Original Research Article

Functional outcome of volar Barton's fracture treated with variable angle plate

Bharath M[1*], Manjappa C N[2], Prashanth G[3]

[1,2,3]Department of Orthopaedics, Mandya Institute of Medical Sciences, Mandya, Karnataka, INDIA.
Email: maheshbharath2@gmail.com

Abstract

Background: This study aimed to evaluate the functional outcome of volar Barton's distal end of radius fracture treated by open reduction and internal fixation by variable angle locking plate using demerit-point system of Gartland and Werley. **Materials And Methods:** 30 patients of volar Barton's fracture treated with variable angle locking compression plates at MIMS Mandya from January 2019 to December 2019 with age from 18 to 60 years. Clinical and radiological assessment for fracture union were performed at 3 weeks,12 weeks and 24 weeks interval and results were analysed by using demerit-point system of Gartland and Werley. **Results:** Thirty patients were followed for 6 months with mean fracture healing time was 16 weeks. 8 patients (27%) had excellent results and 20 patients (67%) had good results according to Gartland and Werley's scoring. Mean grip strength at end of 6 months was 95% of the contralateral side. There was no statistical difference between first postoperative and 6 months follow up radiographs for any of the measured variables. There was one case of screw backout and one case of screw misplacement requiring hardware removal. **Conclusion:** Open reduction and internal fixation with variable angle locking plate provides better functional outcome in treating volar Barton's distal end radius fractures.

Key Words: Distal radius, volar locking plate, variable angle

[*]**Address for Correspondence:**
Dr Bharath M, Department of Orthopaedics, Mandya Institute of Medical Sciences, Mandya, Karnataka, INDIA.
Email: xxxx@gmail.com

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INTRODUCTION

Distal radius fractures are the most common upper extremity fracture encountered by orthopaedic surgeons. Abraham Colles was the one who described this type of fractures in 1814 prior to the advent of radiographs.[1] Distal radius fractures constitute up to 15% of all extremity fractures. As life expectancies increase and the prevalence of osteopenia climbs, it is estimated that the incidence of these injuries will continue to increase over the next decade.[2] Restoration of radial length, radial tilt angle and congruity of articular surface is important for good functional result [3]. Failure to achieve and maintain near anatomic reduction can lead to degenerative arthritis, distal radio-ulnar and metacarpal instability and ulnar impaction syndrome with resultant pain, decreased mobility, strength and function.[4] Number of classification system has evolved taking into consideration the fracture patterns, degree of comminution, radial shortening and displacement, dorso-palmar displacement, angulations and soft tissue involvement. Several classifications have evolved that recognizes some of these variables, however no classification scheme successfully incorporates all the attributes of an individual injury. This led to burden on the surgeon to evaluate each fracture individually. Recent studies have shown that better methods of identifying and classifying distal radial fracture may direct the treating surgeon to alter the treatment and to adopt open reduction of these fractures in the proper circumstances[5] Barton's fracture is intra-articular distal end radius fracture with volar or dorsal displacement and is usually accompanied by subluxation or dislocation of radio-carpal joint. Chauffer's fracture is radial styloid fracture. There are

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many radiological classifications like Fernandez classification based on the mechanism of injury, Frykman classification[6] based on joint involvement and Melone's classification based on the displacement of intra-articular fragments and AO. Variable-angle locking screw technology has been incorporated into locking volar plates. This design allows the surgeon to direct the angle and position of the screws instead of following pre-designated screw position and the use of variable-angle locking screws will allow placement of screw fixation within the radial styloid, targeting higher quality bone. It also prevents the screw from penetrating into the wrist joint[7] Lately variable angle locking plates have become available providing greater versatility as these plates are low-profile, pre-contoured providing less soft tissue irritation as compared to conventional volar fixed locking plates. Variable angle locking screws allows an inclination of the screw insertion angle up to 15˚as compared to 5˚insertion angle in conventional locking plates.[8] With this background the proposed study was designed to evaluate the role of Variable Angle locking compression plates in treatment of distal end of radius volar Barton fracture.

