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Assessment of variable angle volar locking plate as a tool for treatment of unstable intra articular distal radius fractures

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Abstract

Background: Distal radius fractures are one of the common fractures, more so in geriatric age group. Functional outcome is of paramount importance, thus efficacy of newer implant systems remains to be evaluated in terms of patient satisfaction and functional results.

Methods: This prospective study involves 35 patients, all having unstable distal radius fractures and treated with Open reduction and Internal Fixation using Variable Angle Locking Plate system. The mean age of patients was 54 years. The PRHWE score was used for evaluation, and radiological assessment as a tool for fracture healing and union. At the time of final evaluation outcome was assessed as per Gartland and Werley scoring system.

Results: Average Range of motion as achieved in the present study was recorded as Pronation 79.35 Degree, Supination 82.32 Degree, Palmar flexion 59 Degree, Dorsiflexion 61.8 Degree & Ulnar deviation 3.30 Degree. Radiological parameters as measured at final evaluation were: Volar tilt 5.55 Degree, Radial inclination 18 Degree & Ulnar variance -0.52 mm.

At 6 months mean PRHWE score was 6.85 (SD±2.87). At 12 months mean PRHWE score was 4.52 (SD±2.30). Out of 35 patients, 32 patients had final score between 0 to 5 which was statistically significant ($P<0.001$), one patient had score between 6 to 10 and 2 patients between 11 to 15 according to the Gartland and Werley scoring system. All fractures healed within a mean period of 10 weeks ranging from 8 to 16 weeks. Three patients (8.5%) developed complications in the present study, which were screw irritation, delayed union, and Median nerve impingement.

Conclusion: Patients with unstable intra-articular distal radius fractures treated with variable angle volar locking plate shows good functional and radiological outcomes. Also Variable angled plate gives more freedom of screw placement in comminuted fractures.

Keywords: distal radius fractures, variable angle locking plate, PRHWE score, gartland and werley scoring system

Introduction

Fractures of the distal end radius are the most common fracture of upper extremity fracture [1]. They have Bi-modal distribution. Intra-articular fractures of distal end radius are due to high-energy trauma occurring in young adults whereas extra-articular distal end radius fractures are common in geriatric patients caused by fall on outstretched hand

There are various treatment options for intra-articular distal end radius fractures like external fixation, percutaneous pinning, open reduction and internal fixation by volar or dorsal approach. The closed reduction of unstable and comminuted intra-articular distal end radius fractures leads to permanent deformity, residual pain and loss of normal function due to loss of articular incongruity, palmar tilt, radial shortening [2].

In bio-mechanical studies placement of distal screws is important in maintaining articular congruity [3]. And unstable fractures of the distal radius remain challenging problem for orthopedic surgeons, there are increasing evidence of unsatisfactory results in maintaining radial length and radial inclination following reduction [4]. Variable angle volar plates can achieve better subchondral screw placement and provides better stability for the fracture fragments [5]. The main objective of this study is to assess functional outcome after open reduction and internal fixation using variable angle volar plate in intra-articular distal end

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radius fractures by using PRHWE score and radiological outcomes between fixed angle volar plate and variable angle volar plate by radial height, volar tilt, and radial inclination.

Materials and Methods

It includes 35 patients presenting in Outpatient Department and Emergency Department of a tertiary level hospital, operated by first author. The inclusion Criteria included patients with unstable intra articles distal end radius fracture of either sex within age group 18-80 years.

Unstable fracture considered were those that had dorsal comminution greater than 50% of the width of the dorsal cortex or any volar cortical comminution, initial dorsal angulation greater than 20, initial fracture displacement or translation greater than 1 cm, intra-articular disruption, and an associated ulnar neck or shaft fracture.

Exclusion criteria was patients with co morbidity that made anaesthesia administrations highly risky, patients with over 80 years or under 18 years of age, patients with pathological fractures. The surgery was done on patients after written informed consent. Anaesthesia used was either general anaesthesia or regional anaesthesia. All patients were operated with limb under mid arm tourniquet, using Standard Volar approach to distal radius. Fractures were fixed using Side specific variable angle distal radius anatomical locked plates. Postoperatively limb was placed in a wrist splint. Patient was given single dose of pre-operative intra venous anti biotic which was continued for 3 days after surgery. Wound inspection was done on 3rd day, with suture removal on 14th day. Rehabilitation with ROM Exercises were constituted and instructed to patients. Thereafter patient was assessed at 4 weeks, 6 weeks, 3 months, 6 months and 12 months.

