# MANAGEMENT OF VOLAR BARTON FRACTURES BY PLATING IN ADULTS: AN ARTICLE REVIEW

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**ABSTRACT**

Distal radius fractures are one of the most common types of fractures, accounting for around 25% of fractures in the pediatric population and up to 18% of all fractures in the elderly age group. Distal radius fractures include a broad spectrum of injuries from simple isolated fractures of the distal aspect of the radius to comminuted fractures of the distal radius with associated injuries. The goal of distal radius fracture treatment is to restore an upper extremity that has both acceptable mobility and durability. Consider the early outcomes of adult volar Barton fracture surgical treatments by plating, since the majority of publications address the late outcomes of adult volar Barton fracture plating. This study article aimed to review using of plating in the management of volar barton fractures.

**Keywords:** Volar Barton Fractures; Adults; Plating ; Management

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## Introduction

Distal radius fractures are one of the most common hip fractures in elderly, with an estimated incidence of 643,000 per year **[1]**. The fracture pattern and extent of injury is typically predicated upon the mechanism of injury, the energy imparted, and the quality of the patient’s bone. Younger, more active patients are more likely to sustain a distal radius fracture while participating in sports, or in vehicular accidents. Older, less active patients are more likely to sustain fractures by falling onto their outstretched hand from the ground level **[2]**.

Several decision points exist for the patient and physician a cross the care continuum of a distal radius fracture. For example, both conservative and surgical options exist for the treatment of distal radius fractures. While conservative management in the form of immobilization with or without closed reduction remains the most prevalent form of treatment in the older population (>65 years), surgical management (particularly open reduction and internal fixation) is on the rise. As each treatment option and the general care of distal radius fractures carry their own risk/benefit profile, synthesizing and understanding the evidence behind various treatment decision points is fundamental for discussions between patients and surgeons on treatment decisions **[2,3]**. Although the pediatric and elderly populations are at the greatest risk for this injury, distal radius fractures still have a significant impact on the health and well-being of young adults **[4]**.

The young adult population (ages 19:49) is the least affected by Barton fractures, with Agreater predilection for males than females. In the elderly, women are more likely to be diagnosed with a Barton fracture than their male counterparts due to higher rates of osteoporosis. Volar Barton fractures make about 1.3 percent of distal radius fractures **[5]**. It has bimodal distribution younger patients due to high energy mechanisms and older patients due to low energy mechanisms with incidence of 50 % intra articular **[6]**.

Risk factors include osteoporosis and osteopenia as there is a high incidence of distal radius fractures in women > 50 years old. decreased bone mineral density was a better predictor of the risk of distal radius fractures in women than in men, but a significant predictor in both men and women once osteoporosis was diagnosed so DEXA scan is recommended for women with distal radius fractures **[4]**.

Common mechanisms in younger individuals include falls from a height, motor vehicle accident, or injuries sustained during athletic participation. In elderly individuals, distal radial fractures may arise from low-energy mechanisms, such as a simple fall from a standing height and as such are considered fragility fractures **[7]**.

The most common mechanism of injury is a fall onto an outstretched hand with the wrist in dorsiflexion. High-energy injuries (e.g., vehicular trauma) may result in significantly displaced or highly comminuted unstable fractures to the distal radius. Fractures of the distal radius are produced when the dorsiflexion of the wrist varies between 40 and 90 degrees. The radius initially fails in tension on the volar aspect, with the fracture propagating dorsally, whereas bending moment forces induce compression stresses resulting in dorsal comminution. Cancellous impaction of the metaphysis further compromises dorsal stability. Additionally, shearing forces influence the injury pattern, often resulting in articular surface involvement **[6-8]**.

Multiple classification systems have been developed to describe distal radius fracture patterns to better guide treatment, although significant amounts of interobserver and intraobserver variability exist among the early classification system. The most common fracture pattern of the distal radius, the dorsally angulated and displaced extra-articular fracture of the distal radius, after which the fracture was named, and classic eponym coined. **[9]**.

## Barton Fractures

The compressive force travels from the hand and wrist through the articular surface of the radius, resulting in a triangular portion of the distal radius being displaced dorsally along with the carpus. Multiple stabilizing structures help to maintain the relationship between the radius and the carpal bones, including the extrinsic radiocarpal ligaments, the joint capsule, and the scaphoid and lunate fossa of the radius **(Figure 1)**. The associated injuries are distal radioulnar joint disruption, Triangular Fibrocartilage Complex (TFCC) tear, scapholunate ligament injury, and volar intercalated segment instability **[9]**.

