

ORIGINAL ARTICLE

Functional outcome of open reduction and internal fixation by volar locking plate for the treatment of volar Barton fractures of distal radius in active adult patients.

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Abstract:

Background: Volar Barton fractures represent a specific type of intra-articular fracture, resulting from shear pressures that lead to the displacement of the volar lips of the distal radius. Volar Barton fractures are uncommon and exhibit significant instability. This type of fracture is almost always associated with volar subluxation of the radiocarpal joint. The results of conservative treatment for volar Barton fractures are often disappointing and associated with various complications. Volar Barton fractures of the distal radius generally require surgical fixation to achieve the best possible outcomes.

Objectives: To assess the functional results of volar Barton fractures in active adults who have undergone open reduction and internal fixation with a volar locking plate.

Methods: This prospective study was conducted at various private hospitals in Dhaka and Narayanganj from January 2019 to December 2022. We analyzed the outcomes of twenty-two cases of volar Barton fractures, which were managed through open reduction and internal fixation utilizing a volar locking plate. The patients were assessed at regular intervals, with the final follow-up occurring one year later for each individual.

Results: This study comprised the open reduction and internal fixation utilizing a volar locking plate in a group of 22 individuals diagnosed with volar Barton fractures. Throughout the course of one year, all patients underwent monitoring to evaluate the outcomes of their treatment. Every fracture has been successfully fixed. The average time for fracture union was found to be 8.5 ± 2.5 weeks. By the end of the follow-up period, every patient successfully attained the necessary and satisfactory range of motion. Based on the Modified Mayo Wrist Score, a remarkable 54.55% of patients achieved excellent functional outcomes, while 40.91% exhibited good outcomes. It is recommended that open reduction and internal fixation with a volar locking plate serves as a highly effective treatment approach for volar Barton fractures in active adults.

Conclusions: Open reduction and internal fixation with a volar locking plate is a trustworthy treatment option with promising results for volar Barton fractures of the distal radius in active adult patients.

Keywords: Volar Barton fractures, Volar locking plate, Open reduction, Internal fixation, Distal radius.

Introduction

Volar Barton fractures are intra-articular fractures

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resulting from shear forces with displacement of volar lips of the distal radius. Volar Barton fractures are uncommon and extremely unstable.¹ This type of fracture is almost always associated with volar subluxation of the radiocarpal joint. The outcome of conservative management for volar Barton fractures is not satisfactory and is associated with complications like subluxation, instability, deformity and early

osteoarthritis. Therefore, most cases are treated with open reduction and internal fixation (ORIF) to restore articular congruity and function. Open reduction and internal fixation (ORIF) using volar locking plate is one of various management options. In this study, we present our experience regarding the functional outcomes of open reduction and internal fixation by volar locking plate for the treatment of volar Barton fractures in active adult patients

Materials & Methods

This prospective study was conducted at various private hospitals in Dhaka and Narayanganj from January 2019 to December 2022. We analyzed the outcomes of twenty-two cases of volar Barton fractures, which were managed through open reduction and internal fixation utilizing a volar locking plate. The patients were assessed at regular intervals, with the final follow-up occurring one year later for each individual. A functional evaluation was carried out with the Modified Mayo Wrist Score.² The union was assessed using plain radiography.

Inclusion Criteria

- Patients with age >18 years and <60 years
- Fresh injuries, not more than 2 weeks old
- Closed fractures
- Ability to provide informed consent
- Ability to comply with follow-up

Exclusion Criteria

- Age: <18year and >60years
- Polytrauma
- Open fracture
- Pathological fracture
- Fracture >2 weeks old
- Associated wrist injuries
- Neurovascular disorder
- Head injury at time of trauma
- Medical contraindications to general anesthesia

Results

The age of the patients at the time of injury varied between 18 to 60 years with average of 30.6 years. Among 22 patients, sixteen (72.73%) were male and six cases (27.27%) were female. Twelve fractures (54.55%) involved the right side (on the dominant side) and ten (45.45%) involved the left side (on the non-dominant side).

Causes of injury:

In this study, nineteen patients (86.36%) developed fractures as a result of high energy trauma (road traffic accident). Other cause was fall in three patients (13.64%).

Range of Motion:

Mean flexion of $70.23^{\circ} \pm 3.60^{\circ}$, extension of $72.22^{\circ} \pm 3.91^{\circ}$, ulnar deviation of $27.98^{\circ} \pm 2.74^{\circ}$, radial deviation of $9.25^{\circ} \pm 2.10^{\circ}$, pronation of $73.30^{\circ} \pm 2.51^{\circ}$ and supination of $78.11^{\circ} \pm 3.12^{\circ}$ were recorded at the injured wrist at final follow up.

Table-I: Movements of the injured wrist at final follow up

Movement	Mean
Flexion	$70.23^{\circ} \pm 3.60^{\circ}$
Extension	$72.22^{\circ} \pm 3.91^{\circ}$
ulnar deviation	$27.98^{\circ} \pm 2.74^{\circ}$
radial deviation	$9.25^{\circ} \pm 2.10^{\circ}$
Pronation	$73.30^{\circ} \pm 2.51^{\circ}$
Supination	$78.11^{\circ} \pm 3.12^{\circ}$

Union:

Average duration of fracture union was 8.5 ± 2.5 weeks.

