

ORIGINAL RESEARCH

Outcome Analysis of Fracture Lower End Radius (AO Type B & C) Treated by Orifand Plate

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ABSTRACT

Background: Treatment of distal radius fractures is difficult due to comminution and joint involvement. Plating is now the standard treatment method for distal radius articular fractures because of higher rate of complications after conservative management. **Aim:** The aim of the study was to evaluate the usefulness of volar locking plate fixation method of distal radius fracture and to compare it with other results.

Materials and Methods: We evaluated 28 patients from volar locking plates from December 2012 to March 2017, treated for distal radius intraarticular fractures by using a volar locking compression plate. Standard X-ray and clinical assessment after 1 year were measured and final outcome were assessed using modified Gartland and Werley score.

Results: At the end of 12 months, 17 cases out of 28 cases in which most of the excellent results in AO type B fractures (excellent outcome in 13 patients out of 16 patients i.e. 81.25% cases) as compared to type C fracture where it was 33.33% cases (excellent outcome in 4 patients out of 12 patients). One case developed of superficial wound infection which resolves with antibiotics.

Conclusion: The distal radius fixation volar locking plate restores anatomy, helps in speedy movement of wrist and function, prevents postoperative collapse of fracture and hence is an excellent treatment method for distal radius fractures.

Keywords: Fracture Distal Radius, ORIF, Volar Locking Plates.

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INTRODUCTION

Treatment of distal radius fractures is difficult due to comminution and joint involvement. These fractures are unstable & difficult to reduce. They are accompanied by complications which include reduced grip strength, limited motion, carpal stability, malunion, distal radioulnar joint subluxation/dislocation and late disruption of fracture. Multiple procedures like reduction and cast application, external fixator application, k wire fixation leads to a poor

functional outcome. The resulting deformity of the wrist causes pain, movement limitation and wrist joint arthritis.^[1-7]

Restoration of normal alignment and articular surface, with a stable fixation and/or bone grafting can be difficult, but it is needed for a good functional outcome. The fracture reduction directly correlates to the outcome. The plate reconstruction offers fracture reduction directly as well as a stable fixation. Another important benefits are early post-operative mobilization and rehabilitation. With the use of Lock Compression Plate (LCP), small bone piece can be held together. Thus, this study aims to evaluate the role of the volar plate fixation as the treatment method of choice for distal radius fractures and compare it with other results.^[7-9]

MATERIALS & METHODS

Duration & Place of study : 35 cases of fracture distal end radius operated by open reduction and internal fixation by volar locking plates from December 2012 to March 2017 in our institution were reviewed who fulfilled the inclusion criteria. 7 patients were lost in follow-up. Hence records of a total of 28 cases were available for this study.

Type of study randomized prospective study

Inclusion criteria: Adults (age >18yrs and < 60yrs), AO type B&C, Displaced intra articular fracture distal radius with 1) volar or dorsal angulation of >100, 2) radial inclination <150, 3) Intraarticular step off >2mm, 4) >5 mm of shortening by ulnar variance on the posteroanterior radiographic view, fractures < 3 weeks old.

Exclusion criteria: Unfit for anesthesia, skeletal immaturity, pathological fractures, compound fractures, polytrauma, known alcohol or drug dependency, inability to participate in the study, neuromuscular disorder & Inflammatory arthritis. Patients participating in other clinical trials of a drug or device were also excluded.

Consent: Written consent was obtained from the relatives of patients after explaining them the nature and purpose of the study. They were assured that confidentiality would be strictly maintained. The option to withdraw from the study was always open.

Methodology: The mean age of 20 male patients and 8 female patients was 36.86 years (Range from 18-56 years). The most common mechanism of injury was a fall on outstretched hand. Nineteen patients had their dominant limb fractured. Fracture radius was classified by the AO Classification system as follows: Type B1 in 3 cases, B2 in 2 cases, B3 in 11 cases, C1 in 6 cases, C2 in 3 cases and C3 in 3 cases. Most cases were surgically treated within first week of the injury (range 0-14 days).