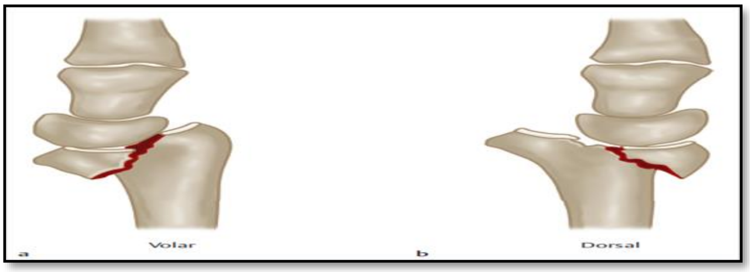


**Fig. (1): Barton fractures a. volar b. Dorsal [8].**

proximal volar fragment. In axial CT scans, a coronal fracture line is through the distal radius, the volar fragment is intact. In sagittal CT scans, both the radio-scaphoid and radio-lunar articular joints are fractured substantially, which makes both scaphoid and lunar subluxated volarly **[10]**.

In typical Barton; a fracture line is hardly seen in anteroposterior wrist film, but overlap of the carpals and dorsal rim of distal radius can be observed **(Fig. 2)**. In lateral film, volar fragment and step-off of radiocarpal joint is obvious. Sometimes a cortical fragment can be found in the


**Fig. (2): Typical Volar Barton fractures [10].**

Furthermore, according to the severity of the injured radiocarpal joint, we graded Barton fractures into two degrees: grade 1 is simple split, the remaining dorsal articular joint is intact, only a volar portion of the joint is split and displaced; and grade 2 is split-depression **(Fig. 3)**, the volar portion of the joint is split and the remaining dorsal articular joint is depressed or comminuted **[10]**.

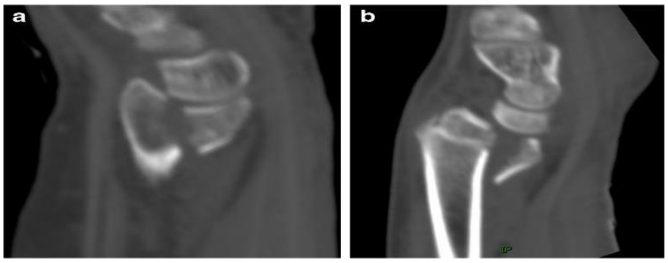


**Fig. (3): Grading Barton fracture into 2 grades according to severity [10].**

Concerning imaging of distal radius fracture, posteroanterior and lateral views of the wrist should be obtained, with oblique views for further fracture definition, if necessary, Shoulder or elbow symptoms should be evaluated radiographically **[8]**. Computed tomography (CT) has evolved as a useful tool for evaluating articular involvement. Improved assessment articular congruity when compared with plain film radiograph. Identification of articular involvement is imperative in the evaluation of distal radius fractures from an operative planning standpoint and prognostic indicator. A study emphasizing the importance of articular evaluation demonstrated any degree of articular incongruity can lead to post-traumatic arthrosis in 91% of patients and 100% if more than 2 mm **[11]**.

Cross-sectional imaging is helpful when the fracture pattern is not clear on plain radiographs and particularly with die-punch patterns. CT scans have also been shown to improve detection of

DRUJ involvement and occult scaphoid fractures **[12]**. A study found that three-dimensional imaging, in combination with two-dimensional imaging, significantly changed treatment plans, including operative approach. CT scans, with added radiation and costs, should not be ordered for all distal radius fractures and the utility of the CT scan as an adjunct is best left to the treating surgeon's discretion **[13]**.

**Management for Distal Radius Fractures**

The primary goal of treatment is to gain bone union without symptomatic malunion. Some degree of displacement is usually tolerated, but only to a certain extent. For the physiologically young and active patients, these measurements should indicate an acceptable range of values **[14]**.

Unless the fracture is undisplaced, closed reduction and immobilization in a forearm cast is almost always indicated in an attempt to gain the best possible anatomical restoration **[15]**. If the reduction is acceptable, and there are no other operative demanding injuries, nonoperative treatment is chosen. If the reduction is acceptable, but the fracture is unstable, operation should be considered, for example, volar angulated fractures (Smith's fractures) and shear fractures (volar or dorsal Barton's fractures). If nonoperative treatment is chosen, the patient must be followed closely with radiographs until union is complete **[16]**. The conservative treatment for distal end of radius should be considered for fractures of the low-demand elderly and infirm patients, as well as undisplaced extra-articular fractures, and Extra-articular fractures with an initial position of <10° of dorsal angulation, minimal comminution, and <2 mm of shortening early motion

**Plating for Volar Barton Fractures**

All volar barton fractures should undergoes open reduction and plate fixationAs these are articular injuries, with a high risk of radiocarpal subluxation, they should normally be fixed **[17]**. Advantages are stability in comminuted fractures, articular congruity, early motion, and used in buttress mode **[17,18]**.