METHODS

This Observational longitudinal Study was conducted in Department of orthopaedics, Mandya Institute of Medical Sciences for a period of12 months (from January 2019 to December 2019) with sample size of 30. Detailed history was taken from patient and clinical examination was done according to pre prepared Performa.Patients were subjected for further radiological investigations like x ray and CT scan when required. Finally, after the diagnosis based on CT scan and classified according to AO classification the patients were selected for the study depending on the fulfilment of inclusion and exclusion criteria. Informed written consent was taken from the study subjects after explaining to them the plan, surgical procedure going to be performed and complications associated with it and intention of the study in language best known to them. Operative procedure open reduction internal fixation with variable angle locking compression plates was performed. Post-operative rehabilitation protocol was followed and results were analysed both clinically and functionally using modified Gartland and Werley's wrist grading system.

INCLUSION CRITERIA

Age 18-60 years, AO Classification- Volar Barton's fracture, Patient with normal contra lateral wrist

EXCLUSION CRITERIA

Patients less than 18 and more than 60 years of age, Open fractures, Neuro-Vascular injury, Pathological fractures

RESULTS

Youngest patients in our series was 20 years and eldest was 58 years old and maximum were in 30 to 39 age group. In our study 16 patients had Left sided injury accounting for 53.3% of the total patients. In our study the most common mode of injury causing distal end radius fractures was Road traffic accident (RTA) 80%, followed by fall on outstretched hand with incidence of 14% (table no 01). Average follow up was 9 months ranging from 6-11 months in our study . There was no loss of follow up and all have completed minimum of 6 months follow up. Average duration of surgery was 55min (45-85 min). Radiological evaluation confirmed fracture healing in all patients by 4 months. There was significant difference in the clinical outcome between different follow ups (table no 02) Final evaluation in our series was done at 6 months follow up on the basis of demerit point system of Gartland and Werley. In our series 8 patients had excellent results accounting for 27%, 20 patients had good results accounting for 68%, 1 patient had fair result accounting for 3% and 1 patient had poor result accounting for 3%.(table no 03)

TABLE 1: MECHANISM OF INJURY

Mechanism of injury	Frequency	Percent
Direct injury	1	3.3
Fall from height	1	3.3
Fall on outstretched hand	4	13.3
RTA	24	80.0

TABLE 2: CLINICAL OUTCOME MEASUREMENT

Movements	At 6 weeks	At final follow up
Flexion	45.34 +/- 7.43	71.56 +/- 8.09
Extension	50.38 +/- 6.89	75.77 +/- 5.90
Pronation	70.67 +/- 5.49	78.43 +/- 6.56
Supination	76.76 +/- 6.02	82.67 +/- 4.98

TABLE 3: FINAL RESULTS

Results	Frequency	Percent
Excellent	8	27
Good	20	67
Fair	1	3
Poor	1	3

DISCUSSION

This study was undertaken to assess the functional outcome of operative management of intra articular fracture distal end radius (volar Barton fractures) by open reduction and internal fixation by variable angle locking plate. The best method of obtaining and maintaining an accurate anatomy remains a topic of considerable controversy. However recent critical evaluation of fracture pattern and results of treatment have demonstrated the need for surgical intervention. The widely used