Surgical Procedure: Patient were taken up for open reduction and fixation with Anatomically contoured Volar locking plate. Of the 35 patients, 15 underwent Surgical fixation under general anesthesia while remaining 20 underwent brachial plexus block. The procedure was done in supine position. A Pneumatic tourniquet was used in all cases. Using the standard Volar (Henry's) approach, intermuscular plane was developed between brachioradialis & FPL. Radial and distal borders of the pronator quadratus muscle were elevated and retracted. Fracture site was exposed subperiosteally.

Fracture fragments were curetted and anatomic reduction achieved with the help of manual distraction, intrafocal leverage, or dis-engaging the fracture. Temporary fixation by Kirschner wires was done. Volar locking plate was fixed and confirmed in C Arm machine. Additional stabilization, if found necessary, was done either with k-wires. After fixation, pronator quadratus muscle was attached to its insertion with absorbable sutures. Postoperatively plaster splint was applied in supination and 100-150 palmar flexion till suture removal. Active and passive finger motion exercises were encouraged post operatively. Post-operatively.

Sitting up in the bed was allowed once the brachial block effect was over. 1st check dress was done on day 2 & Post-operative X Ray was taken. On the 5th postoperative day the patient was discharged after 2nd check dress. Stitch removal was done usually on 11th Post-operative day and splint was removed. Patients were started on wrist and finger range of motion exercises. Both active as well as passive movements were encouraged. Prayer stretch for extension of the wrist, passive flexion, Forearm rotation for supination/pronation, Grip strengthening by ball in the hand exercises, Grasping, opposition and pinch exercises, Elbow flexion and extension, Shoulder flexion, abduction and extension exercises were taught by a physiotherapist and encouraged. Weight lifting was prohibited for at least 12 weeks after operation.

Follow up: All patients were followed up at 1month, 3 months, 6 months, and 1 year post-operatively. At the time of each visit of patients, anteroposterior and lateral view X rays of both wrists were done. They were assessed for reduction and bony union, volar tilt, radial inclination, radial height, and ulnar variance. Range of motion was evaluated at each visit.

Scoring System: Scoring was done by modified Gartland and Werley scoring system. Gartland&Werley's score improved in due course of time at final follow up mean Gartland&Werley score was around 2 which was excellent. [Figure 2]. Poor results can be because of poor reduction of fracture fragments.^[10]

