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A Prospective Study on Fracture of Both Bones of Forearm Treated with Dynamic Compression Plating

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Abstract
Fracture union is decided by many factors. The prime factor being stability of the fracture and soft tissue attachments to the fragments which are fractured. There are certain methods of fracture fixation which offer a rigid stable fixation. But in the case of fracture with comminution and avulsed butterfly fragments, certain precautions in open reduction and internal fixation are necessary to achieve fracture union. Our study is about 30 cases of fracture both bones of forearm with comminution, treated with Dynamic compression plating. The fracture configuration plays a role in the fracture union.

1. INTRODUCTION

The treatment of fracture both bones of forearm in displaced fractures poses challenges. The risk of delayed union and nonunion are more in case of soft tissue entrapment for conservative management and even in open reduction and internal fixation in comminuted and fractures with butterfly fragments.

The fracture union may not be ensured in certain cases with multiple fragments and totally displaced butterfly fragments. Treatment of all fractures by plaster leads to prolonged immobilization of the part. This not only leads to the disability of a person temporarily but also causes dependency. The forearm is the lever for the hand and important segment of the upper limb, as it affects the function & efficiency of the entire part. For full functional recovery of the fracture of forearm not also the flexion & extension at elbow and wrist are important but also the full supination & pronation. The fracture union is essential for the optimum function of the limb. It is not sufficient to maintain the length of each bone but, axial, rotational alignment must be achieved, and radial bow should be maintained. The fixation modalities like Square Nails may not be able to hold multiple fragments and bigger butterfly fragments. The fracture patterns like this will make an unstable construct.

A study of supination and pronation with concerning to forearm fractures by Patrick[1] pointed out that when fractures of both bones of the forearm were perfectly aligned in anteroposterior and lateral radiological views, the degree of rotation must be correct. The fractures with comminution and butterfly fragments will pose a difficulty in ensuring rotational alignment.

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The most effective method for producing rigid internal fixation is by compression. It also ensures compression, impaction and rigid fixation of the fracture site.

Murray[2] advocated the early open reduction of forearm fractures to avoid difficulty in fracture reduction by soft tissue contracture and advised a length of the plate should be five times the diameter of fractured bone at the fracture site and preferred six, eight holed plates.

Eggers[3] established a principle both clinically and experimentally, which is after reduction continuous contact of the fragments under compression promoted union. Thus, the slotted plate described by Egger[3] and compression plate of Mullercame into existence.

The AO group has advocated the design of appropriate instrumentation for fracture surgery and The documentation.[4] They stated that the more accurately a fracture is aligned; the less will be the demand for callus formation. Four principles are accepted as "Working hypothesis"

1) Good Anatomicalreduction.

2) Rigid internal fixation.

3) Atraumatic technique on soft tissue as well as on the bone.

4) Early pain free active mobilization during the first ten postoperative days.

It is best achieved by a stable internal fixation which lasts Study on comminuted fracture of both bones of forearm treated with dynamic compression plating for the whole duration of bone healing. The most effective method of producing rigid internal fixation is by the use of the compression plates developed by the AO.

Perren[5] 1969, developed the Dynamic compression plate. Allgower et al used it successfully in humans in the same year. Its spherical geometry not only allowed self-compression but also enabled the maintenance of a congruent fit between the plate hole and the screw at different angles of inclination. Thus, the plate was more adaptable to varying situations of internal fixation and could fulfil all the different plate functions also. They published an excellent series of cast bracing. They avoided below and above joint immobilization and still documented excellent functional results.[5]

E Schemitsch et al.[6] A study was conducted regarding the effect of malunion on functional outcome after plate fixation of fractures of both bones of the forearm in adults. The authors concluded that restoration of the normal radial bow was necessary to achieve a good functional Outcome.

IversenLD, Marc F. Seinotkowski[7] in their Manual of orthopedic therapeutics have listed following observations and recommendations. Open reduction and plate fixation should be the treatment of Fractures of both bones or a displaced isolated fracture of the ulna or radius.At a minimum, there must be screws engaging six cortices above and below the fracture site. The use of 3.5 mm plate systems has nearly eliminated the problem of refracture after plate removal. Eight-hole plates are used most often.