Functional outcome (according to Modified Mayo Wrist Score):

12 patients (54.55%) were rated as "Excellent", 09 patients (40.91%) as "Good" and 01 patients (4.54%) as "Fair".

Functional Score	Number of patients	Percentage (%)
Excellent	12	54.55%
Good	09	40.91%
Fair	01	4.54%

Complications:

In this study, two patients (9.09%) experienced superficial wound infections necessitating surgical dressing and antibiotic treatment. Early signs of Complex Regional Pain Syndrome (CRPS) were noted in a single patient. The issue was treated with physiotherapy and anti-inflammatory medications. Symptomatic screw misplacement occurred in one patient (4.54%). There was no evidence of median nerve involvement.

Discussion

A Volar Barton's fracture, attributed to the American surgeon John Rhea Barton³, is characterized by a fracture of the distal radius that impacts the volar rim and extends into the intra-articular region. Volar Barton fractures represent rare injuries often associated with high-velocity trauma. Various treatment options are available to address these fractures. The techniques include closed reduction with plaster application, percutaneous pinning, external fixation, open reduction with internal fixation using Kirschner wires, and open reduction with internal fixation featuring a volar plate. Closed reduction is generally a simple procedure, yet maintaining its effectiveness proves to be difficult. The outcomes of conservative treatment frequently fall short, leading to complications like early osteoarthritis, deformity, subluxation, and instability.

The present study aims to evaluate the results of volar Barton fractures in adults treated with a volar locking plate. The site of the fracture was accessed via the distal segment of the volar technique as described by Henry.⁴ The final assessment utilized the Modified Mayo Wrist Score. The Modified Mayo Wrist Score emphasizes the importance of a partnership between the patient and physician in evaluating pain levels, comparing the active flexion and extension range to the opposite side, assessing grip strength in relation to the opposite side, and determining the capacity to resume normal work or activities. Scores are classified into distinct categories: excellent (91-100), good (80-90), fair (65-79), and poor (<65).

This study comprised 25 individuals with volar Barton fractures, with a mean age of 30.6 years. 72.73% of the patients were male, while 27.27% were female. The injury mechanism was high-energy trauma, occurring in 86.36% of patients due to road traffic accidents, whereas the remaining 13.64% resulted from falls. Ansari AR et al.⁵ revealed that the mechanism of injury was a roadside crash in 15 out of 20 cases (75%).

At the final follow-up, the motion of the injured wrist was recorded as follows: $70.23 \pm 3.60^\circ$ of flexion, $72.22 \pm 3.91^\circ$ of extension, $27.98 \pm 2.74^\circ$ of ulnar deviation, $9.25 \pm 2.10^\circ$ of radial deviation, $73.30^\circ \pm 2.51^\circ$ of pronation, and $78.11^\circ \pm 3.12^\circ$ of supination. Raina and colleagues reported similar findings in their study.⁶ In the concluding follow-up, the author recorded a mean flexion of $67.47^\circ \pm 4.8^\circ$, a mean extension of $71.52^\circ \pm 3.98^\circ$, a mean radial deviation of $8.45^\circ \pm 2.6^\circ$, a mean ulnar deviation of $27.56^\circ \pm 2.9^\circ$, a mean pronation of $72.65^\circ \pm 2.3^\circ$, and a mean supination of $76.35^\circ \pm 3.67^\circ$.

Khatri K et al.⁷ detailed in their study that the measurements were $71.91 \pm 8.08^\circ$ for flexion, $76.95 \pm 5.70^\circ$ for extension, $77.65^\circ \pm 6.01^\circ$ for pronation, and $81.86^\circ \pm 6.28^\circ$ for supination. The observations presented here draw parallels to the study carried out by Karthik SJ et al.⁸

All fractures in this series healed within 11 weeks post-surgery, with a range of 6 to 11 weeks and a mean of 8.5 weeks. Aggarwal AK et al.⁹ stated in their study that all fractures healed within 7.0 to 10.0 weeks (mean, 8.8 weeks).

The ultimate functional outcome at one year was assessed utilizing the modified Mayo wrist score. In 54.55% of the patients, calculated scores were classified as "Excellent," while in 40.91%, they were classified as "Good." These data are analogous to the study conducted by Kolla A et al.¹⁰ In their study, 55% of patients attained outstanding outcomes, while 35% received good outcomes.

The primary issue identified in this study was superficial wound infection, which was addressed through standard dressing procedures and the use of antibiotics tailored to specific cultures. One patient exhibited initial symptoms of CRPS. The condition was effectively managed with physiotherapy and analgesic anti-inflammatory medication. One patient exhibited symptomatic screw misplacement. No instances of median nerve compression or any significant complications were seen. Elerian S et al.¹¹ found problems in 11 out of 61 individuals (18%). The complications consisted of superficial infections of the wound, carpal tunnel syndrome, superficial nerve injury, tenosynovitis, and symptomatic screw misplacement.

There are certain flaws in the current study. The control group is absent, and the study is conducted with limited sample size. It is imperative that extensive randomized controlled trials be conducted on the subject.

Conclusion

To attain a favorable functional outcome, volar Barton fractures of the distal radius necessitate surgical fixation, which can be accomplished through several fixation techniques. This study demonstrates that open reduction and internal fixation with a volar locking plate yields excellent to good functional outcomes in 95.46% of patients. In conclusion, open reduction and internal fixation with a volar locking plate is a trustworthy treatment option with promising results for volar Barton fractures of the distal radius in active adult patients.

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