Clinical assessment, PRHWE Score and radiological assessment was done at each follow up visit. Radiographic assessment was done to assess consolidation or collapse at the fracture site. The fracture was considered united when clinically there was no tenderness and subjective complaint like pain, and radiologically when the fracture line was not visible in Antero-posterior and lateral view radiographs.

At the time of final evaluation, outcome was assessed as per Gartland and Werley scoring system. Radiological assessment was done at final evaluation which included measurement of volar tilt, radial inclination and ulnar variance.

Statistical assessment was done using Chi-square test and *p* values were obtained at final follow up.

Results

A total of 35 patients (Male 20 and Female 15) were treated in this study with average age of 54 years (range 18-76 Years). The average follow up was 14 months. All fractures healed within a mean period of 10 weeks ranging from 8 to 16 weeks. Average Range of motion as achieved in the present study was recorded as Pronation 79.35 Deg ($P<0.001$), supination 82.32 Deg ($P<0.001$), palmar flexion 59 Deg, dorsiflexion 61.8 Deg & Ulnar deviation 3.300. Radiological parameters as measured at final evaluation were: volar tilt 5.55 deg, radial inclination 18 deg & ulnar variance -0.52 mm.

At 6 months mean PRHWE score was 6.85 (SD \pm 2.87). At 12 months mean PRHWE score was 4.52 (SD \pm 2.30), suggesting that patient satisfaction was significantly improved at 12 months as compared to that at 6 months.

Out of 35 patients, 32 patients had final score between 0 to 5 which was statistically significant ($P<0.001$), one patient had score between 6 to 10 and 2 patients between 11 to 15 according to the Gartland and Werley scoring system. In the

present study out of 35 patients, 31 patients (88.5%) had excellent outcome, which was statistically significant ($P<0.001$), 2 patient (5.7%) had good outcome, 1 patient (2.8%) had fair outcome and 1 patient (2.8%) had poor outcome.

Three patients (8.5%) developed complications in the present study. One of the patients complained of screw irritation for which implant removal was done later, one patient had delayed union, and another one patient developed Median nerve impingement which was managed conservatively. There was no case of infection, tendon ruptures, neuro-vascular injury, and non-union or implant failure observed in the present study.

Discussion

Fractures of the distal end radius particularly requiring anatomical reduction of radio-carpal and radio-ulnar joint congruency must be treated with open reduction and internal fixation for better radiological and functional outcomes [6]. The return of better hand and finger functions has been attributed with early wrist movements [7]. The work of Knirk and Jupiter showed intra-articular fractures with displacement of more than 2 mm in the radio-carpal joint results in osteoarthritis and functional disability [8].

In this study we used volar plating to improve pull out strength in osteoporotic bone and volar surgical approach that avoids extensive dorsal dissection. Patients tolerate volar area scars better then dorsal area scars. And complications like flexor tendon rupture were unlikely with volar plating as volar surface of radius provides more space and implant is isolated from flexor tendons by the pronator quadratus [9].

In this study used PRHWE score which is a self-administered, patient specific questionnaire. In 2004 it was modified from the original PRWE score. PRWE was designed to measure wrist pain and disability in activities of daily living, and consists 15 items with two sub scales pain and function. The pain sub scale includes five items where 0 is no pain and 10 is worst pain ever experienced, while function sub scale includes six specific activities and four usual activities where 0 is no difficulty experienced and 10 is unable to do mentioned activities. The total score of PRWE is the sum of the both scores of sub scales. A score of 100 represents the worst functional score, whereas 0 represents no disability. PRHWE consists of same items as PRWE with minor changes like wrist was replaced by wrist/hand, also two items which are not part of scoring system were added [10, 11].

A bio mechanical study by Stanbury *et al.* expressed superiority of a variable angle volar locking plate for capturing a distal radial styloid fragment compared to fixed angle plate [12].

Conclusions

This study supports the hypothesis of early fixation of these fractures to persist good results and early return of the activity. To conclude patients with intra-articular distal radius fractures (AO type B and C) treated with variable angle volar locking plate shows better functional and radiological outcomes. Also Variable angled plate gives more freedom of screw placement in comminuted fractures and those with far distal styloid or other fragments.

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