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Original Research Article

# A CLINICAL STUDY OF FUNCTIONAL OUTCOME OF DISTAL END OF RADIUS FRACTURES TREATED WITH BUTTRESS PLATING

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## Abstract

**Background:** Distal radius fractures are one of the most common injuries that orthopaedic surgeons will face during their trauma practice. Despite this, many aspects in distal radius fracture management like the definition of what constitutes an acceptable reduction and when or even whether to operate a patient with a distal radius fracture remain a poignant subject of debate even to this day. We wanted to evaluate the functional outcome of fractures of distal end of radius managed with buttress plate. The importance of anatomical reduction in attaining a good functional outcome and post-operative complications of the procedure are also studied. **Materials and Methods:** A prospective study of cases of distal end of radius fractures meeting the inclusion criteria who were admitted in Government General Hospital / Kurnool Medical College, Kurnool, between 1 – 01 - 2021 to 1 – 06 - 2022 was carried out. Fractures were classified according to Frykman system and anatomical reduction of fragments attempted using buttress plate and screws. After a minimum follow up period of 3 months, the anatomical and functional outcomes were standardised using Lindstorms anatomical and functional scoring system. **Result:** A series of 32 cases with distal end of radius fracture were studied comprising of 24 males and 8 females. Majority were in the age group of 20 to 29 years (50 %). Road Traffic Accidents was the commonest cause of injury (62.5 %). Type III Frykman made the largest contribution with 11 (34 %) cases. A total of 7 cases were found to develop complications including blisters, joint stiffness, infection and paraesthesia. Postoperatively, excellent anatomical reduction was achieved in 75 % of cases and good results in 12.5 % cases. Functionally 68.75 % cases had an excellent outcome and 18.75 % had a good result. **Conclusion:** Good to excellent results were seen in majority of patients after buttress plate fixation of the distal radius, with outcomes and complications comparable to other studies in literature. This study supports the finding that precise identification of unstable lower radial fractures, and satisfactory anatomical restoration results in improved functional outcome.

## INTRODUCTION

Lower end of radius fractures is arguably one of the most common fractures of the upper extremity, encountered in clinical practice and constitute almost 17 % of all fractures and 75% of all forearm fractures.[1] This fracture shows a bimodal distribution with increased incidence in the young and in the elderly.[2] Pathologically distal radial intra-articular fractures are quite troublesome and represent a very unstable and complex injury which can prove quite challenging to manage. In order to achieve restoration of wrist function to near pre-injury levels effective treatment is needed in both young individuals and in active elderlypopulation.[3] As such conservative management of these fractures are still the most popular; cast immobilization after an attempted closed reduction had been in vogue as a means of treatment of these fractures for a long time but it often results in the disastrous complications of malunion and subluxation or dislocation of distal radioulnar joint which manifests as a degraded functional outcome along with poor cosmetic result. Wrist motion and hand function are adversely affected by these residual deformities due to disruption of the extrinsic hand musculature. It can also result in arthrosis of the radiocarpal and


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distal radioulnar joints resulting in pain, limitation of forearm motion, and decreased grip strength.

At present, a variety of treatment options are available at the disposal of an experienced orthopedician.[4-6] These range from percutaneous pins and external fixation to a plethora of plates and screws for fixation.[5,7] The choice of surgical technique for reduction and fixation depends on fracture displacement, joint surface involvement, patient age, bone quality, dominant handedness, occupation, surgeon's experience and patient's preference.[8] The fixed angle plate is arguably the most popular for intra articular fractures which helps to maintain the Radial length and tilts better than External Fixation. But open reduction and internal fixation is not a panacea in and of itself and has got its own complications like – interference with flexor tendon system in a very distal palmar plate, too long screws can penetrate the extensor compartments, and distal screws in comminuted fracture patterns can cut through the subchondral bone and penetrate into the radiocarpal joint resulting in arthritis.[9]

Usually a volar locked plate is the preferred choice for articular unstable distal radius fractures with locking providing increased rigidity and fixation especially in the elderly population. Another advantage of locked plates is the ability to perform indirect reduction. Bringing the plate to the bone for proximal fixation performs the indirect reduction. Radiological measurements to be considered for evaluation are radial height, radial inclination, volar tilt and ulnar variance, which are measured both preoperatively and post operatively. They are also to be compared to the contralateral side.[10-14] Recent studies have also shown that volar tilt along with ulnar variance are the most important radiographic parameters to be restored to obtain good functional outcomes.[15] It is heartening to note that the majority of patients will have near complete recovery of range of motion if all radiological measurements are restored. Hence this study was planned to evaluate the anatomical and functional outcome of distal radius fractures treated with buttress plating in consenting patients treated at a tertiary care setting in Government General Hospital / Kurnool Medical College, Kurnool,

**Aim of the Study**

To evaluate the anatomical and functional outcome of distal radius fractures treated with buttress plating.

