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Original Research Paper

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PROSPECTIVE STUDY OF FUNCTIONAL OUTCOME OF UNSTABLE DISTAL END RADIUS FRACTURE FIXATION WITH VOLAR BUTTRESS PLATING

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ABSTRACT **Introduction:** Distal end of radius fractures are the most common fractures of the upper extremity in adults. The goal of surgical fixation in the unstable distal radius fracture is to restore intra-articular and extra-articular anatomic alignment. This greatly reduces the incidence of post-traumatic arthritis and also the quality of reduction relates directly to the final outcome. **Methods:** Clinically proven 25 patients of distal end radius fracture were included in this study according to inclusion and exclusion criteria after getting written and informed consent, **Results:** In ORIF with volar buttress plating, we noted patient with poor outcome of 1 (4%), fair outcome of 2 (8%), good outcome of 2 (8%) and excellent outcome of 20 (80%) at the end of 6 months according to PRWE scoring. **Conclusion:** ORIF with volar buttress plating is a successful procedure for distal end radius fractures. Early return to pre morbid level of activity and functions occurs very swiftly.

KEYWORDS : Distal end of radius fractures, ORIF, Range of movements, Volar barton type

INTRODUCTION

Distal end of radius fractures are the most common fractures of the upper extremity in adults. The goal of surgical fixation in the unstable distal radius fracture is to restore intra-articular and extra-articular anatomic alignment. This greatly reduces the incidence of post-traumatic arthritis and also the quality of reduction relates directly to the final outcome.

The approach and management of distal end radius fractures has undergone a metamorphosis over time. Despite being a very common fracture, there is a lack of evidence in support of a single reparative technique as opposed to the use of others.

Distal radius fractures amount to around 15% of all fractures diagnosed and managed in the emergency rooms, with a 17% lifetime probability of sustaining this injury.[1] The approach and management of distal radius fractures has undergone a metamorphosis over time. Despite being a very common fracture, there is a lack of evidence in support of a single reparative technique as opposed to the use of others.

Distal radial fractures have a bimodal age distribution, consisting of a younger group who sustains relatively high-energy trauma to the upper extremity and an elderly group who sustains both high-energy injuries and insufficiency fractures.

Following a distal radial fracture, the attainment and maintenance of anatomical reduction of the articular surface is crucial to the preservation of wrist function. The degree to which articular step–off, gapping between fragments, and radial shortening can be improved with surgery correlates strongly with improved outcome. Hence, a treatment method that is more likely to achieve these results in better function. The volar buttress plate system has been shown to be reliable for the fixation of distal radius fractures. The volar approach is less disruptive to the nearby tendon than the dorsal approach, because there is more space available for the plate on the volar surface of distal radius. An advantage of the volar buttress plating technique is the comfort that it provides to patients in initiating early finger and wrist motion. Early rehabilitation possible with the new design, the distal screws are locked to the plate, which stabilizes the screw against lateral movement (toggle) and resist loosening. This provides additional strength to the fixation by constructing a scaffold under the distal radial articular surface. The proximal diaphyseal screws fix the plate strongly to thick cortical bone, completing this stable form of fixation.[2] As open reduction and volar buttress plating ensures more consistent correction of displacement and maintenance of reduction, this study evaluates the anatomical and functional outcome of open reduction and volar buttress plate fixation in the management of distal end radius fracture.[3]

Distal end of radius fracture accounts for 17% of all fractures in adults. The primary goal of treatment is to return the patient to his or her pre fracture functional status and to independent to carry out their daily needs. The most widely used conceptions are volar buttress plates with screws or pegs offers stability and a safe approach to the fracture. Previous studies suggest that on basis of biomechanical studies of two types of plating systems, in comparison volar buttress plate was a better outcome to locking plate. To obtain the anatomical reduction methods of treatment involving open reduction and internal fixation with volar buttress plates are being preferred.[4]

Malunion occurs more often in Volar Barton's fracture and can result in considerable disability. Malunion can be caused by failure to secure an accurate reduction, recurrence of deformity after an accurate reduction, marked combination of fragments. Complete rupture of the distal radio ulnar ligaments with excessive mobility of distal ulna, failure to keep the fracture immobilized until consolidation is complete and marked crushing of fragment in elderly people with osteoporosis. In the clinical practices, various methods are used for the management of Volar Barton's fractures. The Volar buttress plate technique is now mostly chosen for the management of this type of fracture.

