



Original Article

Outcome of Volar Barton Fractures Treated with Locking Compression Plates: A Cross-Sectional Study

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ABSTRACT

Volar Barton fracture is the fracture of distal radius bone associated with ventral displacement. It is an oblique intra-articular fracture. **Objective:** To investigate the results, both functional and radiological, of open reduction and internal fixation with locking compression plates of the volar Barton fracture. **Methods:** A total of fifteen patients were included in this study. All of the participants had volar fragment type B3 fractures of the wrist. All the patients underwent open reduction to treat the fracture. Internal fixation was done using a locking compression plate (LCP). Out of a total of 15 patients, 10 were male and 5 females. The most common cause, almost 67 %, of the fracture was a road traffic accident (RTA). The mean age of the patients was 33 years, ranging from 21 to 55 years. All the patients had their respective surgeries within 7 days of the fracture accident. Quick Dash score-, and Gartland and Werley score were used to assess the function of the hand and wrist. **Results:** All the fractures took the meantime of 8 weeks for the bone union. The mean Quick Dash score was 10, ranging from 0 to 60. According to Gartland and Werley's score, 9 patients were excellent, 4 patients were good and 2 were fair. No postoperative complication occurred. **Conclusions:** Open reduction and internal fixation with locking compression plates of the volar Barton fracture is an effective treatment for functional and radiological restoration.

INTRODUCTION

Volar Barton fracture is the fracture of distal radius bone associated with ventral displacement. It is an oblique intra-articular fracture. Volar Barton fracture is also called reverse Barton fracture or Smith's type II fracture [1]. Volar Barton fracture is more common than Barton fracture. Its most common cause is falling on the outstretched hand or direct trauma injury, such as in the case of road traffic accidents [2]. Severe trauma or bolt can also be one of the

causes of volar Barton fracture. Its incidence is almost 1.5 % of all distal radius fractures [3]. Its symptoms include pain, swelling, restricted wrist movement, bruising, tenderness, and deformity of the wrist. It is more common in females as compared to males. It is diagnosed through the radiograph of the wrist. The treatment method depends upon the age of the patient, degree of damage, stability of the fractured bone, extent of fracture

displacement, and recovery demand. In most cases, open reduction and internal fixation (ORIF) are required to treat the fracture. Volar Barton fracture can also cause complications like median nerve neuropathy, flexor pollicis longus rupture, extensor pollicis longus rupture, malunion of the fractured bone, compartment syndrome, etc [4]. The main aim of the treatment of volar Barton fracture is fracture stability, restoration of movement, and evading complications. It also decreases the possibility of wrist stiffness. Open reduction and internal fixation via locking compression plates are considered the gold standard treatment of the volar Barton fracture [5]. The high-speed impact on the articular surface of the wrist and carpal joints during volar flexion (leading to volar marginal fractures) or dorsiflexion is the mechanism of damage for these fractures (causing dorsal marginal fractures). PA and radiographs of the outside of the wrist show palmar and dorsal marginal fractures. The side image (lateral), on the other hand, best demonstrates the degree of fracture displacement related to the degree of joint region involvement (figure 1) [5]. Some of the treatment approaches can also cause complications. For instance, fixation with plates and screws can rupture the extensor tendon [6]. Replacement with dorsal plate does not show any significant difference in the results of surgery and postoperative complications [7]. On the other hand, the use of compression locking plates via the volar approach shows better results and lesser soft tissue-related complications [8]. The purpose of this study was to investigate the results, both functional and radiological, of open reduction and internal fixation with locking compression plates of the volar Barton fracture.



Figure 1: AP and a lateral view showing volar Barton fracture

METHODS

A total of fifteen total patients were included in this study. All of the participants had volar fragment type B3 fractures of the wrist. Only patients with epiphyseal closure were included in this study. Patients with compound fractures

were excluded from the study. Permission was taken from the ethical review committee of the institute. Arbeitsgemeinschaft für Osteosynthesefragen (AO) classification system was used to classify volar Barton fractures. All 15 patients had type B3 fractures, and partial volar rim fractures. For further elaboration, subtypes were classified. A total of 5 cases were of the B3.1 subtype, having only one small volar fragment. A total of 8 cases were of subtype B3.2, having only one but a large volar fragment, and 2 cases were of subtype B3.3, having multiple fragments of volar rim [9]. Initial emergency treatment of all the patients was the same, closed reduction and splint. After this, open reduction and internal fixation were done using a locking compression plate (As shown in figure 2) [5]. All the patients had their respective surgeries within 7 days of the fracture accident.