Volar surgical interval is in line with the flexor carpi radialis longus tendon between the radial neurovascular bundle and the median nerve **(Fig. 4)**. The flexor pollicus longus (FPL) lies just deep to the flexor carpi radialis (FCR) sheath and is the first structure encountered in the deep interval. Retraction of the FPL ulnarly facilitates exposure of the distal radius (based on its origin from the anterior/ulnar aspect of the radial shaft and interosseous membrane in the forearm).. The pronator quadratus (PQ) overlies the distal radius. It has two heads. The superficial head attaches broadly over the radial aspect of the distal radius and is involved in initiation of pronation. The deep head is more oblique and attaches distally on the radius. The deep head acts as a stabilizer of the DRUJ and is less likely to be disrupted **[18]**.

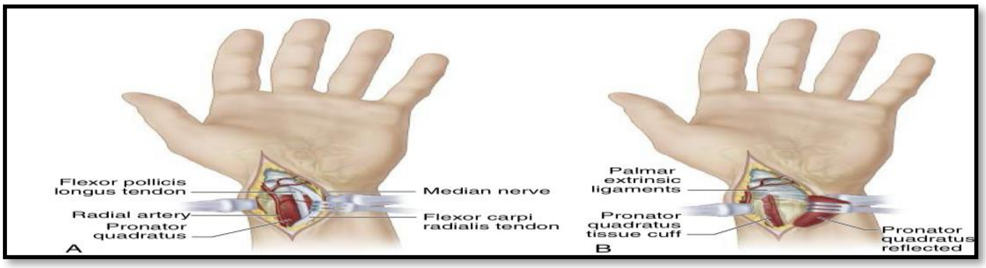


**Fig. (4): Underneath the FCR sheath lies the flexor pollicis longus muscle this must be released and retratced ulnarly [18].**

The palmar cutaneous branch of the median nerve crosses radially into the palm at the distal aspect of the exposure.The branch originates between 4 to 5 cm from the wrist crease and generally runs ulnar to the FCR. It can occasionally take an anomalous course through the tendon sheath **(Fig. 5)**. The median nerve lies just deep to the palmaris longus, along its radial border. The radial septum separates the volar and dorsal forearm compartments. At the level of the distal radius, the septum extends contributing to the brachioradialis insertion, first extensor compartment, and radial carpal ligaments. The distal watershed line marks the junction between the distal tendinous insertion of the PQ and the volar joint capsule/extrinsic ligaments. This serves as a landmark for the extent of distal release as well as plate placement **[18,19]**.

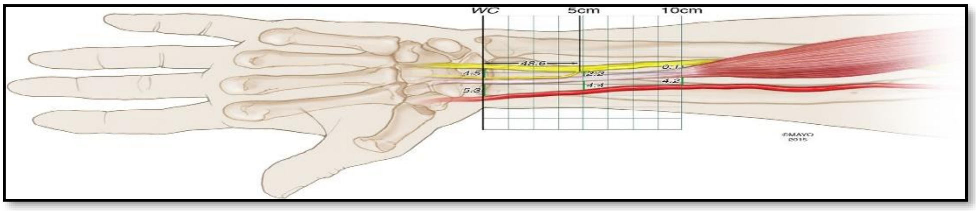


**Fig. (5): The distance of the median nerve and radial artery to the FCR at three locations in the volar approach [19].**

- **Volar Exposure(modified Henry approach)**

Incision in line with the FCR tendon starting distally at the wrist crease. Length of incision is dependent on fracture specifics and extent of proximal exposure required. The FCR tendon is located; the volar flexor sheath is incised longitudinally. The FCR tendon is retracted ulnarly, protecting the median nerve and palmar cutaneous branch. The FCR subsheath is then sharply incised to expose the deep interval and underlying FPL. The palmar cutaneous branch must be protected as dissection proceeds through this layer. Deeper handheld or self-retaining retractors can then be used to retract the radial neurovascular bundle radially. The FPL and remaining flexor tendons/median nerve are retracted ulnarly. This exposes the pronator quadratus, which is sharply released from its radial border. Distally, its tendinous insertion is reflected ulnarly with the remaining muscle belly. Meticulous subperiosteal elevation facilitates later repair, although the utility of this is debated **[20]**.