METHODS:

This study was conducted in Department of Orthopaedic, Sardar Patel Medical College, Bikaner (Rajasthan). Twenty-five patients was considered who was undergo the procedure between December 2018 to December 2020. The total follow up times was 6 months. All patients having isolated distal end of radius fracture volar barton type AO type 23-B1, 23-B2, 23-B3. Open fracture, pathological fracture, distal end of radius fracture associated with other injury around the wrist joint, patients with comorbid conditions preventing surgical intervention, patients with more than 3 weeks duration of injury, patients with local tissue condition making the surgery inadvisable were excluded.

Patients attending Trauma Casualty was undergone for primary survey and categories according to triage system in Green, Yellow and Red from severity of the patients. Selection of patients was done randomly according to the criteria mentioned. Importance was given to the general examination to rule out any other associated injuries. Below elbow (B/E) slab was applied after evaluating the neurovascular status and supplemented with analgesics. Radiograph of involved wrist joint in antero-posterior and Lateral view was taken. CT scan of the wrist was done if required for planning of surgery and to rule out any other subtle injuries.

Fracture was classified according to AO/OTA classification. Radiographic evaluation of affected & normal side was done at the time of injury with the antero-posterior and lateral views. The radiographs was assessed in terms of loss of Palmar tilt or presence of dorsal tilt, radial shortening and loss of radial inclination. Fractures was classified according to the AO/OTA Classification into types partial articular (23-B1, 23-B2, 23-B3) of distal end of radius fracture Volar Barton fracture.

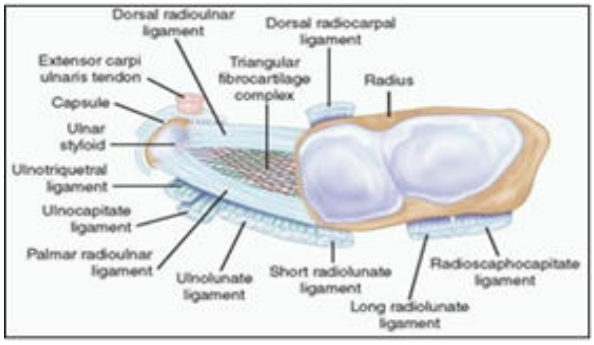

Figure 1

Surgical techniques:

All surgeries were performed on an elective basis under standard aseptic precautions. Surgery were performed under general anesthesia or regional anesthesia. Standard position was supine with arm on side of OT table.

Painting and draping was done under all aseptic precaution. The skin were incised longitudinally along the course of the flexor–carpi–radialis (FCR) tendon. The flexor–carpi–radialis (FCR) tendon were retracted to the radial side to expose the ulnar corner of the distal end of radius. The flexor–carpi–radialis (FCR) tendon may also be retracted to the ulnar side to expose the radial styloid and scaphoid fossa. Great care was taken to avoid pressure on the median nerve. Underneath the flexor–carpi–radialis (FCR) the flexor–pollicis–longus (FPL) tendon was retracted ulnarly to reveal the pronator quadratus (PQ) muscle. The pronator quadratus (PQ) muscle was elevated from its radial origin and reflected ulnarly to expose the distal end of radius. Pneumatic tourniquet was used.

Open reduction were performed with the aid of intrafocal leverage, traction by an assistant/distractor, and provisional fixation by temporary Kirschner wires followed by definitive volar buttress plate and screws. Image intensifier was used in theatre to assist the evaluation of fracture reduction and fixation. Final position of the plate and screws were checked under C- Arm to ensure proper reduction and fixation.

After reduction and plate fixation layer by layer closure was done with the help of suture material. Aseptic dressing and above elbow slab was applied.