**Objectives of the study**

1. To assess the functional outcome of fractures of distal end of radius managed with buttress plate in consenting patients of both sexes who were treated in Government General Hospital / Kurnool Medical College, Kurnool, between 1 – 01 - 2021 to 1 – 06 - 2022
2. To study the complications of buttress plating in these patients

## MATERIALSANDMETHODS

A prospective study was conducted on consenting patients in the age group 18 - 70 yrs attending the Department of Orthopaedics of Government General Hospital / Kurnool Medical College, Kurnool, between 1 – 01 - 2021 to 1 – 06 - 2022, who sustained fracture of distal end of radius and was treated with buttress plating. A total of 32 patients were included in the study. Sample size was calculated using the formula n = 4 pq / d2 where p = 90 %, the proportion of patients with good to excellent results as seen in a study by Gyaneswar et al.16 Patients in whom surgical intervention was prevented by associated comorbid conditions, those with duration of injury more than 3 weeks, those with poor local tissue condition that preclude surgical intervention and patients presenting with compound fractures of distal end of radius were excluded from the study.

**Ethical Considerations**

The study was undertaken after obtaining clearance from the Institutional Ethics Committee. Informed written consent was obtained from all the patients.

**Method of Data Col lection**

After taking prior consent, data regarding socio demographic variables like sex, age, occupation, socioeconomic status, data pertaining to the injury like time, cause, type of injury, associated soft tissue injuries etc was collected using a pre tested semi-structured questionnaire. Radiographs were taken at the time of presentation and were assessed in terms of loss of volar tilt or presence of dorsal tilt, radial shortening and loss of radial inclination. The fractures were then classified according to Frykman classification system. The Frykman classification17 is an anatomical classification and based on the extent of involvement of the articular surface of the distal radiocarpal (DRCJ) and distal radio-ulnar (DRUJ) joints.

Patient's occupation and general conditions were also taken into consideration. All patients were admitted, detailed evaluation done for assessing other injuries like chest, head or abdomen trauma and also associated other long bone or spine fractures. After assessing the general condition of the patient and doing routine blood investigations including screening tests for common blood transmitted diseases, the surgery was done by a qualified orthopaedic surgeon.

**Procedure**

All procedures were performed under either general or regional anaesthesia. Preoperative prophylactic intravenous cefuroxime was given. Intraoperative use of tourniquet and diathermy was done to achieve haemostasis.

**Surgical Approach**

The standard volar/anterior approach (Henry's) was undertaken to fix the fragments. Dissection between theflexor carpi radialis tendon and radial artery was used in cases initially approaching the radial styloid


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fragment. Dissection between the median nerve and flexor carpi radialis tendon was used for the die-punch volar fragment. The pronator quadratus is detached with a scapel on the radial side and later re- inserted after the fixation. Open reduction was performed with the help of traction by an assistant/distractor and intrafocal leverage. Provisional fixation was done with the help of temporary Kirschner wires if needed, followed by definitive fixation using volar buttress plate and screws. Intraoperative evaluation of fracture reduction and fixation was done for restoration of the radial length, volar tilt, ulnar inclination and articular congruency with the help of an image intensifier.


**Figure 1. Preoperative X-Ray**


**Figure 2. Postoperative X-Ray**

**Follow up and Evaluation**

Postoperatively radiographs were taken to confirm the implant placement and fracture reduction.The limb was kep elevated in below elbow plaster slab. Active finger and shoulder exercises were started at the earliest possible. Parenteral antibiotics and analgesics were given during the first 3 postoperative days, which were later converted to oral medication.

After suture removal on the 10th day, the plaster slab was converted into a short arm cast. The patients were reviewed after 3 weeks when the plaster cast was removed and crepe bandage applied. Active exercises of wrist, elbow and shoulder were started.

The patients were followed up for a minimum period of 3 months. The subjective, objective and radiographic findings were quantified according to Lindstorms anatomical and functional scoring system.

**Statistical Analysis**

Data was entered and analysed using Microsoft Excel Application. Quantitative variables were expressed in mean ± S.D. Qualitative variables were expressed in proportions.

