically and clinically at 6 weeks, 3 month and 6 month interval using Mayo wrist score i.e. pain, satisfaction, range of motion and grip strength.

Results

The study comprised a total of twenty five patients of volar barton fractures of the distal radius. The period of study was Between January 2019 to June 2020. Minimal period of follow-up was 6 months and Functional outcome was evaluated using mayo wrist score.

Demographic characteristics

Age distribution

Table 1: Age of patient ranges from 22 to 69 years. Mean age was 39 years. Maximum patients were in the age group of 18-30 years.

Age group	No. of patients	Percent
18 to 30	10	40
31 to 45	8	32
>45	7	28
Total	25	100

Sex distribution

Table 2: Number of males were more than females.

Gender	No. of patients	Percentage
Males	20	80
Females	5	20
Total	25	100

Side distribution

Table 3: Among 25 patients, injury was on right side for 13 patients and left side for patients.

Side	No. of patients	Percentage
Left	12	48
Right	13	52
Total	25	100

Mode of injury

Table 4: 21 patients got injury due to road traffic accidents, other than this 4 patients had history of fall at home.

Mode of injury	No. of patients	Percent
RTA	21	84
Fall at home	4	16
Total	25	100

Classification

According to AO classification system all patients included in our study are of AO-23-B3.

Table 5: Range of motion achieved at final follow up.

Movement	No. of cases	%
Dorsiflexion (45)	25	100
Plantar flexion (30)	25	100
Pronation (50)	25	100
Supination (50)	25	100
Radial deviation (15)	23	92
Ulnar deviation (15)	22	88
Pain in DRUJ	3	12
Grip strength (60% or less than on opposite side)	1	4

Table 6: Functional outcome

Functional score	6 weeks	3 month	6 month
Excellent	0(0%)	2(8%)	16(64%)
Good	8(32%)	18(72%)	8(32%)
Fair	17(68%)	5(20%)	1(4%)
Poor	0(0%)	0(0%)	0(0%)
Total	25	25	25

Complications

In present study, out of 25 patients, only 1 patient had developed the complication i.e. superficial infection. The patient having a superficial infection was successfully treated with oral antibiotics.



Fig 4: Functional range of motion



Fig 1: Preoperative x-ray



Fig 5: Preoperative x-ray



Fig 2: Postoperative x-ray



Fig 6: Postoperative x-ray



Fig 3: 6 Month follow up



Fig 7: 6 Month follow-up



Fig 8: Functional range of motion

Discussion

Barton's fracture, named after the American surgeon John Rhea Barton. A Barton fracture is a compression injury with a marginal shearing fracture of the distal radius. The most common cause of this injury is a fall on the outstretched, pronated wrist. As far as the treatments of volar Barton fractures of distal end radius are concerned; it is one of the most challenging types. The main objective of treatment is to re-establish anatomic integrity and function. Several studies have been directed towards clarifying with surgical treatment methods would be best for fracture of the distal extremity of the radius. In this context, Osada *et al.* [4] recently documented

the increasing popularity of open reduction and internal fixation, especially since the introduction of locked volar plates. They demonstrated that the volar plates are well tolerated, allow early mobilization and provide good support for deforming muscle forces after the surgical reduction, even in volar Barton fractures.

In the present study the average age of the patients was 39 years. The eldest patient in the study was 69 years of the age and the youngest patient was 22 years old. In Anakwe RE *et al.* [8] average age of the patients was 48 years with minimum age of 22 years and maximum years 67.

Table 7: Age comparison

Study	Min. Age	Max. Age	Mean Age
Kevin C, Chung <i>et al.</i> [5]	18	83	48.9
Rohit Arora <i>et al.</i> [6]	17	79	57
Kilic A <i>et al.</i> [7]	18	77	45
Anakwe RE <i>et al.</i> [8]	22	67	48
Our study	22	69	39

In our study, most of the patients were males 20 (80%) as compared with females 5 (5%). The study done by Ayhan Kilic [7] *et al.* included 12 female and 15 males. In Margaret Fok WM [9] *et al.* study there were 56 (57.7%) male and 41 (42.3%) female while AK Aggarwal, ON Nagi *et al.* [10] study had female 5 and male was 11 in number. As compared with other studies in our series most of the patients are male (80%). Increased incidence in males is probably due to their involvement in outdoor activities, riding vehicles, and heavy manual labor.

In the current study, the mode of injury was a road traffic accident in 21 patients (84%), a fall in 4 patients (16%). In the study of Ayhan Kilic *et al.* [7] also found road traffic accident in 13 patients (48.1%) and fall in 14 patients (51.9%), while Chung KC *et al.* [5] found 42 patients (48.3%) had a road traffic accident and 45 patients (51.7%) had trauma due to fall. Our study is comparable to Sohael M. Khan *et al.* [11] in which 44 patients had a road traffic accident and 16 has an injury due to a fall.

According to AO classification system, all patients included in our study are of AO-23-B3.

In our study, all fractures were reduced and fixed anatomically and the union rate was 100%. The fracture healing process is not hindered due to the cancellous bone

character. The success rate is therefore high.

In our series, we had 64% excellent, 32% good, 4%, fair and no poor results using the Mayo wrist score. Patients, who obtained excellent results, had normal regular activities and no pain. Range of motion was within the normal functional range. Radial length, volar tilt and articular step-off were within acceptable limits. Patients with good results had minimal residual deformities, pain and slight limitation. 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 movements were less than that required for normal function.

Our patients were routinely followed up with physiotherapy and subsequently asked to return to clinics if they have any further problems. In our study, out of 25 patients, only 1 patient had developed the complication i.e. superficial infection. The patient having a superficial infection treated with oral antibiotics. None of our patients suffered any extensor tendon or flexor pollicis longus rupture. Both of these complications are well described and we believe care should be taken intra-operatively to ensure that the dorsal cortex is reached but not penetrated by the distal locking screws and the pronator quadratus is laid back over the metal work, tacking it into a place where possible. On the other

hand, the short study period does not allow us to comment on later complications such as tendon irritation or injury and implant loosening. Final radiographic examination at union

confirmed that the locked volar plate maintained a satisfactory position in keeping with previous studies.

Table 9: Results compared with other studies.

Study	Excellent	Good	Fair	Poor
Chavhan AN <i>et al.</i> ³	16(45.7%)	15(42.9%)	4(11.4%)	0(0%)
Rohit Arora <i>et al.</i> ⁶	31(27.19%)	54(47.36%)	23(20.17%)	6(5.26%)
AK Aggarwal, ON Nagi ¹²	9 (56.25%)	5(31.25%)	2(12.5%)	0(0%)
JoideepPhadnis <i>et al.</i> ¹³	133(74%)	41(23%)	6(3%)	0(0%)
Our study	16(64%)	8(32%)	1(4%)	0(0%)

Conclusion

Our study concludes that fixation of volar barton fracture of distal end radius treated with plating showed excellent functional outcomes with early ROM and good grip strength without any major complications.

Limitations of study

- Our study had a smaller sample size and shorter follow-up period.

Declaration of conflicting interest

The authors declare no potential conflict of interest with respect to the research, authorship, and or publication of this article.

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