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Cancellous bone grafting to these fractures, in addition to plate fixation, should be considered, as the union rate using this method of treatment has been nearly 100%. The arm is immobilized in a long arm plaster cast until there is roentgenographic evidence of union. Reliable patients may be placed in a removable splint, and early motion started as soon as wound healing is complete. The relationship between the radius and ulna in the forearm is critical for function, especially pronation and supination.

This relationship is so critical that the forearm has been called a “functional joint.” Malunited fractures can impair this functional joint, with resulting impairment of pronation and supination. It is important to reestablish length, alignment, and rotation for the forearm to maintain its dynamic function. Operative treatment is indicated for almost all both-bone forearm fractures in adults. The goal is to reestablish the anatomic relationship between the radius and ulna with rigid fixation.

There is almost no role for closed treatment except in the most infirm patients, and, although intramedullary nailing of the forearm has its indications, the most common form of stabilization is plate-and-screw fixation. Our study is designed as observational study for fracture union in diaphyseal fractures of the forearm with comminution when treated with dynamic compression plate.

2. MATERIALS AND METHODS

Our study has involved 30 cases of fractures of both bones of forearm at BIRRD Hospital, Tirupati.

The inclusion criterion are:

(1) All adult fractures of both bones of forearm,
(2) Diaphyseal fractures
(3) intact skin,
(4) intact blood supply

The Exclusion criterion are:

(1) Pediatric fractures
(2) Open fractures
(3) Vascular deficits
(4) Neural deficits

All the patients with the inclusion criterion are subjected to thorough skeletal evaluation to rule out concomitant injuries and for Pre anesthetic check up to establish their fitness to undergo surgical procedure. The evaluation is done with good quality AP and Lateral view Radiographs. The cases are initially stabilized with Iv fluids, above elbow POP slabs and absolute limb elevation.

The Diaphyseal fractures of both bones of forearm are planned for internal fixation with Dynamic Compression plating. The cuff of pneumatic tourniquet is applied. The skin is thoroughly scrubbed and draped with the forearm on a side arm board. The standard approaches Volar for Radius and Subcutaneous for Ulna are used.

The approach for radius is carefully selected depending upon the displacement of the comminuted fragments. The totally displaced comminuted fragments are easily identifiable on AP and Lateral views. Expose both fracture sites before fixation of either and reduce the fracture. The fracture with less comminution and acceptable stable configuration should be fixed first and then the comminuted and unstable fracture.

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Surgical approaches are chosen in such a way that the maximum hold on the avulsed and comminution is achieved by plating on the surface.

For the Anterior approach the forearm is supinated, a longitudinal incision is given at a point just lateral and proximal to the biceps tendon and extend it distally in the forearm along the medial border of the brachioradialis and up to the radial styloid process if necessary. The biceps tendon is exposed by incising the deep fascia on its lateral side, the deep fascia is divided in line with the skin incision and the radial vessels are protected. The recurrent radial artery and vein are isolated and ligated, otherwise, the cut ends may retract, resulting in a hematoma that causes Volkmann's ischemic contracture of the forearm flexor muscles. The bicipital bursa is incised, which lies in the angle between the lateral margin of the biceps tendon and the radius.

Strip the supinator subperiosteally from the radius and reflect it laterally, it carries with it and protects the deep branch of the radial nerve. The surface of Radius to plate can be brought into field by pronation at this stage.

For anterior approach in distal Radius the forearm is kept in supination to make a 10 to 15cm longitudinal incision over the interval between the brachioradialis and the flexor carpi radialis muscles. The sensory branch of the radial nerve is identified and protected which lies beneath the brachioradialis muscle. The flexor carpi radialis tendon and the radial artery and vein medially are carefully mobilized. The flexor digitorum sublimus, flexor pollicis longus, and pronator quadratus muscles are now exposed. Subperiosteally the flexor pollicis longus and pronator quadratus muscles elevated and to strip them medially, exposing the radius.

The approach for ulna is same for various displacements of comminuted fragments, since part of the posterior surface of the ulna throughout its length lies just under the skin any part of the bone can be approached by incising the skin, fascia and periosteum along this surface. The extensor carpiulnaris and flexor carpi ulnaris with their aponeurosis are reflected subperiosteally the shaft is exposed.

After the surgical exposure of the fracture, ends are freshened, and soft tissue attachments are preserved as far as possible to the avulsed and comminuted fragments. The fracture is reduced in such way the non-comminuted portions come into contact and even let to get compressed with plating.