## RESULTS

The age distribution of the 32 patients ranged from 20 to 58 years in our study and the mean age was 31.6 years + / - 10.13 with majority (50 %) being in between 20 to 29 years of age. 75 % of the study subjects were males. In 62.5 % of the cases, the mode of injury was Road traffic accidents while the remaining were due to fall on outstretched hand. Functional and anatomical grading was done by Lindstorms Scoring System. Functional grading is based on Residual Disability, Wrist and Forearm Movements, Loss of Grip Strength and persisting deformity. There are four grades namely Excellent, Good, Fair, Poor. Functional Grading has shown that there was no residual disability in 22 out of 32 cases while 6 cases showed minimal disability. Grip strength was not lost in 28 cases whereas 2 cases showed slight loss. Grip strength was lost in cases complicated by infection or joint stiffness. There was no residual deformity in 26 cases while 4 cases showed minimal disability. None of the cases had gross residual disability, gross limitation of wrist and forearm movements, severe loss of grip strength or gross deformities.

Functional grading has shown that 22 cases had an excellent outcome. None of the cases reported a poor outcome. [Table 1]

**Anatomical Grading Analysis**

Anatomical grading is done by Lindstorms Anatomical Scoring System. It is based on Deformity, Residual Dorsal Tilt, Radial Shortening and Loss of Radial Inclination.

Anatomical Grading has shown that 24 patients had a residual dorsal tilt post-surgery of 0 degrees, 4 cases had 1 to 10 degrees and another 4 had a residual dorsal tilt of 11 to 14 degrees. 23 cases had radial shortening of less than 3 mm whereas 4 cases had 7 to 11 mm shortening. Post-surgery, 26 patients had no deformity while 4 had minimal deformities. 21 patients had a loss of radial inclination of less than 5 degrees whereas 7 patients had 5 to 9 degrees. None of the patients had more than 15 degrees of residual dorsal tilt, radial shortening of more than 12 mm, gross deformity or loss of radial inclination of more than 15 mm. [Table 2]


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Anatomical grading has shown that 24 cases had excellent outcome and 4 patients had a good outcome. A total of 28 (24 + 4) cases i.e. 87.5 % have shown a satisfactory outcome. [Table 3]

A total of 7 cases had complications ranging from mild (blisters) to potentially devastating (Infection). 2 cases developed blisters which were promptly treated and healed well. 2 cases developed infection which was treated by debridement and parenteral antibiotics. Both of these cases went on to develop joint stiffness and a lower functional scoring. One of the cases developed paraesthesia along median nerve distribution which has since then recovered. [Table 4]

**Table 1:**

| Results | Number of Cases (%) |
|---|---|
| Excellent | 22 (68.75) |
| Good | 6 (18.75) |
| Fair | 4 (12.5) |
| Total | 32 (100) |

**Table 2: Anatomical Grading Using Lindstorms Anatomical Scoring System**

| Parameters | Criteria | Number of Cases (%) |
|---|---|---|
| Residual Dorsal Tilt | 0 degree 24 (75) | 24 (75) |
| | 1 to 10 degrees | 4 (12.5) |
| | 11 to 14 degrees | 4 (12.5) |
| Radial Shortening | <3mm | 23 (72) |
| | 3 to 6 mm | 5 (15.5) |
| | 7 to 11 mm | 4 (12.5) |
| Deformity | None | 26 (81.25) |
| | Minimal | 4 (12.5) |
| | Moderate | 2 (6.25) |
| Loss of Radia | <5 degrees | 21 (65.5) |
| | 5 to 9 degrees | 7 (22) |
| | 10 to 14 degrees | 4 (12.5) |

**Table 3: Anatomical Grading**

| Results | Number of Cases (%) |
|---|---|
| Grade 1 | 24 (75) |
| Grade 2 | 4 (12.5) |
| Grade 3 | 4 (12.5) |
| Total | Total 32 (100) |

**Table 4. Complications**

| Complications | Number of Cases |
|---|---|
| Joint Stiffness | 2 (6.25) |
| Infection + Joint Stiffness | 2 (6.25) |
| Blisters | 2 (6.25) |
| Paraesthesia (Median Nerve) | 1 (3) |
| No Complications | 25 (78.25) |
| Total | 32 (100) |

## DISCUSSION

In our series of 32 cases, we observed that maximum number of patients were from the age group 20 to 29 years (50 %). Being one of the most active stages of life it can be assumed natural to have a spike at this age group which is further cemented by the observation that almost all of these cases were attributed to road traffic accidents. The second largest age group was between 40 to 59 years (28 %). These can be attributed to the increasing disabilities of old age including osteoporosis, diminution of vision and a decrease in locomotor coordination.