Volar approach (Fig.3): After painting and draping, a longitudinal incision of about 7.5cm long was made on the radio-volar aspect of the distal forearm. The plane between the flexor–carpi–radialis and the Palmaris– longus was developed. The flexor–pollicis longus tendon was retracted radial ward and the median nerve and the other tendons were retracted ulnar ward. The fibres of the pronator quadratus were erased from their origin on the radius and fracture was exposed.[5-8] Fracture was reduced and a volar buttress plate was contoured so that, when it is applied and fixed to the proximal fragment, the distal transverse part was act as a buttress and hold the fracture reduced. A minimum of two screws were inserted in the proximal fragment. In this study volar approach was found to be more advantageous because of the smooth and flat surface of bone where the plate could be placed well. A better buttress effect was provided against volar collapse. There was also no evidence of tendon rupture in this approach. Post operatively, the upper limb was elevated for 24 hours with monitoring of neurovascular status. Early motion of digits, elbow and shoulder was encouraged Patients were assessed subjectively and objectively. A detailed questionnaire was prepared for each patient to evaluate factors like pain, functional limitations and occupational hindrance. PRWE wrist scoring system was used.

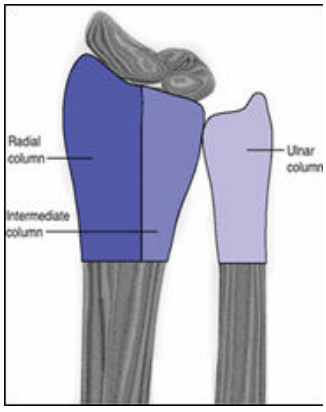

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

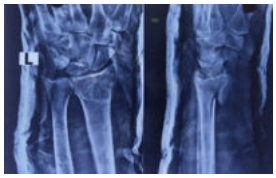

Figure 7

Figure 8

Operative protocol: The upper limb was elevated for 24 hours with monitoring of neurovascular status. Early motion of digits, elbow and shoulder was encouraged. Post–operative results progress of total study population. The most common category was Excellent in which 20 patients, out of total study population.

Follow ups: The patient was asked to come for follow up at 2 weeks, 6 weeks and at 12 weeks. Final evaluation of result was done at 6 month for functional and radiological outcome.

Figure 9

After discharge from hospital on postoperative day 5, patient was followed up on 2 weeks, stitch line margins was assessed and if found normal then stitches were removed. Active finger movements and neuro-sensory status was assessed. Patient was encouraged for wrist, elbow and shoulder exercises. Slab was removed or kept according to the status of pain and swelling. On 6 weeks, X-ray wrist AP and Lateral view was taken to assess the process of healing, position of plate and screws for any loosening, radial length, radial inclination, dorsal angle, and ulnar variance. Instructions was given to patient regarding active strengthening of muscles of forearm and arm. Clinically range of movements (active and passive dorsiflexion, active and passive palmar flexion, radial and ulnar deviation, supination and pronation) were assessed. On 12 week, patient was assessed for any tenderness, plate and screws irritation. Range of movements (active and passive dorsiflexion, active and passive palmar flexion, radial and ulnar deviation, supination and pronation) and pain on movement was assessed. X-ray of wrist joint AP and lateral was taken to assess the union of fracture (callus appearance) and disappearance of fracture gap, plate loosening, radial length, radial inclination, dorsal angle and ulnar variance.

Radiological assessment was done in terms of residual dorsal angulation, radial shortening and loss of radial inclination and the results was graded according to the Sarmiento's modification of Lind Storm Criteria.

These parameters was assessed during follow up of the patient to assess quality of reduction and ability of the technique to maintain the reduction.

RESULTS:

It was a prospective study with the duration of follow up of 6 months. There were total number of 25 patients in which 17 were male and 8 were females between 18 to 68 years (Mean age 41 years) of age groups. 20 (80%) of patients sustained from Road traffic accidents, 3 (12%) were fall injury and 2 (8%) were from other assaults. Out of total 25 patients, 22 patients were operated in 0–10 days, 2 patients were operated in 11–20 days, 1 patient was operated in 21–30 days. There is no patient which is operated in >30 days. Side of operation of the total study population, Out of total 25 patients 13 patients were operated left side and 12 were in right side.