The plate is placed in such a way that the comminuted fragments will come under the surface of the plate. All the fragments which cannot be held by a late are reduced onto the main fragment and held with a 2.7 mm with lag effect. The 3.5 mm Dynamic Compression plate is placed centering over the fracture site to have a span of three holes over the fragment without comminution and is held by the clamps. The corresponding drill holes are made near the fracture site using the neutral drill guide. The hole is tapped, and the corresponding screw is placed.

The second drill hole is placed on the other side of the fracture using the eccentric drill guide, and the process is repeated with a neutral guide. All the other screws are threaded in a similar fashion. Finally, the clamps are removed, and the last degrees of twists are made in every screw. The neutral drill guide is positioned in the plate hole nearest the fracture. A hole is drilled in the bone tapped, and a screw is inserted but not seated completely. Next, the nearest hole from the fracture site on the other side is drilled using an eccentric drill guide. This is tapped, and other screws as inserted and the neutral screw is seated. Then the eccentric screw is tightened.

The surgical planes exposed are thoroughly lavaged and closed in layers. A mild compression bandage applied. Limbs are kept elevated. Pre and post operative antibiotics are given with sufficient symptomatic management. The post operative dressings are done on second post

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op, fifth post op and suture removal is done after two weeks. Throughout the post operative period active finger movements are encouraged as soon as patient tolerates pain. Active wrist and elbow movements are encouraged from second post op week. The Post operative Radiographs of same views are taken at Fourth week, Sixth week and Eighth week.

3. RESULTS

Our Observational study is carried out to identify the fracture union in both bones of forearm treated with dynamic compression plate. The fracture union at the earliest cannot be expected in all fractures, especially when the fragments are comminuted. The radiographs are spaced in such a way that the earliest fracture union cannot be missed. The fractures where the fragments have more than 50% contact at the diaphysis offer good scope for compression and then the rest of the small fragments can get incorporated into the union process with a strong, rigid construct and support for the fragments which are also covered by the plate. The fracture in our study is distributed like almost equal number of Radius and Ulna fractures. The findings are consistent with previous study that the AO principles should be followed to get union at the fracture site. The severe comminutions require care full planning in selection of the plane to dissect and not to disturb already disturbed soft tissue and vascular planes to protect and retain the blood supply. Our Results have found a total of 6 fractures not showing callus even at 8 weeks radiographs post operatively, eventually all these six cases required bone grafting.

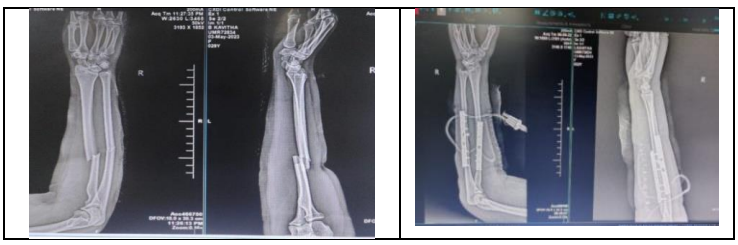
Table 1: Distribution of Fractures.

Bone	Simple	Comminution	Butterfly Fragments	Total
Radius	16	10	4	30
Ulna	18	8	4	30

Table 2 Fracture Union

Bone	simple	comminution	Butterfly fragments	Total
Radius	16	10	4	30
Ulna	18	8	4	30
Union	6 weeks	10 weeks	8 weeks	

Pre and post-operative images



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4. DISCUSSION

The Dynamic Compression plate offers a fixation which is stable and rigid. The plane of dissection is better chosen to incorporate as much of bone as possible on both fragments to achieve maximum contact and hold to get compression. The cortices with no comminution are used for getting maximum compression possible depending on the fracture pattern. The fragments splayed away from the main fragments are better incorporated in the main construct so that the callus formation is essentially involves the fragments which are held in the fixation per se. The planning of fracture fixation is done while keeping the plane of avulsion also so that the further loss of blood supply to the comminuted fragments can be avoided and these fragments can get incorporated along with their intact blood supply or the fragments are held by the plate used for fixation.

The delayed and non-union can occur in fragments which are comminuted and could not get incorporated in the main construct. These cases require primary bone grafting to avoid secondary procedures. The Dynamic compression plate allows early mobilization to achieve maximum functional retaining at the hand and wrist.

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