

Intra-articular Fracture of Distal End of Radius Treated by Open Reduction and Internal Fixation with Buttress Plate- A Clinical Study

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Abstract

Background: Fracture of the distal radius is one of the most common skeletal injuries treated by orthopedic surgeons restoration of radial length, radial tilt angle and congruity of the articular surface is important for good functional result. Devices like buttress plates allow improved fracture fixation without leading to soft tissue and vascular complications. They have been shown to provide excellent stability for an unstable fracture with either dorsal or volar metaphyseal comminution. The objective of the study was to evaluate the functional outcome of intra-articular fracture of distal end of radius treated by open reduction and internal fixation by buttress plate using Criteria of Gartland and Werley Point System.

Materials and Methods: Twenty patients with intra-articular fracture of the distal end radius were treated by open reduction and internal fixation using buttress plate.

Results: The study included 20 patients, 11 male and 9 females aged from 21 to 69 years with a mean of 40.2 years. The average duration of follow-up was 7 months ranged from 6 to 10 months. Using the demerit scoring system of Gartland and Werley, we had 20% excellent results, 45% good results, 20% fair results, and 15% poor result. As per our results, excellent to good results were found in 65% of patients.

Conclusion: Open reduction and internal fixation by buttress plate provide a better functional outcome in treating the intra-articular fracture of distal end radius. Excellent to good results are produced using buttress plate for fixation of intra-articular fractures of distal end radius.

Keywords: Distal end radius, intra-articular fracture, open reduction internal fixation, buttress plate.

Introduction

Fractures of the distal radius have been associated with colorful history since its first description by Pouteau in 1783 and later by Abraham Colle's in 1814 [1]. Previously, it was considered as dislocation of the wrist. Fractures of the distal end of the radius continue to pose a therapeutic challenge. Some of these fractures are caused by high-energy trauma, resulting in intra-articular

involvement, and comminution. These injuries account for approximately one-sixth of all fractures treated in emergency room [2]. Restoration of radial length, radial tilt angle, and congruity of the articular surface is important for good functional result [3]. Failure to achieve and maintain near anatomic reduction can lead to degenerative arthritis, distal radioulnar 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, the degree of communication, radial

shortening and displacement, dorsopalmar displacement, angulations and soft tissue involvement. This places burden on the surgeon to evaluate each fracture individually. Open reduction and internal fixation are indicated to address the unstable distal radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through external manipulation and ligamentotaxis provided sufficient bone stock is present to permit an early range of motion [6]. Since the loss of reduction with subluxation of the carpus is so common, frequently used is a small buttress plate, as described by Ellis, as a fixation for volar marginal fractures [7]. The purpose of this study

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was to evaluate the functional outcome of surgical management of intra-articular fractures of distal radius by open reduction and internal fixation with buttress plate.

Materials and Methods

In our study, 20 patients were selected with intra-articular fractures of distal end of the radius were treated by open reduction and internal fixation with buttress plate. Varying pattern of intra-articular fractures of the distal end of the radius is common in adults. These injuries are commonly referred as Colle's, Barton's, or Smith's fractures, depending on the involvement of the distal radioulnar and radiocarpal joint surfaces and the displacement of the fracture fragments. Some of these fractures, however, are caused by severe trauma, and resulting comminution may defy inclusion in a single eponymous group. In our series cases were selected from patients with fracture distal end of radius classifiable on the Frykman classification system. Radiographic assessment of wrist: Anteroposterior and lateral view were taken, analysis of the articular involvement and extension of fragments into diaphysis was done. All the patients selected for the study were admitted, examined according to the protocol, associated injuries if any were noted and clinical and laboratory investigations were done to get fitness for surgery. Open reduction and internal fixation by buttress plate were done in all patients within 5-7 days of initial trauma. Follow-up and assessment at 6 weeks, 3 months, 6 months, final evaluation was performed at 6 months using a demerit point system of Gartland and Werley [8]. All the cases with age group between 20 and 70 years of both sexes were selected on the basis of clinical signs and symptoms with radiological findings confirming intra-articular fracture of distal end radius, based on Frykman classification.

Surgical Approaches and Technique

In our series, all patients underwent open reduction and internal fixation by buttress plate. The aim was to restore the radiocarpal, radioulnar joint congruity and to regain radial length. The fractures were approached according to the direction of the displaced fragment. The surgery was carried out under general anesthesia or brachial block after thorough preparation of the parts.

Surgical exposure Volar approach

In planning the surgical approach, it is important to consider the anatomy of the fracture surface. A longitudinal incision about 7.5 cm long was taken on the radiovolar aspect. The plane between the flexor carpi radialis and the palmaris longus was developed. The flexor pollicis longus tendon was retracted radially, and the median nerve and the other tendons were retracted toward ulna. The fibers of the pronator quadratus were severed from their origin on the radius, and the fracture was exposed. Fracture was reduced, and a buttress plate was contoured so that when it is applied and fixed to the proximal fragment, the distal transverse part will act as a buttress and hold the fracture reduced. A minimum of two screws was inserted in the proximal fragment. Whenever possible, screws were inserted through the distal part of the plate into the fracture fragments. The reduction of the fracture and restoration of the articular surface was confirmed by direct observation and by anteroposterior and lateral views in C arm. Pronator quadratus was placed over the plate to its origin on the radius, and wound was closed.