DISCUSSION:

In our study, we focused specifically on rate of recovery noted by return of motion, function, and strength in patients treated with the same volar buttress plate. Extension improved significantly between 2 and 6 weeks and 3 months. Flexion showed significant improvement between visits until 6 months. There was some concern that a statistical improvement for later intervals may have been washed out by our carry forward method for missed follow-up appointments. However, a second analysis was performed evaluating only patients with complete data sets and the findings were the same. Pronation improved more rapidly than supination and both returned to near normal at the 1 year time point; supination returned to 99% of the uninjured side.

The PRWE score, which is more specific for the wrist, improved from the 3 to 6 month time period.

The primary limitation of the study was patient non-compliance with follow-up visits greater than 3 months. This was an unfunded study; therefore, patients were not compensated for returning to hospital. The majority of patients lived a significant distance from our center and were doing well, making it difficult in some cases to convince them to return to our hospital. It is possible that patients returning after 3 months may have created a negative bias; patients whose wrists were not performing to expectation were more likely to return. Having different hand therapists taking the measurements could be considered a limitation. Other limitations include small subject numbers and lack of a comparison group.

These results should provide answers as surgeons respond to their patients' questions about recovery time following volar buttress plate ORIF for treatment of an unstable distal radius fracture. Greatest gains in motion occur during the first 3 months after surgery; however, all measures continue to show improvement until 1 year. Patients' grip strength, a good indirect measure of function, showed steady improvement. Recovery was more rapid when the dominant side was injured, with grip strength 97% of the contralateral side at 6 months. Grip strength of the injured, non–dominant side only reached 84% of the uninjured side at 1 year. Despite the relatively quick return of motion, patients may expect some differences in motion of the injured wrist compared to the contralateral wrist to persist at 12 months.

The rise of intra articular distal radius fractures and its various presentations of complexity in even younger individuals are predominantly due to high energy trauma especially road traffic accidents.

In our study, around 80% of patients are due to RTA and presented with polytrauma at the emergency ward. The exact incidence and demography of distal radius intra- articular fractures.

It's a most common mode of injury was RTA 80% cases, fall 12% and others 8%.

In the study, belong to AO type 23B1, 23B2, 23B3 of distal end of radius fractures and graded the severity accordingly. Out of 25, 8 cases were AO type 23B1, 9 were from 23B2 and 8 were from 23B3 cases had sustained a partially intra–articular (AO type B) fracture. The volar buttress plate was the relatively newer choice of implant was used in all our patients, with maximum number of screws in the metaphyseal region in the desired direction of anchorage.

Recent biomechanical and clinical studies which were undertaken for knowing the distal radius fixation revealed placement of screws in the metaphyseal bone with as close as 5mm close to the distal subchondral bone without violating its articular surface.

It became evident that more screw placement in the distal metaphyseal acts as buttressing of fractured distal fragment and maintain the articular surface.

The clinical assessment of the distal radioulnar joint becomes difficult in the emergency room setting but it can be assessed under anesthesia after rigid fixation of the distal radius like piano key test.

Improved biomechanical understandings of the ligaments of the wrist led to the implementation of reefing technique, placement of plate more distally in volar aspect such that screws in the distal metaphyseal fragment was buttress the fragments well and prevent collapse of the articular comminution.

The mean range of functional outcome was Palmar flexion was 74°, Dorsiflexion 71°, Supination 78° and Pronation was 74°.

In the study, volar buttress plates associated with very good results based on PRWE score and are comparable to other studies as tabulated below:

Table 1

Results	Age (In yrs.)						Total
	20	21–30	31–40	41–50	51–60	61–70	
Excellent (0–1)	1	7	4	4	4	0	20
Good (2–4)	0	0	0	1	1	0	2
Fair (5–7)	0	0	0	0	1	1	2
Poor (8–10)	0	1	0	0	0	0	1
Total	**1**	**8**	**4**	**5**	**6**	**1**	**25**

CONCLUSION:

Complications were at least and are comparable with standard studies. We had one patient with painful movement of wrist (Dorsiflexion, Palmar flexion) and difficult to lift heavy weight at 10 weeks.

The results of the study patients were comparable to studies like Dennison et al and better from Bradway et al and Anakwe et al but a vast majority (80%) had excellent functional score (PRWE score) and satisfactory movement.

Primary internal fixation of the distal end of radius fixed with volar buttress plate facilitates early mobilization and hence earlier return to activities with good range of movements, especially rotations.

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