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**Original Article**

# Radiological and Clinical Outcome of Volar Barton Distal Radius Fractures Treated by Variable Angle Volar Locking-Plates (Chinese Version)

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## Abstract

**Background: To evaluate the functional and radiological results of treating volar Barton fractures of the distal radius with the variable Angle Volar Locking Plates (Chinese version).**

**Methods: In this prospective study patients(n=50), of volar Barton fractures, which were fixed with Variable Angle Volar Locking Plates (Chinese version) were evaluated. Short arm back splint was applied . Volar approach was used for distal radius. After sweeping away the FPL muscle belly and retracting it ulnarly, pronator quadratus was exposed and released from its radial attachment in L shaped fashion using scalpel. Under direct visualization and with the aid of fluoroscopy, the fracture was then reduced. Plate was initially secured proximally with a 3.5-mm cortical screw in the oval hole of plate. Distal fixation with locking screws was then performed while maintaining the reduction. Radiological outcome (residual dorsal angulation, radial shortening and loss of radial inclination) was assessed according to Lidstorm criteria and clinical outcome was done using Mayo score .**

**Results: Forty five cases were caused by road traffic accident and five cases were of domestic fall. Majority (n=28) sustained B3.1. Majority of the patients were operated within the first week of injury (60%). Mean time for radiological union was 08 weeks (6-12 weeks).Duration of hospital stay ranged from 2 to 3 days. Forty-six patients had excellent functional score at the end of six months. Forty-three patients (86%)had volar tilt in the range of 6-11 degrees and 2 patients (4%) had volar tilt in the range of 11-15 degree.Radiologically 96% patients had excellent to good results.**

**Conclusion: Volar Barton fracture are best treated with osteosynthesis using variable angle volar locking plates.**

**Key words:Volar Barton fracture, Variable Angle Volar Locking Plates.**

## Introduction

Barton's fracture is named after an American orthopedic surgeon John Rhea Barton. It is defined as fracture of the distal end of the radius that involves the articular surface and is usually accompanied by subluxation or dislocation of the radiocarpal joint .[1] These fractures are usually associated with high energy trauma. In AO classification these fractures are classified as 23B-3. Treatment options for the distal radius fracture vary widely from closed reduction and casting, percutaneous pinning, external fixator and open reduction and internal fixator (ORIF). Closed reduction is usually easy to achieve but difficult to maintain.[2, 3] Conservative treatment is usually associated with complications, such as early osteoarthritis, deformity, subluxation, and instability.[4, 5] Open reduction and internal fixation allows direct reduction, stable internal fixation, a decreased period of immobilization, and early return of wrist function.ORIF options include volar plating and fragment specific plating. [6, 7] In the recent years volar locked plating is gaining popularity because of stable fixation for periarticular fractures despite of osteopenia and ability to facilitate early motion and rehabilitation. [6] More recently variable angle locking plates and screws have become available providing greater versatility. These plates are low-profile, precontuored providing less soft tissue irritation as compared to conventional volar locking plates. Variable angle locking screws permit an inclination of the screw insertion angle up to 15˚ as compared to 5˚insertion angle in conventional locking plates.[2,8,] The main aim of this study was to assess the radiological and functional results of volar Barton fractures treated with open reduction and internal fixation using Variable Angle Volar Locking Plates (Chinese version) (Figure 1).

## Patients and Methods

This prospective study was conducted in the Department of Trauma and Orthopaedics Shalimar

Medical and Dental Ccollege Lahore, Pakistan from January 2017 and December 2017. Total 50 patients of volar Barton fractures which were fixed with Variable Angle Volar Locking Plates (Chinese version) were evaluated and managed. Inclusion criteria comprised all the patients aged 18 years and above having volar barton fracture of distal radius. Patients with active or recent infection, extensive comminution, open fractures with extensive soft tissue damage and/or contamination and patients with neurological deficit were excluded. All the patients with volar barton fracture were evaluated with X-ray of wrist with forearm AP and Lateral views. Short arm back splint was applied immediately for all patients. Volar approach was used to assess to distal radius. Surgery was performed under general anaesthesia under tourniquet control.