Dorsal approach

The dorsal surgical approach is more straightforward because fewer soft

tissue structures need exposure. A longitudinal, midline skin incision provides excellent exposure. The plane of dissection is between the second and third compartment. In a similar manner, the articular fragments can be seen by extension of the approach through the dorsal capsule and fracture exposure is accomplished. Dorsal buttress plate contoured over the distal radius. Reduction checked under image intensifier. A minimum of two screws inserted in the proximal fragment. Whenever possible, screws were inserted through the distal part of the plate into the fracture fragments and wound closed in layers.

Bone Grafting

Bone grafting was done in 3 patients. All the patients were above 40 years of age. Bone grafting was done for severe comminuted and age-related osteoporosis.

Post-operative Protocol

After the surgery, the operated limb was supported with an anterior or posterior splint and was kept elevated for 3 days till the edema subsided. All the patients received antibiotics, analgesics and anti-inflammatory drugs to prevent infection and to relieve pain and swelling. Active movements of the fingers, elbow and shoulder were started on the first post-operative day. On the 3rd post-operative day, the operated wound was inspected, and active movements of fingers and wrist were encouraged, and the range of movements is depending on the tolerance of pain by the patients. As the patient's tolerance to pain increased, they were motivated for more vigorous physiotherapy regime. Sutures were removed on 10-12th post-operative day. The splints were discarded and were replaced by a crepe bandage and patients were advised to carry out normal activity within the crepe bandage and resistant major activities.

Noncompliant patients were advised to wear the splints till the first follow-up. All the patients were reviewed at the 6th week, 3rd month and 6th month postoperatively and were evaluated clinically and radiologically. Patients were enquired regarding pain, restriction of motion, disability and grip strength. Clinical examination regarding the movements of the wrist and fingers were done. Careful examination was done to rule out any infection. Radiological examination consisted of assessing the consolidation of the fracture site, collapse at the fracture site and any displacement of the implant. The final evaluation was done on the 6th month. The patients were evaluated according to standard objective and subjective criteria using a demerit point system of Gartland and Werley [8]. According to points the results are graded as excellent (0-2 points), good (3-8 points), fair (9-20 points) and poor (>20 points). The longest follow-up in this series was 10 months.

The objective evaluation is based on the following range of motion as being the minimum for normal function; dorsiflexion, 45°; palmar flexion, 30°; radial deviation, 15°; ulnar deviation, 15°; pronation, 50°; and supination, 50°.

Results

Final evaluation in our series was done at 6 months follow-up on the basis of demerit point system of Gartland and Werley [8]. The minimum duration of follow-up for final evaluation in our series was 6 months. The maximum duration was up to 10 months. In our series 4 patients had excellent results accounting for 20%, 9 patients had good results accounting for 45%, 4 patients had fair results accounting for 20%, and 3 patients had poor results accounting for 15%. Distal end radius fractures were seen more commonly on the right side. Most common mode of injury causing

distal end radius fractures was road traffic accident (RTA) 40%, followed by fall on outstretched hand with the incidence of 30%. Frykman type VII fractures of distal end radius were observed more commonly due to RTA mode of injury, and Frykman type III fracture of distal end radius was more seen in the fall on outstretched hand. In our study, a maximum number of cases was of Frykman type III fractures, 8 cases followed by Frykman type VII fractures, 5 cases.

Discussion

This study was undertaken to assess the functional outcome of operative management of intra-articular fracture distal end radius by open reduction and internal fixation by buttress plate. In our study, Frykman's classification was used for classification of the fracture type. In this study, we have used buttress plates for intra-articular fractures of distal end of the radius. In our study, the number of male patients was more than female patients. They were best handled by open reduction and internal fixation by buttress plates. It should be emphasized that these fractures not only have a gross displacement of fragments but also have compressed and crushed juxtaarticular fragments which are of no supportive value. A buttress purchasing instrument provides a good hold on proximal fragments and lays a very important role by contributing to the stability. In our study, 20 patients were treated with buttress plates for intra-articular fractures of distal end of radius, followed up for a minimum of 6 months, were analyzed according to the criteria of demerit point system of Gartland and Werley [8]. 4 patients had excellent results (20%), 9 patients had good results (45%), 4 patients had fair results (20%), and 3 patients had poor results (15%). A study was conducted by Bradway and Cooney on 16 patients with comminuted intra-articular