Almost half of these cases were due to fall on an outstretched hand. This was congruent with the findings reported by Austine in his study where a fall on the outstretched hand (60 %) was the most common mode of injury followed by road traffic accident (33.3 %).[18]

In our study, it was found that postoperatively the posterior tilt of the distal radius could not be restored even to a neutral angle in 11 patients (34 %) while the dorsal tilt could be corrected to the anatomical palmar tilt or at least a neutral angle in 21 patients (66 %). The radial shortening varied from 1mm to 11 mm and the average radial shortening was found to increase as we move to higher types on Frykman's classification. The loss of radial inclination varied from 0 degrees to 13 degrees with an average loss of radial angle of 4.65 degrees. It was observed that the more comminuted and more displaced the fracture fragments, the more difficult it was to attain anatomical reduction. This was comparable to the findings of Jairam et al where the radiographic results at the final follow-up showed a mean of 17° of radial inclination, 2.5-mm radial shortening, and mean volar tilt of 3.4°.19 Gyaneswar et al16 in their study on distal end of radius treated with volar plating found that


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anatomically 24 patients (80 %) had excellent restoration of anatomy while 4 patients (13 %) had good restoration. This is comparable to our results where 75 % had an excellent and 12.5 % had a good restoration of anatomy.

**Functional Outcome**

At present the treatment strategy is based on a multitude of factors which include not just the fracture type, stability of fracture and joint, patient characteristics and demands, but also the treating surgeon's experience and preference.[6,20,21] There has lately been a drastic increase of new treatment options available at the disposal of the surgeon including plate designs and fixation techniques.[22] Restoration of bone length, congruity of the articular surface, radial inclination and maintenance of the DRUJ are the goals of treatment with plate fixation.[9] Restoration of wrist function to pre-injury levels and limitation of pain at the lowest possible cost are the clinical goals.6 In order to optimise function and to reduce future degenerative disease with subsequent disability, achievement of as near anatomic position as possible is required.[4,9,13,23] There must be a calculated balance between stable fixation and soft tissue disruption, even though stable fixation has been shown to allow early rehabilitation.

Recently several authors have promoted internal fixation as the treatment of choice which has only increased the bias towards the same.[3,24] More specifically the recent volar locking plates have been in vogue.8 This trend is mostly dueto an improved understanding of the distal radio ulnar joint.[3]

Nakata R.Y in his series of 22 patients compared the movements of the affected side with that of the opposite side and found it to be as follows - palmar flexion 60°, dorsiflexion 60°, ulnar deviation 25, radial deviation 15°, pronation63° and supination 65°.[25]

The results of movements and grip strength of our series was comparable to the majority of the above series, the average results in our series were palmar flexion 72.8°, dorsiflexion 67.5°, radial deviation - 18.3°, ulnar deviation - 32.3°, pronation - 72.4° and supination of 77.6°. Our present study also reports an excellent grip in about 87.5 % of our cases. The results of our study were also comparable to that reported by Shushrut in his study on 30 patients.[26] Ketan Gupta in his study comparing open reduction & internal fixation with closed reduction & external fixation in volar displaced distal radial fractures obtained satisfactory results in 86 % cases and fair results in 14 % cases.[27] This is comparable to our study where 87.5 % satisfactory result was obtained.

Sushrut reported good outcome of 50 % and excellent outcome of 16.67 % in the treated patients,[26] while Austine J in his study reported that the functional outcome based on the Mayo Wrist Score was found to be excellent in 13.3 % and good in 60 % of the patients.18 Nagaraju in his study had obtained excellent functional outcome in 50 % and good results in 40 % as scored using the demerit scoring

system of Gartland and Werley.[28] 45.7 % had excellent functional outcome while 42.8 % had a good outcome among the 35 operated patients in the study by Chavhan et al.[29] The findings of all these studies are comparable to that obtained in our study since our study also reports excellent results in 68.75 % and good results in 18.75 % of the treated cases.

## CONCLUSION

This study demonstrated good to excellent results in the majority of patients after buttress plate fixation of the distal radius, with outcomes comparable to other well-designed studies. Volar buttress plating represents a valuable treatment modality for the most frequent types of unstable fractures of the distal radius in young and elderly adults providing a stable construct that helps in early mobilisation and thereby better functional outcome and minimising the chances of delayed union and malunion. This surgical approach is simple and can be extended depending on the complexity of the fracture. The biomechanical features of the volar buttress plate eliminates the need for bone grafting. New generation of palmar plates have made secondary displacement a rarity these days.

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