

Diaphyseal Fracture-Nonunion of Forearm Bone Treated by Compression Plating Aided with Autologous Bone Grafting – A Study Outcome

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The forearm fulfills an important role in the integrated function of the upper extremity. Fracture-nonunion of forearm bone singly or both interfere with normal forearm function grossly. Nonunion of the forearm bone cause dysfunction of forearm as they effect interosseous membrane, elbow and wrist which limit the rotational movement of forearm that is pronation and supination, stiffness of the elbow and wrist due to long term immobilization. But treatment of fracture - nonunion of forearm bone are still a therapeutic challenge and outcome are moderate at best. This study was design and carried out to assess the outcome of treatment of fracture-nonunion of forearm bone by dynamic compression plating aided with autologous bone grafting from iliac crest. A prospective study was carried out from January, 2011 to December 2015 in where 20 cases of fracture-nonunion of forearm bone (radius n=8, ulna n=6, both n=6) were treated in government or private hospital situated in Kishoreganj of Bangladesh. Surgical procedures were performed following AO principle by dynamic compression plating aided with autologous bone grafting taken from iliac crest. Outcome was assessed by regular follow up, radiograph and functional outcome design by Anderson et. al. Follow up time was 10 months to 24 months. Bony union was achieved within a median of 5 months. According to the system of Anderson et. al 11 cases (55%) achieved excellent result. 4 cases (20%) had satisfactory and 5 cases (25%) had an unsatisfactory result. 1 patient developed infective non-union. This study showed that treatment of fracture – nonunion of forearm bone using technique of compression plating osteosynthesis aided by autologous bone grafting represent an effective treatment option of this challenging condition.

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Introduction

Nonunions of the radius and ulnar shaft cause a severe anatomic and functional impairment related to disturbance of the interosseous membrane and dysfunction of the adjacent joints, elbow and wrist. These demanding nonunions require the surgical correction to restore the anatomy of the forearm and to improve function.¹⁻⁶

Compression plate-and-screw fixation of diaphyseal fractures of the radius and ulna in adults has been common practice since the

late 1950s. Large series have shown this technique to be straightforward with a low complication rate. Controversies focused on bone grafting for acute fractures, the type and length of the plate and the risk of refracture after plate removal. Benefits of plate-and-screw fixation are the ability for anatomic and secure reconstruction allowing early motion. Complications of open reduction and internal fixation of forearm function are infection, malunion, nonunion, nerve injury, compartment syndrome, bleeding, formation of a synostosis and limited function.⁷⁻¹¹

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New techniques have been recently postulated for the treatment of forearm nonunions, including distraction-compression osteogenesis, locked plating, and locked intramedullary nailing. even free flaps have been advocated as a means to restore anatomic length and ensure bony union.¹²⁻¹⁴

In this study we applied the option of compression plating supported with autologous bone grafting for fracture-nonunion and evaluate the outcome radiologically and functional activities of affected extremities.

Methods

A prospective study was designed from January' 2011 to December 2015 in where 20 cases of fracture-nonunion of forearm bone (radius n=8, ulna n=6, both n=6) were treated in government or private hospital situated in Kishoreganj of Bangladesh (Table I). Age of the patient were within 18 years to 58 years where male were 14 and female were 6 in number (Table II). 12 cases involved the right forearm and 8 patient involved in the left. No one of both forearms.

Table I: Fracture that involve the bone

Bone involve	No of case	Percentage
Radius	8	40%
Ulna	6	30%
Both	6	30%

Table II: Gender distribution

Sex	Number	Percentage
Male	14	70%
Female	6	30%

Mechanism of injury was in majority cases road traffic accident (n=14) and then accidental fall (n=5). One patient had history of physical assault (Table III). Two patients of diabetes mellitus (Controlled) in where one developed infection but improve after judicious use of antibiotic. Another one

patient developed infected-nonunion with poor outcome left for further intervention.

Table III: Mechanism of injury

Mechanisms	No of case	Percentage
Road Traffic Accident	15	75%
Accidental Fall	4	20%
History of Assault	1	5%

Isolated fracture of diaphyseal of the radius in 8 patient and in ulna 3 patient, Monteggia fracture in 3 patient and rest six patient involved both radius and ulna. 15 fracture were closed in nature and 5 fracture were open in of Gustilo type-I, Gustilo type-II A (Table 4).

Table IV: Type of fracture

Types	No of case	Percentage
Close Fracture	15	75%
Open (Gustilo type-I)	4	20%
Open (Gustilo type-II A)	1	5%

Fortunately 19 patient did not involved with nerve injury. Only one patient with history of assault developed radial nerve palsy of neuropexia due to blunt trauma to arm which correct spontaneously within two months. Only in case of open fracture (n=5) four patient previously treated conservatively by recognized physician and majority of patient (n=16) were neglected and take treatment from Kabiraj (An ancient method like Tarzan medicine) . All the patient were treated with open reduction and internal fixation with DCP aided with autologous bone grafting from iliac crest according to AO principle. Drain tube (where applied) were removed after 48 hours and patient ware discharge from hospital after two weeks after removal of stitches. Follow up was done after 15 days and then every months upto 10 to 24 months. Data were maintained according to follow up

finding and results were recorded with radiological and clinical finding. Final outcome was designed with the method of Alderson et. al.