**Figure 1: The Variable locking plate with locking head screws.**

**Table 1: Lidstrom Classification**

| |
|---|
| Excellent |
| Insignificant deformity |
| Dorsal angle >0 Degree |
| Radial shortening < 3mm |
| Loss of radial tilt not more than 4 |
| Good |
| Small deformity: |
| Dorsal angle 1-10 Degree |
| Radial shortening 3- 6mm |
| Loss of radial tilt 5-9 |
| Fair |
| Moderate deformity |
| Dorsal angle 11-14 Degree |
| Radial shortening 7-11mm |
| Loss of radial tilt 10-14 |
| Poor |
| Severe deformity |
| Dorsal angle >15 Degree |
| Radial shortening >11mm |
| Loss of radial inclination greater than 15 |

The incision was made over the tendon of FCR. After sweeping away the FPL muscle belly and retracting it ulnarly, pronator quadratus was exposed and released from its radial attachment in L shaped fashion using scalpel. Under direct visualization and the aid of fluoroscopy, the fracture was then reduced. Provisional fixation with k-wires was occasionally performed. The plate was initially secured proximally with a 3.5-mm cortical screw in the oval hole of plate. Distal fixation with locking screws was then performed while maintaining the reduction. The minimum follow up was 6 months. Radiological outcome (residual dorsal angulation, radial shortening and loss of radial inclination) was performed according to Lidstorm criteria (Table 1) and clinical outcome was done using Mayo score (Table 2).

**Table 2: Mayo Score**

| Pain Intensity | Range of Motion(% of normal side) |
|---|---|
| No pain | 100% |
| Mild occasional pain | 75-99% |
| Moderate tolerable | 50-74% |
| Severe intolerable | 25-49%<br>0-24% |
| Functional status | Grip strength(% of normal side) |
| Regular job | 90-100% |
| Restricted employment | 75-89% |
| Able to work but unemployed | 50-74% |
| Unable to work due to pain | 25-49%<br>0-24% |

# Results

There were 34 males and 16 females, age range from 18 to 70 years with a mean age of 42.7 years. Left side was involved in 26 cases and right side in 24 cases. Forty five cases were caused by road traffic accident.Five cases were of domestic fall. As per AO classification, 10 patients sustained (B3.1) 28 patients had B3.2 and 12 patients sustained AO Type B3.3. Majority of the patients were operated within the first week of injury (60%), mean time from trauma to surgery was 3 days. The mean operative time was 50 minutes (40-60 minutes). Majority resumed regular jobs (Table 3). Mean time for radiological union was 08 weeks (6-12 weeks). All patients were followed up for minimum of 6 months postoperatively. There was one superficial wound infection which was resolved with daily dressings and one week of oral antibiotics. In our study duration of hospital stay ranged from 2 to 3 days with maximum number of patients stay up to 2 days. Clinically patients were evaluated using Mayo score.[11] All patients resumed their respective job at the end of six months, and all patients had full range of motion as compared to uninjured site. Out of fifty, 36 patients had excellent grip strength i.e. 90to-100% of an uninjured site. Forty-six patients had excellent functional score at the end of six months (Table 4).

**Table3: Patient clinical assessment using Mayo score**

| Pain Intensity | Functional status | Range of motion (% of normal side) | Grip strength (% of normal side) |
|---|---|---|---|
| No pain-40 patients | Regular job-50 patients | 100%-10 patients | 90-100%-36 patients |
| Mild occasional pain-8 patients | Restricted employment-0 patients | 75-99%-40 patients | 75-89%-10 patients |
| Moderate tolerable -2 patients | Able to work but unemployed -0 patients | 50-74%-0 patients | 50-74%-4 patients |
| Severe intolerable-0 patients | Unable to work due to pain-0 patients | 25-49%-0 patients; 0-24%-0 patients | 25-49%-0 patients 0-24%-0 patients |

**Table 4: Functional end result of healed fracture**

| Functional Score | Frequency | Percentage |
|---|---|---|
| Excellent | 23 | 46% |
| Good | 20 | 40% |
| Satisfactory | 7 | 14% |
| Total | 50 | 100.0% |

Radiological evaluation was assessed by measuring different components of Lidstrom classification, such as radial angle, volar tilt and shortenings . [11] Twenty-three patients (46%)had radial angle of 20 -25 degree(Table 5). Forty-three patients (86%)had volar tilt in the range of 6-11 degrees(Table 6). Thirty three patients (66%) who had less than 3 mm of shortening (Table 7). Radiologically 96% patients had excellent to good results and 04% had satisfactory results (Table 8).