Figure 2: Post-Operation AP And Lateral Views Showing Locking Compression Plates

All surgeries were held with the patients under the effect of general anesthesia. For restricting the blood flow towards the surgical area, the pneumatic tourniquet was used. Volar approach of the radius (Henry) was used to expose the fracture [10]. The main focus of reduction in all the cases was the restoration of joints and their functioning. In 3 patient's alignment of the distal radio-ulnar joint was not proper. For these patients, K-wire was used for temporary fixation. For three weeks after the surgery, a plaster slab was applied below the elbow. After 3 weeks, active movement of the wrist was begun. Patients were asked for follow up checkups after every three weeks to six weeks. Then follow-up duration was increased to every six weeks to three months and then every three months to a year. The absence of pain at the fracture site during palpation was considered as fracture union. AP and lateral wrist radiographs of the patients were compared to the healthy radiographs for radiographical control. The radiographs were compared to assess radial height, radial inclination,

the tilting angle of radius and ulnar differences. Quick Dash score-, and Gartland and Werley score were used to assess the function of the hand and wrist.

RESULTS

A total of 15 patients with volar Barton fractures were treated with open reduction and internal fixation. Out of total 15 patients, 10 (67 %) were male and 5 (33 %) female. This is shown in table 1.

Gender	Number (%)
Male	10 (67 %)
Female	5 (33 %)
Total	15

Table 1: Gender Distribution

The mean age of the patients was 33 years, ranging from 21 to 55 years. The mean follow-up time was 15 months, ranging from 10 to 20 months. Out of 15 patients, 9 had right-hand fractures, 60 per cent and 6, (40 per cent), had left-hand fractures. This is shown in table 2.

Fracture side	Number (%)
Right hand	9 (60 %)
Left hand	6 (40 %)

Table 2: Fracture side Distribution

The most common cause, almost 67 % (10 patients), of the fracture was road traffic accidents (RTA). Other causes were falling in 26 % of cases (4 patients), and direct hits in 7 % (1 patient). All the fractures took 8 weeks of mean time for bone union, ranging from 5 to 10 weeks. No post-surgery complication occurred. Post-surgery radiographic examination was done, and the results showed Hulten (ulnar) variance equalized in 67 % of patients, (10 cases). A total of 80% of patients, (12 cases), had radial inclination the same as that of the healthy radius bone. In the rest of the 20 per cent patients, (3 cases), operated sides mean angle was 22.5°, ranging from 20° to 30°. While healthy sides' mean angle was 25°, ranging from 23° to 30°. In 12 patients, (80 % of cases), the tilting angle of the radius was the same as that of the healthy side. In 3 patients, (20 % of cases), on the healthy side, the mean value of tilting angle was 7 degrees towards the volar side, ranging from 0 to 15 degrees. On the operated side, however, the mean angle was 3.9 degrees towards the volar side. Radius height was the same on both sides, healthy and operated, in 13 (87 %) patients. On the final follow up, the mean angle of flexion was 56degrees, ranging from 0 to 80 degrees. The mean angle of an extension was 44 degrees, range 25 to 60 degrees. The mean angle of pronation was 65 degrees, ranging from 0 to 75 degrees. The mean angle of supination was 80 degrees, ranging from 0 to 90 degrees as shown in table 4. The mean deviation of the radius was 22 degrees, ranging from 10 to 30 degrees. The mean Quick Dash score

was 10, ranging from 0 to 60. According to Gartland and Werley's score, 9 patients were excellent, 4 patients were good and 2 were fair as shown in Table 3. At the end of the mean follow-up of 1 year, significant recovery was seen in all patients radiographically. Only one patient had dehiscence early on after the surgery. In this case, the wound healed via secondary wound healing. None of the patients had any post-operative infection or neuropathy. Loss of reduction resulting in malunion was seen as a late complication in 2 patients. MCP joint stiffness was reported in 1 patient as a late complication. This patient recovered with physiotherapy.