RESULTS

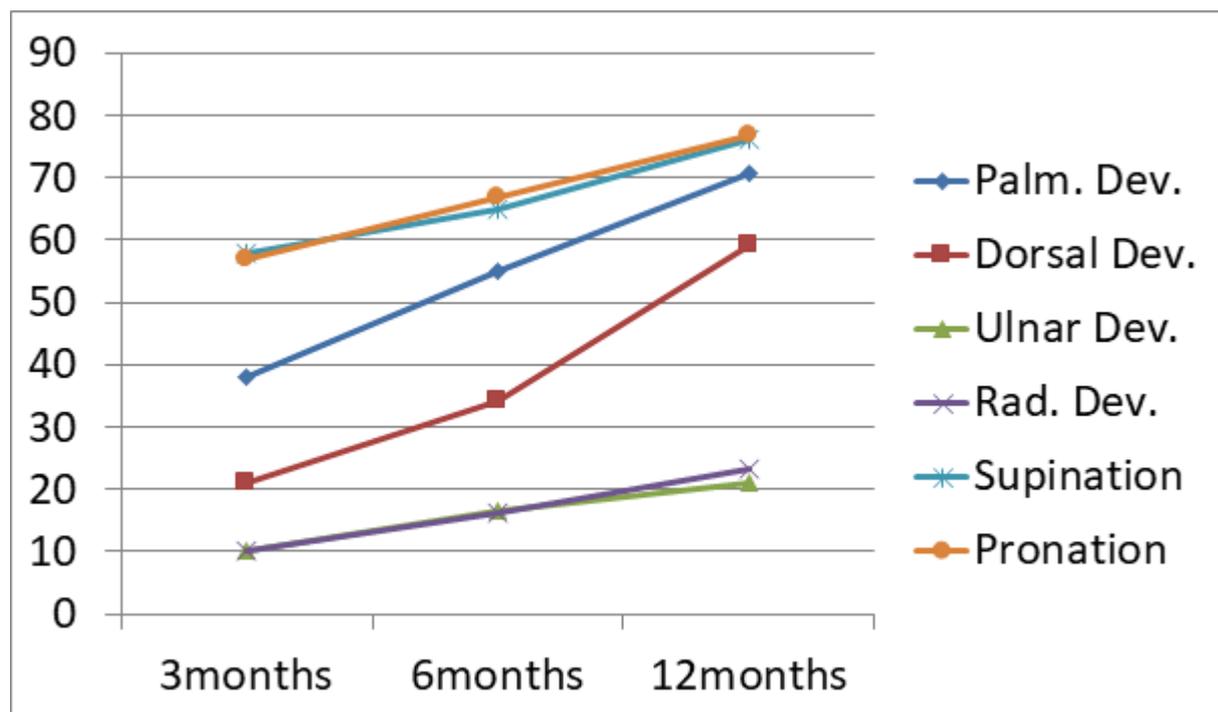


Figure 1: Average Movements at wrist gained with time

Patients were traced for a minimum duration of one year. (range: 12-24 months). Radiographic parameters assessment revealed average radial height, radial inclination, ulnar variance and palmar tilt, calculated at one to three months was found to be 8 ± 1 mm, 17 ± 4 degrees, -0.1 ± 0.6 mm, and 7 ± 5 degrees respectively. At the end of 12 month of visit, the average radial height, radial inclination, ulnar variance, and palmar tilt changed to 8 ± 1.2 mm, 17 ± 4 degrees, -0.1 ± 1.9 mm, and 7 ± 5.1 degrees respectively.

No significant difference x-ray parameters were noted at the end of 12month follow-up, indicating no further appreciable collapse of fracture and maintained reduction in due course

of time. The flexion at the end of 12month of follow-up was 60 ± 9 degrees and extension 50 ± 10 degrees. The average supination was 77 ± 11 degrees and pronation 84 ± 5 degrees at 12month of follow-up as shown below. [Figure 1] 90% of patients reported pain grading on the visual analog scale one or less than one at 12 weeks and at final follow-up.