fractures of the distal radius, with a mean, follow-up of 5.7 years. The evaluation was based on the criteria of Garland and Werley and also by Green and O'Brien scoring system. They had 56% of their patients rated excellent, 25% good, and 19% fair [15]. They had no poor results. This high percentage of excellent and good results compared to our study may be due to the fact that the follow-up was of longer duration, and they had better patient's compliance. Bone grafting was done in more number of patients. In our series, 11 patients were below the age of 40 years. 3 patients were between 40 and 50 years and 2 patients were between 50 and 60 years, and 4 patients were above 60 years. The average age of 20 patients was 40.2 years. In the series of Bradway and Cooney [15], the average age of the 16 patients was 40 years and the youngest being 18 years and oldest being 75 years. Thus, compared to this series the average age of the patients in our study was almost similar and there was a high incidence of male patients in our series. In our study involvement of right side (70%) was more than the left (30%). The right side was dominant for all the patients with right side involvement. This may be due to the fact that dominant extremity reaches out first to have the first impact of trauma. In our series, the mode of injury in 8 patients was due to RTA (40%), 6 patients sustained injury due to fall on an outstretched hand (30%), 4 due to fall from height (20%), and 2 patients (10%) sustained a direct blow. In the series of Bradway and Cooney [15], the most common mechanism was fall on an outstretched hand, seen in 11 patients (69%) and RTA in 4 patients (31%). The final result in our series after an average follow-up of 7 months (6-10 months) showed that 4 patients (20%) had an excellent result. Of this 1 patient was above 40 years and 2 were below 30 years and 1 below 40 years. 3

patients had Frykman type III, and 1 patient had type VII fractures. 2 patients had their trauma due to RTA, 1 patient had sustained injury due to fall on an outstretched hand, and 1 patient due to fall from height. Nine patients (45%) in our series had a good result. 4 patients were below 30 years, 1 patient was below 40 years, 1 patient was below 50 years, 2 patients were below 60 years, and 1 patient was above 60 years. Of these 4 patients had Frykman type III injury, 1 had type IV, 2 had type V, 1 had type VI, and 1 had type VII injury. The mode of injury in 3 patients was due to RTA, 2 patients had fall on an outstretched hand, 2 had injury due to fall from height, and 2 due to direct injury. Four patients (20%) in our series had fair results. 2 patients were over 60 years, 1 patient was below 30 years and 1 patient below 40 years. 2 patients sustained injury due to fall on the outstretched hand, 1 patient sustained injury due to RTA, and 1 due to fall from height. Three patients had poor results in our series (15%). 1 patient below 40 years, 1 patient below 50 years and 1 patient above 60 years of age. 2 patients had RTA, and 1 patient had fall on an outstretched hand injury. 1 patient had type 5 and 2 patients had type 7 injury. Analyzing the results as per the age, revealed that 11 patients (55%) were below 40 years of age, of these 3 had an excellent result (27.2%), 5 had good results (45.4%), 2 had fair, and 1 had poor results. 9 patients were above 40 years of age of which 1 had excellent results (11.1%), 4 had good results (44.4%), 2 patients had fair results, and 2 had poor results. This reveals that younger the patients better is the result. This may be due to a better quality of the bone, high motivation to get back pre-injury status and better patient compliance. In our series of 20 patients bone grafting was done in 3 patients. All were over 40 years of age. Of these none had excellent result, 1 had good results, 1 had fair result, and 1

had poor result. This shows that the use of bone grafting may not have a bearing on the end result.

Complications

The complications encountered in our study were as follows. Two patients had deformity due to malunion, which put them into poor and fair category due to the restriction of wrist movement and finger stiffness. One of them had bone grafting done. All were of 40 years and above. Five patients had finger stiffness, and 4 patients had restricted wrist movements and stiffness at wrist and fingers. With the increase in vehicular accidents, high-energy fractures of the distal radius are being more common. In our series, we have used the buttress plate in treating intra-articular fractures of the distal radius. The results of our study show that excellent and good results were achieved in 65%, i.e., in 13 patients and fair and poor results were seen in 35%, i.e., in 7 patients. This means that the use of buttress plates gives relatively better results in intra-articular fractures of the distal radius. This does not mean that buttress plating is the gold standard in the treatment of intra-articular fractures of the distal radius. This is only an alternative method in treating these injuries. Hence, we recommend buttress plating in intra-articular fractures of distal radius gives acceptable results. Some of the advantages of buttress plating:

- Fracture fragments can be reduced under direct vision.
- Joint congruity can be maintained.
- Buttress plate provides stability and prevents collapse at the fracture site.
- Better patient compliance as the fixation is internal.
- Early mobilization can be achieved, thus reducing complication arising from cast immobilization.

Conclusion

- Excellent to good results were seen in 65% of patients using buttress plate for fixation of intra-articular fractures of distal end radius.
- Thus, open reduction and internal fixation by buttress plate provide better functional results in intra-articular fractures of distal end of the radius. So this procedure can be used as an alternative to other procedures in treating intra-articular fractures of distal end radius.
- RTAs and fall on outstretched hand were the most common modes of injury.
- Males were affected more than female.
- Younger the patients better the results.

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