**Table 5: Radial angle**

| Radial angle | Frequency | Percentage |
|---|---|---|
| 10-14degree | 7 | 14% |
| 15-19degree | 20 | 40% |
| 20-25degree | 23 | 46% |
| Total | 50 | 100.0% |

**Table 6: Volar tilt presentation**

| Volar tilt in degrees | Frequency | Percentage |
|---|---|---|
| -5 -0 | 0 | 0% |
| 0-5 | 5 | 10% |
| 6-11 | 43 | 86% |
| 11-15 | 2 | 4% |
| Total | 50 | 100.0% |

**Table 7: Radial length shortening.**

| Radial length shortening | Frequency | Percentage |
|---|---|---|
| < 3mm | 33 | 66% |
| 3-6mm | 13 | 26% |
| >6mm | 04 | 08% |
| Total | 50 | 100.0% |

**Table 8: Radiological outcome of healed fracture**

| Radiological Score | Frequency | Percentage |
|---|---|---|
| Excellent | 28 | 56% |
| Good | 20 | 40% |
| Satisfactory | 02 | 04% |
| Total | 50 | 100.0% |


**Figure 2: (A) Pre-op x rays; (B)Postop x rays.**

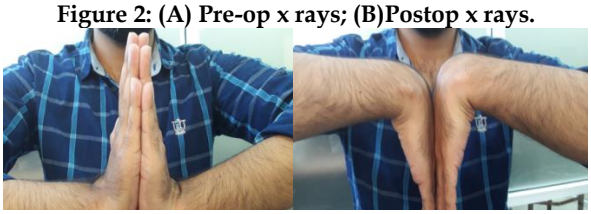

**Figure 3: (A) Dorsiflexion; (B) Palmarflexion.**

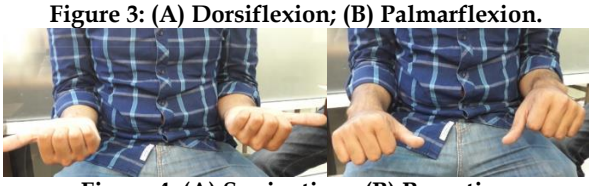

**Figure 4: (A) Supination (B) Pronation**

# Discussion

The widely used conventional fixed angle locking screws provide stable locking in the plate hole if these screws are inserted within less than 5˚ of the precise perpendicular direction to the hole. [9,10,23] These screws are dependent on precise placement of drill sleeve in the threads of the plate hole. Without the use of the drill sleeve, the correct screw insertion angle could not be maintained. This concept resulted in the development of novel plate designs, to allow more accurately placing the locking screws.[2,3,23] Subchondral screw placement avoiding intra-articular misplacement of the screw remains sometimes challenging, due to the fixed angle of the locking screw. [2, 11,12] These difficulties have led to the development of variable angle locking screws which permit an inclination of the screw insertion angle up to 15˚.[25] Chinese version of variable angle locking plates was used in present study, due to the cost issue in our socioeconomic group patients.

The large number of the studies on distal radius fractures have used subjective criteria for measuring quality of life,such as the Gartland and Werley

calculation and the DASH score while others have given greater emphasis to the radiographic parameters obtained after surgical reduction of fractures of the distal end of the radius. [2, 14] The average age of the patients in our study was 42.7 years. The eldest patient in our study was 70 years of the age and the youngest patient was 18 years old (mature skeleton) as compared with other studies like Kevin C, Chung et al had average age of the patients was 48.9 years with minimum age 18 years and maximum years 83 years.[7] In Rohit A et al average age of the patients was 57 years with minimum age 17 years and maximum years 79. [15] In Killic A et al average age of the patients was 45 years with minimum age 18 years and maximum years 77. [16] In a study by Anakwe RE et al average age of the patients was 48 years with minimum age 22 years and maximum years 67. [17]

In our study, most of the patients were males 34 (68%) as compared with females 16 (32%). The study done by Hanae Minegishi et al included most female 12 (80%) and male 3 (20%). [18] In Margaret Fok WM et al study there were 56 (57.7%) male and 41 (42.3%) female while Tank Gyaneshwar study had female 52 (65%) and male was 28 (35%) in number. [18,19]

# Conclusion

Variable angle locking screws allow screw orientation in a cone of 15˚, facilitating direct fracture fragment fixation, and exact screw placement. Their locking strength in inclination up to 15˚ is comparable to orthogonally placed fixed angle locking screws while fixed angle screws inserted at 5 to 15˚ inclination lacked locking strength.

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