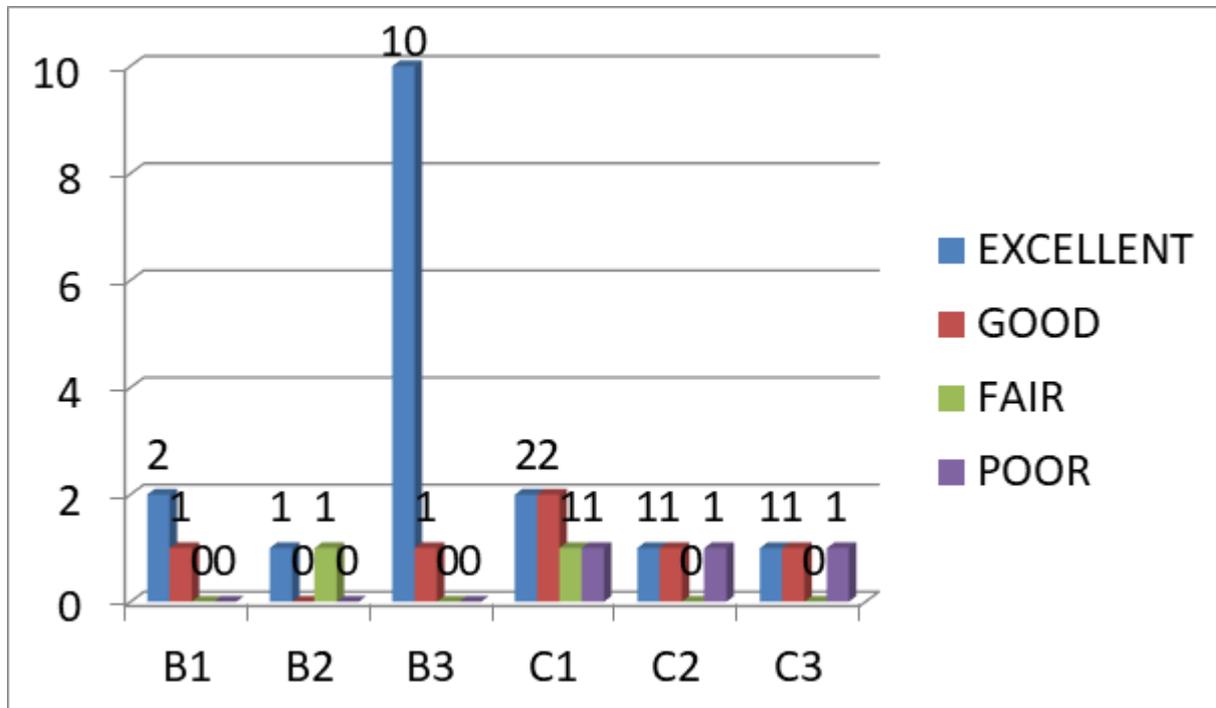


Figure 2: BAR DIAGRAM showing AO subtype and functional outcome

In our series; [Figure 2] At the final follow-up,

- Excellent results in 17 cases out of 28 cases in which most of the excellent results in AO type B fractures (excellent outcome in 13patients out of 16patients i.e. 81.25% cases) as compared to type C fracture where it was 33.33% cases (excellent outcome in 4 patients out of 12 patients).
- Good results in 6cases out of 28 cases out of which mostly patients were AO type C fractures.
- Fair results in 3 cases out of 28 cases.
- Poor results in 2 cases out of 28 cases which were in AO type C fractures.
- So plating has a better outcome in AO type B fractures, While equivocal results in type C fractures.
- One patient developed superficial skin infection on the 5th postop day which was resolved around the 10th postoperative day and the rest of the period was uneventful. So overall complication was reported in one patient. None of the case had any nerve palsy, tendon rupture, nonunion or implant failure.

Statistical Analysis

The collected data was summarized by using frequency, percentage, mean & S.D. To compare the qualitative outcome measures Chi-square test or Fisher's exact test was used. To compare the quantitative outcome measures, Independent t test was used. If data was not following normal distribution, Mann Whitney U test was used. SPSS version 22 software was used to analyse the collected data. p value of <0.05 was considered to be statistically significant.

DISCUSSION

Stable fixation along with joint surface reduction is the primary goal in the treatment of distal radius fractures. Secondary goal is to prevent secondary arthritis and poor functional outcome. Various treatment modalities for distal radius fracture fixation include close/open reduction and cast application, k-wire fixation, external fixator, plates application. Volar plate approach offers spacious distal radius suitable for implant fixation. Also, its application technique is relatively simple and prevents damage to the blood supply which is important for bony union. Locking plates are especially useful in osteoporotic fractures to prevent fracture collapse. The single unit plate and screw locking construct holds and supports the bony fragments. Plating offers direct visualization of fracture fragments helpful in anatomy restoration, early mobilization and hence early and better return of wrist function and hence reduce morbidity.^[11-12]

Numerous complications are described with plating which include risk of infection, tendon irritation, tendon rupture requiring implant extraction in few cases. The pronator quadratus muscle acts as a barrier to minimize flexor tendon irritation. In our study, pronation improved more rapidly as compared to supination. While both returned to near normal at the end of final visit. No significant collapse of the fracture occurred at the end of 12 months. Our results compared favorably with existing literature. In 2010 Gerald Gruber et al reported >90% of patients had excellent to good results by Gartland and Werley score after plate fixation of distal radius.^[13,14]

Sharma H et al studied outcomes and complications of fractures of distal radius (AO type B and C): volar plating versus nonoperative treatment. The range of movement, grip strength, functional outcome scores and radiological parameters were compared. Range of movement and functional scores were significantly ($p < 0.001$) better in the volar plating group, but the difference in ulnar variance and radial and ulnar deviation was insignificant as compared to the nonoperative group. At 24 months follow-up, the nonoperative group had significantly more cases with malunion, articular incongruity and osteoarthritis. In cases of AO type B or C fractures of the distal radius, volar locked plating provides anatomical stable fixation and early mobilization with better clinico-radiological outcome as compared to conservative treatment.^[15-17]