- **Extended FCR approach**

The FCR approach can be extended to provide access to the radial and dorsal surfaces of the distal radius. After completion of the traditional approach, dissection is carried out radially to release the radial septum and brachioradialis tendon. Progressive dorsal subperiosteal dissection can then be performed. Care must be taken to avoid injury to the first dorsal extensor compartment, which lies in close proximity to the brachioradialis tendon. Pronating the proximal radial shaft then provides full access to the articular segment **[19,21]**.

- **Reduction and plate fixation**

Hyperextension of the wrist Reduce the fracture by hyperextension of the wrist over a pad.Perfect anatomical reduction can be achieved by direct manipulation of the distal fragment using a dental pick or a fine hook **[17,22]**.

- **Create a buttress**

The plate is contoured so that its distal limb exerts even pressure over the fragment or fragments of the palmar rim of the radius. The distal end of the plate should end at the anatomic watershed zone of the distal radius. Attaching the plate to the distal radial shaft, using an appropriate screw through the oblong plate hole. Before fully tightening it, check the plate position using intraoperative imaging, adjusting the position of the plate as necessary to provide an optimal buttress effect **[23]**. Now tighten the first screw and insert a second screw, check adequate buttress pressure on the palmar rim fragment(s) **[23]**.

- **Insertion of distal screws**

Secure the distal fragment(s) with at least two screws through the appropriate distal holes, as dictated by the fracture pattern. The screws must not penetrate the dorsal radial cortex. If a plate is selected with threaded holes in the distal limb, then locking head screws are used **[24]**.

- **Plate selection:**

For a multifragmentary fracture comprised of a small distal articular rim fracture, a palmar plate which directs the very distal screws proximally may be applicable.As the screws are placed in a very subchondral manner, there is a high risk that there may be some inadvertent penetration of the joint. Special care must be taken to exclude this with imaging.As the plate is so distal, flexor tendon irritation is common and so this plate usually must be removed **[18]**.

- **Assessment of Distal Radioulnar Joint (DRUJ)**

Before starting the operation, the uninjured side should be tested as a reference for the injured side.After fixation, the distal radioulnar joint should be assessed for forearm rotation, as well as for stability. The forearm should be rotated completely to make certain there is no anatomical block. The elbow is flexed 90° on the arm table and displacement in dorsal palmar direction is tested in a neutral rotation of the forearm with the wrist in neutral position. This is repeated with the wrist in radial deviation, which stabilizes the DRUJ, if the ulnar collateral complex (TFCC) is not disrupted.This is repeated with the wrist in full supination and full pronation **[17,25]**.

- **Closure and Imaging**

The wound should be irrigated thoroughly. Minimal subcutaneous absorbable sutures followed by interrupted vertical mattress skin closure. Final imaging should be performed. Standard AP and lateral views checking reduction/alignment parameters. Distal fixation should be checked for intra-articular penetration using the 20° to 30° oblique lateral view Dorsal cortex perforation should be checked using the dorsal horizon view. DRUJ stability, wrist range of motion (ROM), and forearm rotation are then assessed clinically. DRUJ stability should be checked in three positions: full pronation, neutral rotation, and full supination **[19,21]**.

Functional exercises Immediately postoperatively, the patient should be encouraged to elevate the limb and mobilize the digits, elbow and shoulder.Some surgeons may prefer to immobilize the wrist for 7-10 days before starting active wrist and forearm motion. In those patients, the wrist will remain in the dressing applied at the time of surgery.Wrist and forearm motion can be initiated when the patient is comfortable and there is no need for immobilization of the wrist after suture removal.Resisted exercises can be started about 6 weeks after surgery depending on the radiographic appearance.If necessary, functional exercises can be under the supervision of a hand therapist **[17]**.

- **Implant removal**

Implant removal is purely elective but may be needed in cases of soft-tissue irritation, especially tendon irritation to prevent late rupture. This is particularly a problem with dorsal or radial plates. These plates should be removed between nine and twelve months **[22]**.

Therefore, fixation of volar Barton fractures with variable locking plates has a better role in immediate stability, maintaining anatomic reduction, and early mobilization. It also provides better functional outcomes and a good anatomical reduction **[24]**.

## Conclusion

Volar Barton's fracturesis a compression injury with a marginal shearing fracture of the distal radius. Surgical treatment by plating in adults provides an excellent outcome, improvement in symptomatology, deformity, stability and lifestyle in patient suffering from volar Barton distal radius fractures.

**No Conflict of interest.**

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