Results

Bony union was achieved within a median of 5 months of surgery. 18 patient of non-union healed within 4 months. 2 patient develop infection in where 1 cure with use of antibiotic therapy with unsatisfactory outcome. Another patient of infection with diabetes mellitus developed infected-nonunion with poor outcome left for further procedure. 1 patient with history of assault that develop radial nerve palsy improved satisfactorily within two months without any surgical intervention. Range of motion of wrist flexion was average of 68° (range 10 to 90), for wrist extension 65° (ranging from 10 to 90), for pronation 60° (ranging from 0 to 80), for supination 60° (ranging from 0 to 80). Movement of elbow joint average is 138° (ranging from 120 to 140).

According to the system of Anderson et. al (Table V)

Table V: Anderson et al criteria for assessment of functional outcome

Result	Union	Flexion and extension at wrist joint	Supination and pronation
Excellent	Present	< 10° loss	<25% loss
Satisfactory	Present	< 20° loss	<50% loss
Unsatisfactory	Present	< 30° loss	<50% loss
Failure	Nonunion with or without loss of motion		

11 cases (55%) achieved excellent result. 4 cases (20%) had satisfactory and 5 cases (25%) had an unsatisfactory result. 1 patient developed infective non-union which was

needed further intervention latter on (Figure 1).

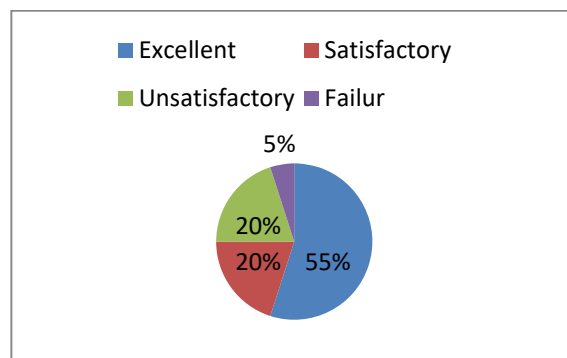


Figure 1. The final outcome of the study

Discussion

There are different options in treatment of diaphyseal fracture of forearm bone and compression plate and screw fixation is well established method. Union rate has been consistently high with good functional outcomes in up to 85%. Risk factors for development of a nonunion are comminution, high energy fractures, open fractures and suboptimal surgical technique. Preservation of soft tissue attachments is important. There is no role for minimally invasive techniques as limited exposure will likely compromise the ability to obtain anatomic alignment. Stability of fixation is important in achieving early consolidation.⁷⁻¹¹

Result of treatment of diaphyseal fracture-nonunion in forearm bone treatment is good if principles of nonunion surgery are followed. The principle are through debridement of avital tissues, removal of failed hardware, restoration of alignment, length, rotation, stable fixation using compression if possible, optimization of a bone forming environment including bone grafting if needed, allowing for early motion.¹⁵ In this study the above principal were followed and the result was satisfactory according to study of Anderson et. al.⁷

Infection is a common threat in all surgery and a big subject to overcome. In this study only 2 patient develop infection in where 1 in open fracture and other is in open fracture with diabetes mellitus which is compatible with the study of Fernondo B.D et. al.¹⁶ On the other hand fracture failed to unite in one patient out of 31 (3.2%) in their series which is better than our study (5%). There is no significant risk for ulna than radius to produce nonunion in both bone fracture which is as like as the result of Peter Kloen et. al.¹⁵

The result of this study is excellent in 55% (11 case) and satisfactory in 25% (4 case) which is also near to the result of Peter Kloen at. el.¹⁵ which was excellent in 62% and satisfactory in 17%. In their study no treatment failure was observed but in our study one patient failed to unite with poor outcome. In their studies only one patient develop infection (3.2%) but in our study 2 patient develop infection (10%) which is double in our study.

Following AO technique with adequate debridement, eradication of infection and stable fixation using compression will lead to successful healing of the vast majority of forearm nonunions. Despite a very high chance of obtaining clinical and radiological healing of the nonunion, patients should be informed that long-term functional outcome might be disappointing.¹⁷⁻¹⁸

In the present study, the incidence of postoperative infection was much lower (2/20 patients). One case resulted in failure by developing a chronic infected nonunions, while the other case was successfully managed by antibiotic therapy, resulting in a healed union and a good functional outcome.

Conclusion

In treatment of fracture of forearm bones treatment with dynamic compression plate is

gold standard but in case of fracture-nonunion this is not always suffice. Autologous bone grafting specially from iliac crest is another standard method to enhance the union in fracture-nonunion of forearm bones. Reconstruction of the anatomy of both forearm bones is of crucial importance in the management of the diaphyseal forearm nonunions. This study showed that treatment of fracture – nonunion of forearm bone using technique of compression plating osteosynthesis aided by autologous bone grafting represent an effective treatment option of this challenging condition.

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