Piuzzi NS et al analyzed the clinical and radiologic outcomes in the elderly patients with AO type C DRF treated with volar locking plate (VLP). Mean follow-up was 28 months. Outcome assessment included range of motion, grip strength, VAS pain, Mayo Clinic Score, and DASH score. Analysis of pre- and postoperative radiographs was performed. Complications were recorded. Five (7%) patients required plate removal. The treatment of articular DRF (AO type C) with VLP in the elderly patients achieved greater than 90% of the wrist range of motion and grip strength with no residual pain in greater than 90% of the patients.^[18]

Gerald G et al hypothesized that volar locked plate fixation of AO type C2 or C3 fractures could effectively maintain radiographic reduction as shown by comparison of immediate postoperative alignment and that seen after more than 12 months' follow-up. The main outcome measures were volar tilt, radial inclination, radial length, and articular incongruity were radiologically assessed immediately postoperatively and at the time of final follow-up. Conclusion was that the treatment of intra-articular fractures of the distal radius with a volar locked plating system is associated with a small but statistically significant loss of volar tilt and radial inclination upon comparison of immediate postoperative alignment with that seen after more than 12 months' follow-up.^[19]

Roh YH et al too did a randomized comparison of volar plate and external fixation for intra-articular distal radius fractures. They evaluated functional assessments (wrist range of motion, grip strength, and Michigan Hand Questionnaire) at each patient visit and measured

radiographic assessment (radial inclination, volar tilt, ulnar variance, and articular congruity) at 12 months. These results for functional recovery after distal radius surgery offer insight into treatment decisions and interpretations of treatment outcomes for patients with comminuted intra-articular distal radius fractures.^[20]

Jeudy J et al did treatment of complex fractures of the distal radius in a prospective randomised comparison of external fixation 'versus' locked volar plating. The clinical results on the Green and O'Brien rating were significantly better in the ORIF group than in the EF group ($p < 0.01$ at 6 weeks, $p < 0.05$ at 6 months). Nevertheless, open reduction and volar plating did not yield better subjective results than EF. However, although not statistically significant, patients treated by ORIF seemed to resume their usual activities quicker than those treated with EF, suggesting that this technique may be adapted to a greater extent in the case of active, young individuals. Similar results are seen in our study too. Another study by David H. Wei. Et al (2009), reported better DASH scores after locking volar plate fixation comparable to our study. Anatomical reduction and stable internal fixation is the primary goal of treatment for intrarticular distal radius fracture.^[21]

Grewal R did a randomized prospective study on the treatment of intra-articular distal radius fractures: open reduction and internal fixation with dorsal plating versus mini open reduction, percutaneous fixation, and external fixation. Objective, subjective, and radiographic outcomes were assessed at 2 weeks, 4 to 6 weeks, 10 to 12 weeks, 6 months, and 1- and 2-year intervals. The groups were equal with respect to age, gender, fracture subtype, and number of workers' compensation cases. The dorsal plate group showed a significantly higher complication rate compared with the external fixator group; therefore enrollment in the study was terminated. The dorsal plate group also showed statistically significant higher levels of pain, weaker grip strength, and longer surgical and tourniquet times. Based on these results we cannot recommend the use of dorsal plates in treating complex intra-articular fractures of the distal radius. This study is in contrast to our study result.^[22]

Bajwa AS et al during treatment of unstable distal radius fractures compared non-invasive dynamic external fixator versus volar locking plate and saw functional and radiological outcome in a prospective case-controlled series. The outcome measures included demographic details, injury mechanism, AO fracture type, risk factors, body mass index (BMI), ulnar styloid fracture and dorsal comminution, radiographs, grip strength and DASH score. DRF treated with non-invasive external fixator can give functional results superior to ORIF at three-months and the trend is maintained at one and two-year post-operatively.^[23]

CONCLUSION

Our study demonstrates that locking compression plate offers a good method of treatment for articular distal radius fractures. Reduction is maintained with lock compression plates in due course of time so that secondary displacement doesn't occur. Also, early return to functional activity can occur with vigorous physiotherapy. Based on our results, we opine that excellent functional outcome can be obtained in AO-type B fracture with volar locking compression plates. However, role of volar plating in AO-type C fracture is inconclusive and needs further studies to prove its role.

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