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A prospective study of surgical management of distal end radius fractures using volar rim variable angle locking plates

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Abstract

Background: To assess the clinical and functional outcome of surgically treated distal radius fractures specially involving volar rim fixed with Volar Rim Variable Angle Locking Plates.

Objectives: To evaluate the radiological union in fractures of distal radius fixed with Volar Rim Variable Angle Locking Plates. To evaluate clinical and functional outcome associated with this treatment modality. To study the complications associated with this treatment.

Materials and Methods: 20 cases of distal end radius fractures surgically treated with Volar Rim Variable Angle Locking Plate according to inclusion and exclusion criteria, all patients followed up for a period of 1 year and results assessed with using the Demerit point system of Gartland and Werley.

Results: In our study mean duration of complete union was 11 weeks which is comparable with other similar studies. We have achieved excellent results in 65% of cases, good in 20% of cases, fair in 10% and poor results in 5% of cases. Complications like stitch abscess, reduced range of motion, complex regional pain syndrome seen in 4 (20%) of cases.

Conclusion: Volar Rim Variable Angle Locking Plate gives an adequate buttress of the volar radius distal to volar projection of the lunate facet and do not interfere with wrist mobility. Volar rim plate in distal radius fractures provide good to excellent results and are effective in the correction and maintenance of distal radius anatomy.

Keywords: distal radius fracture, volar rim fracture, volar rim variable angle locking plates

Introduction

Fractures of distal end radius are one of the most common skeletal injuries of upper extremity. The application of locking plate technology of the distal radius fracture fixation enables dorsally unstable fracture configurations to be reliably reduced and internally fixed using a volar approach and volar implant placement. The volar approach has gained widespread popularity due to the perceived benefits of greater soft tissue cover over the implant and less tendon irritation than with the dorsal approach. This technique may be used for the majority of distal radius fractures, however an understanding of distal radius anatomy and biomechanics as well as correct implant choice and placement are critical to successful outcome [3]. Coronal split of the distal radius, or volar rim fractures, are classified as fractures type 2.3B3 according to the AO / OTA Classifications. These fractures are a subset of unstable distal radius fractures caused by shearing forces [1]. The orientation of the lunate rim creates a setup for a triangular fragment that a conventional volar plate is unlikely to capture because the distally directed screws may penetrate the wrist joint. The risk of loss of reduction or failure is increased if the lunate facet fragment is less than 15 mm and the fracture is fixed with a standard volar plate; this situation merits additional fixation technique. In addition some volar rim fractures are not restricted to the volar cortex but extend to the dorsal cortex, creating a complete articular fracture in which a single buttress plate would displace the articular surface dorsally. For very small fracture fragments, wire loop fixation techniques have been described where a wire is passed through the volar capsule or intercapsular ligaments without disrupting the vasculature and connective tissues around the volar lunate fragment. Fragment- specific devices have also been tried for comminuted fractures but they require multiple incisions and have a steep learning curve [2].

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Materials and Methods

The study was conducted on 20 patients diagnosed with distal radius fracture admitted in SSIMS & RC teaching hospital, Davangere. They were treated with volar rim variable angle locking plate. The study period was from Aug 2017 to Aug 2019. The study is a clinical, prospective and observational study. After obtaining a detailed history, complete general physical and systemic examination, the patients were selected according to inclusion and exclusion criteria.

Inclusion criteria

1. Adults over 18yrs of age, both male and female with distal radius fracture AO Muller type 2 3- C.
2. Patients medically fit for surgery.
3. Fractures of distal end of radius of either side with or without ulnar styloid fracture.
4. For fixation of complex intra and extra articular fractures.

Exclusion criteria

1. Pathological fractures
2. Skeletally immature patients.
3. Non union and late presentation of fractures more than 2 weeks.

Patients admitted with distal radius fractures were classified under AO and Gartland and Werely classification.

Implant used: The 2.4mm Variable Angle LCP Volar rim distal radius plate is part of the 2.4 mm Variable Angle LCP Distal Radius System. The plates are anatomically contoured and allow buttressing of distal fragments, and are designed to address complex intra- articular and extra- articular distal radius fractures.

The plate is low profile stainless steel and titanium plate. The distal articular end of the plate consists of 5 locking holes for 2.7mm locking screws angle at 15 degree. The shaft of the plate consists of combi holes for insertion of 3.5mm locking or cortical screws.

Fig 1: Volar Rim Variable Angle Locking Plates

Operative procedure

Description: Modified Henry's Approach or trans flexor carpi radialis (FCR) approach between radial artery and FCR tendon. With the forearm in supination a longitudinal skin incision was used in line with FCR tendon. The length of the incision depends on the size of the plate. The fascia was released to expose tendon of FCR, which was mobilized by releasing the tendon sheath. The tendon was then retracted in an ulnar direction and an incision was made in the floor of tendon sheath. This exposed Flexor Pollicis Longus muscle belly which was swept to the ulnar side by blunt dissection. The tranverse muscle fibres of pronator quadratus were then evident and release from the radial side of the radius and elevated subperiosteally from the radius in a volar direction.