Category	Number (%)
Excellent	9 (60 %)
Good	4 (26.7 %)
Fair	2 (13.3 %)

Table 3: Gartland and Werley score

Causes of Fractures	
Road Traffic Accidents	10 (67%)
Falls	4 (26%)
Direct Hit	1 (7%)
Mean time of bone union (weeks)	8±3
Post-surgery radiographic examination	
Hulten (ulnar) variance	10 (67%)
Radial Inclination	12 (80%)
Mean angle at follow-up	
Flexion	56 degree
Extension	44 degree
Pronation	65 degree
Supination	80 degree

Table 4: Various preoperative and postoperative parameters of study participants

DISCUSSION

Volar Barton fracture is not a very common fracture. Its incidence is almost 1.5 % of all distal radius fractures [3]. Many treatment methods are available. Gartland and Werley's score in our study were: 60 % of patients were excellent, 26.7 % of patients were good, and 13.3 % were fair and no poor patients. While in the study of Julfiqar et al., Gartland and Werley's score was: 47.8 % excellent patients, 39.1 % good, 8.7 % fair and 4.4 % poor [5]. Some of the methods are: closed reduction, cast immobilization, external fixation, percutaneous pinning, open reduction and internal fixation via plates. Almost all of the treatment methods are somehow related to one or another complication. For instance, closed reduction is difficult to maintain. Percutaneous pinning is not adequate to uphold the reduction position, also there is the risk factor of infection at the pin site [10]. Infection at the pin site and reduction in the length of radius are the complications

associated with external fixation [11]. Formation of soft tissue adhesions, tendonitis and tendon tearing occur with dorsal plates. On the other hand, volar plates are linked with lesser complications [7]. In a study, the mean time of bone union was 7.5 weeks, while in our study it was 8 weeks [9]. In our study, the mean Quick dash scores were 10, while in another study it was 8. Gartland and Werley's score in our study were: 60 % of patients were excellent, 26.7 % of patients were good and 13.3 % were fair. While in the study of Jalil et al., Gartland and Werley's score was: 72.7 % excellent patients, 18.2 % good and 9.1 % fair [9]. In this study, volar locking compression plates were used and satisfactory results, bone alignment and stability, were achieved. As a result, all the patients started active movement early on after the surgery. Unlike another study, sudeck's atrophy did not develop in any of the patients included in our study [10]. No nerve dysfunction or neuropathy was reported in our study. These results are similar to Julfiqar et al., and Jalil et al., studies [5,10]. This suggests that nerve decompression, especially of the median nerve, is not essential in the case of open reduction and internal fixation done for the treatment of the volar Barton fracture. Only a few studies have reported the use of open reduction and internal fixation for the treatment of volar Barton fracture [3,5,10,12]. The main goal of volar Barton fracture treatment is fracture reduction and stability [10]. A total of 70% of Barton fractures occur in young male employees or motorcycle riders. Barton's fractures are particularly unstable and must be treated with open reduction and internal fixation (ORIF). The key to treating intra-articular dislocation fractures is the surgical anatomical reduction and wrist stability. Wrist-neutral disaccharide forceps sprint fixation and rapid patient referral to an orthopedic specialist should be the initial treatment [13,14]. Recently locking compression plates are slowly replacing the old support plates. This is because of the advantages they offer over the support plates. For instance, locking compression plates have more strength in terms of biomechanics, which is useful against the forces of fractured fragments. This is because of the interlocking mechanism of the screw plate [15]. This is why locking compression plates are being successfully used in the treatment of distal radius fractures [16,17]. Locking compression plates hold the reduction position and provide adequate stability because of their biomechanical strength [18]. As a result, early post-surgery mobilization is possible. Conventional treatments require a long-term immobilization and movement restriction as stability requires longer duration [19]. Its result is poor functioning in the long run [20].

CONCLUSIONS

Open reduction and internal fixation with locking

compression plates of the volar Barton fracture is an effective treatment for functional and radiological restoration. Early postoperative mobilization and fracture stability are achievable through the use of locking compression plates. It provides fast recovery of the movements and activities.

Conflicts of Interest

The authors declare no conflict of interest

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