conventional fixed angle locking screws provide stable locking in the plate hole if these screws are inserted within less than 5^0 of precise perpendicular direction to the hole. Subchondral screw placement avoiding intra articular misplacement of the screw remains challenging, due to fixed angle plates. These difficulties have led to development of variable angle locking screws which permit an inclination of screw insertion angle up to 15^0. In our study, AO classification was used for classification of the fracture type. In this study we have used variable angle plates for intra articular fractures of distal end of radius volar Barton fracture. The present study includes 30 patients with intraarticular distal end radius volar Bartons fractures treated by volar plating. The average age of the patients in our study was 37 years with minimum age of 20 years and maximum age of 58 years. The average mean age of our study is comparable to the one by Bradway *et al.* and Arora S *et al.* who had an average age of 40 and 36 years respectively. Our study had a male predominance with 27 of 30 cases. Our study's male predisposition of 90 % which could be attributed to a highly active work group with a higher involvement in high energy trauma and high velocity injuries of RTA. In Arora S *et al.* study 65% were males and 35% were females while John R *et al.* in his study reported 70% female and 30% males. In our study left side (non-dominant) was involved in 53% study cases. The relatively more predisposition could be attributed to a less- protective and late defence mechanism when fall on the left side or using left hand. John R *et al.* and Arora S *et al.* in their study showed involvement of dominant right hand in 59% and 80% respectively while comparing to our study. In our study RTA was the most common mode of injury accounting for 80% which was comparable to other studies done by John R *et al.* (67%) and Arora S *et al.* (71%).in our study RTA was most common in younger age group and fall on outstretched hand was common in older age group. Radiographic evaluation in our study confirmed fracture healing in all patients by 4 months. There was no statistical difference between the first postoperative visit and final follow up radiographs for any measured variables. John R *et al.* in his study on 37 patients treated with variable angle plate for unstable distal end radius fracture showed radiological fracture healing in all patients by 3 months with 100% patients maintaining acceptable alignment at final follow up. At final evaluation, average volar tilt was 3^0, average radial inclination was 21^0, average radial height was 12mm. The current study had similar radiological results with average volar tilt was 5.26^0, average radial inclination was 22.78^0, average radial height was 11.34mm. Mignemi *et al.*[9] performed a retrospective study of 185 distal radius fractures who underwent fixed angle volar plate fixation and found that 88% of patients in their series achieved acceptable radiological parameters after internal fixation. These parameters remained stable from radiographs taken in the immediate postoperative period compared with final follow up at 3 months, the current study found 100% acceptable radiographic parameters using the same criteria. Figl *et al.*[10] retrospectively reviewed 85 patients who underwent variable angle volar plate fixation and obtained an average wrist extension of 54^0 and wrist flexion of 52^0. Patient in our study achieved better extension and flexion of 75^0 and 71^0 respectively. Figl *et al.* found forearm pronation and supination to 80^0 and 81^0 respectively. patients in our study achieved forearm pronation and supination to 78^0 and 75^0 respectively. The study of Figl *et al.* was retrospective in nature and also included AO type C fractures, compared to our prospective study, which had only AO type B3 fractures. In our study group the average grip strength increased from 6 weeks to final follow up from 42% to 95% which was comparable with the study done by John R Fowler *et al.* where mean grip strength at 1 year was 96% of the contralateral side. Evaluation of our results according to Gartland and Werley scoring is comparable with Figl *et al.* Final results as reported by Arora s *et al.* in their study were 85% excellent, 5% fair,5% good and 5% poor results according to Gartland and Werley system. In the present study there was 27 % excellent, 3% fair,67 % good and 3% poor results. This difference in the excellent results may be due to use of titanium implant for all the patients in the study conducted by Arora *et al.* and study sample was less compared to our study. Overall complications rate in our study was 20.8%, which is comparable to Jagodzinski *et al.*[11], they reported a complication rate of 19.6% with majority had screw misplacement. There was only one case of screw misplacement in our study because extra care was taken to prevent this complication by taking multiple C-arm images. The smaller sample size in our study could also be a reason for lesser screw misplacement. One patient had loosening and backing out of subchondral variable angle screw at 4^{th} week of follow up, patient was explained about the same and the screw was removed. Patient was asymptomatic post screw removal.

Earliest complication was seen at 2^{nd} week where one patient developed carpal tunnel syndrome, which was managed with a nocturnal splinting and the symptoms resolved in one month. This complication might be due to the edema post operatively. Two patients had sudeck's osteodystrophy these patients were treated conservatively with active wrist exercise and with NSAIDS. One patient ended up in malunion and was treated with aggressive physiotherapy. None of the patient experienced tendon rupture, nonunion.

Strengths of this study include the high follow up rate, standardized protocol and a prospective design with a

minimum follow up of 6 months. Moreover, we use routinely variable angle plates for all our distal end radius volar Barton fractures, so there was no selection bias in terms of choosing a fixed angle variable angle construct in this study.

Limitations of our study include the use of a single type of variable angle plate, in that outcome may not be transferable to other plates. We have only included volar Barton fractures (AO = B3) in our study and single scoring system. It is difficult to compare the treatment outcomes of this study with those of other modalities of treatment as we did not compare treatment methodologies. However, we believe that the data from the present study can be used for comparison in future studies. Future studies could benefit from comparative study with a fixed angle volar locking plate construct.

CONCLUSION

Open reduction and internal fixation by variable angle locking plate provides better functional outcome in treating intraarticular distal end radius volar Barton's fractures. The variable angle locking plate fixation restored and maintained acceptable reduction in all patients in our series with less complication rates. Range of motion at the wrist were satisfactory at the end of 6 months final follow up. The use of such plates helps in early rehabilitation without decrease in radiographic indices and hence better function outcome. However, a large group with long term follow up is needed with comparison study of variable and fixed angle constructs.

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