Fig 2: Modified Henry's Approach

The fracture line was clearly visualized and reduced by manipulation and ligamentotaxis. Provisional K- wires used to maintain the reduction. The appropriate plate with 2.7mm locking screws which were inserted in various desired angles of upto 15 degrees. 3.5 mm cortical and locking screws were applied.

Pronator quadratus sutured covering the distal end of the plate to prevent tendon irritation. Image intensifier is used to assist the evaluation of fracture reduction and fixation. Patients with unstable fractures, the wrist immobilised in a below elbow spint for 4 weeks. Patients were allowed to start wrist movements at an average of four weeks post operatively. After the discharge, patients were followed at regular intervals every 4 weeks for 4 months, then at 6 months and 1 year. Subjective and objective functional results were graded using Demerit point system of Gartland and Werley.

Results

20 cases of distal end radius fractures were treated surgically by volar rim plate in S.S. Hospital, Davangere between Aug 2017 to June 2019. All cases were followed up regularly. Average age in our study was 45.2 years. We evaluated our results and compared the functional outcomes with various other studies. There were 13 male patients (65%), 7 female patients (35%) in our study, the majority being male patients [Graph 1].

In our study the fracture of distal end radius was, right side (dominant wrist) involved in 12 cases (60%) and 8 cases (40%) involved in left side [Graph 2].

Graph 1: Sex distribution.

Graph 2: Side distribution.

In our study 6 (30%) patients met with road traffic accident. 14 (70%) cases had history of domestic fall. [Graph 3]

Graph 3: Mode of injury

Type C1 Muller's fracture was the most common fracture type 10 out of 20 [Graph 4]. Out of 20 cases 5 (18%) patients had associated injuries. In which one patient had Ipsilateral shaft femur fracture, two patients had head injury and one patient had ipsilateral clavicle fracture.

Graph 4: Type of fracture.

In our study 13 (82%) patients had union within 2-3 months and 5 (18%) patients had union in 3-4 months. There was no case of delayed union. Mean time for radiological union was 11 weeks. In our series, we had 70% excellent, 20% good, 10%, fair and no poor results. [5]

Graph 5: Results.

Discussion

Distal radius fractures are the most common fractures encountered in routine orthopaedic practice, restoration of articular anatomy is important for normal functioning. A combination of an improved understanding of distal radial anatomy, patient demands and the new fixation devices have changed the management of distal radial fractures [4]. Locking plates are preferred in osteoporotic and in multiple complex fractures [5]. During the recent years, volar approach has become more popular. Variable angle LCP is the newer implant in the treatment of comminuted intra-articular fractures of distal end of radius [6]. Variable-angle locking compression plates (VALCPs) have increased versatility in subchondral screw placement while maintaining the advantages of a standard fixed-angle locking plates. In particular, VALCPs facilitate surgeon-directed targeted placement of the subchondral screws that can potentially maximize fracture fragment fixation [7]. Volar rim variable angle locking plates has advantage of reduction of more comminuted type of distal radius fracture with placement of subchondral screws in any angle. Our results are compared with various other studies, in various parameters like involved side, mode of injury, type of fractures etc.

In our study the right side (dominant wrist) was involved in 16 cases and left side involvement was 12, male patients were 18 and females were 10, majority of cases were due to domestic fall at home i.e., 17 cases vs 11 cases due to road traffic accident. AO/OTA classification was used in our study for classifying the fractures which included type 2.3C fractures, majority of cases fell into type 2.3C1 i.e., 14 cases vs 9 cases type 2.3C2, and 5 cases were type 2.3C3. We encountered four complications (13.3%) in our study one being stitch abscess, 2 patients developed reduced range of movements and one case developed complex regional pain syndrome.

In our series, we had 70% excellent, 20% good, 10%, fair and no poor results. Patients who obtained excellent results had normal regular activities without any pain. Range of motion was within the normal functional range. Radial length, volar tilt and articular step-off were within acceptable limits. They underwent earlier physiotherapy. 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.

Case scenario

Fig 3a: Pre-Op X-rays

Fig 3b: Immediate Post-Op

Fig 3c: 6 Weeks Post-Op

Fig 4a: Active Dorsiflexion & Volarflexion

Fig 4b: Active Supination & Pronation

Conclusion

A fall on a outstretched hand is the common mode of injury causing distal radius fractures. Distal radial fractures which occur due to road traffic accidents (high energy trauma) are mostly intra-articular, displaced and unstable Gartland and Werley group II and III and AO type B2, B3, C1, C2 and C3 [11, 12]. The results are evidence that Variable angle locking plates are good implant in the treatment of intra-articular unstable fractures of distal radius. It allows effective anatomic realignment and early wrist mobilization. It is biomechanically superior due to closer joint interface placement and better screwing capability in different directions. A successful anatomic alignment was made possible regardless of the direction of fracture angulation with Variable angle volar locking plate. 90% of the patients went back to their daily activities with good recovery. Use of variable angle locking compression plates in distal radius fractures provide good to excellent results and are effective in the correction and maintenance of distal radius anatomy. By using these plates, joint motions and daily functioning is recovered in a shorter time. Hence Variable angle locking compression plate is a useful implant in fixing unstable and comminuted extraarticular distal radius fractures.

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