

Outcome of Forearm Shaft Fractures in Adults Treated by Dynamic Compression Plate (DCP)

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ABSTRACT

Objective: To evaluate the clinical and radiographic outcome after open reduction and internal fixation of the forearm diaphyseal fractures by Dynamic Compression plate (DCP).

Methodology: We prospectively, investigated the clinical and radiographic outcome for 94 adult patients with 154 forearm shaft fractures. The study groups include 70 males, and 24 females. Patients were treated by open reduction and internal fixation with small DCP and followed up for 24 months. Time of union, rate of union, complications and outcome were assessed according to the modified system of Price and Daruwalla Score.

Results: Out of 154 fractures 149 (94.155%) had united at a mean time of 15.4 weeks (range 11-26weeks), there was 02(3.08%) superficial infection that healed by debridement and antibiotics, and 01(1.54%) deep infection which caused to delayed union and underwent reoperation, including change of implant and bone graft. Two (3.08%) radial nerve injuries occurred after operation, full recovery in one and partial in another patient was observed after 6 months. Excellent and good results were seen in 40 (66.7%) and 20 (33.3%) of the patients with both bone fractures, in radius Excellent and good results were seen in 16(80%) and 04(20%) patients, in ulna Excellent and fair 14(85.75%) and 2(14.25%) of adults forearm shaft fractures with conventional 3.5 mm DCP was associated with a high rate of success. The results with this type of plate are comparable with the never and more expensive implants.

Key Words: diaphyseal forearm fracture, Radius, Ulna, Open Reduction, Internal Fixation, Dynamic Compression Plate.

INTRODUCTION

Forearm serves an important role in function of the upper extremity. It facilitates the position of the hand in space and help to provide its unique mobility. Forearm fracture involving radius, ulna or both bone, which may present unique problems and effect the function of the upper limb. These fractures can be regarded as articular fractures as slight deviation or malalignment will significantly decrease the forearm rotational amplitude by impair the positioning and hand function.¹⁻³

The Preferred method for forearm shaft fractures is anatomic reduction and stable fixation using plate and screw. The introduction of AO principles and implants changed the outlook of closed treatment with its poor results toward open reduction and stable internal fixation that can provide good function.⁴ Dynamic compression at the fracture site using DCP has a lower incidence of nonunion and can improve functional outcome

Table 1: Modified system of Price and Daruwalla for evaluation of reduction in ROM of Elbow, Forearm and Wrist.

Result	Elbow	Forearm	Wrist	ROM restriction
Excellent	//	//	//	<9 deg
Good	//	//	//	10-19 deg
Fair	//	//	//	20-29 deg
Poor	//	//	//	>30 deg

ROM: Range of motion (deg: degree)

with less joint stiffness. Chapman et al found 90% union rate and 92% satisfactory results in 129 forearm diaphyseal fractures treated by compression plate.⁵ There is a variety of plates for internal fixation of forearm shaft fractures such as DCP, LC-DCPP (limited contact), LCP (locking compression) PC-Fix⁷⁻⁸ (point contact fixator) and semi tubular plate, but no one is as effective type of implant or the most effective type of the plate has not been defined. We supposed that the traditional DCP is an effective device for stabilization of the most transverse and oblique diaphyseal forearm fractures. This study was conducted to assess the short-term outcome of

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forearm diaphyseal fractures by 3.5mm small DCP at our hospital.

METHODOLOGY

This prospective study was between July 2008 to Feb 2012, 94 adults patients with closed displaced forearm shaft fractures type A or B according to the AO classification were treated by open reduction and DCP selected for this study. Type C fractures, Open fractures, concomitant humerus, elbow or hand injury was excluded. Patients were operated at mean time of 3.6 days (2-10days) after injury. One dose of cefalotin (1gr) was given before surgery and continued for 24 hours. Direct dorsal approach for ulna and volar approach for radius, was used based on the fracture location. We used tourniquet in all patients and 3.5mm DCP 5-7

Table II: Frequency of the fractures and time to union.

Localization	No. of fracture	Union time(weeks)
Both Bone fx	120	11-26
Radial fx alone	020	11-17
Ulna fx alone	014	13-21
Total	154	

For internal fixation

A long arm splint was applied for three weeks, then stitches were removed and physiotherapy was initiated. Gentle active motion of the hand and daily activities was permitted after splint removal, but heavy works or sport activities was delayed until fracture union was observed. Follow-up visits

Table III: Result of treatment according Price and Daruwalla score.

Fracture	Result			
	Excellent	Good	Fair	poor
Total patients = 94				
Total of Fractures = 154	N%	N%	N%	
Both Bone	60=120	40(66.5%)	20(33.5%)	-
Radius Alone	20=20	16(80.0%)	04(20.0%)	-
Ulna Alone	14=14	12(85.75%)	-	02(14.25%)

Two patients had superficial infection, which subsided by antibiotics and irrigation. According to the Price and Daruwalla index system, excellent and good results for both bone fractures were seen in 66.7% (40 patients) and 33.3% (20 patients) respectively. Restriction in supination and

were done at 1,2,3, and 6 months after surgery till radiologic healing was seen. Fracture union was defined as to see bridging callus at the fracture site and disappearance of fracture gap in AP and Lateral radiography. Clinical result was assessed based on a scaled evolved by Price et al⁹ as modified from Daruwalla and Grace.¹⁰⁻¹². This system evaluation degree of reduction in range of motion of the elbow, forearm and wrist joints (Table-I) We compared the results with the opposite normal forearm. Statistical analysis was performed using test and chi-square tests, in SPSS version 13 software.

RESULTS

A total of 94 patients with 154 forearm fractures were included in the study. There were 70 males with a mean age of 33.3 years +9.5 and 24 females with a means age of 36.9 +11.2 years. 149 fractures (94.15%) united in a time between 11 to 26 weeks. Table-II, Shows the number of fractures and time to union.

The mean time to union was 15.4 weeks. Non-union was seen in two patients with isolated ulna and radius fractures. These needed a second operation using bone graft from iliac crest and change of the plate in ulnar nonunion. Both of them achieved radiographic union at 11 and 14 weeks thereafter. One case of delayed union was observed following deep infection in a patient with ulnar fracture. After debridement, change of implant with a longer plate and autogenous bone graft, bony union was achieved at 17 weeks.

pronation was seen in 20 among 60 patients with both bone fracture and in three patients with single radius and ulnar fractures. In both bone Fractures, 7 had restriction in flexion and extension of the elbow and wrist, but 2 out of 94 patients with single bone forearm fractures had Radial nerve injury

occurred in two patients after dorsal (Thompson) approach for radius fracture.

Full Recovery in one and partial in the other patients was seen at six months post operation.

DISCUSSION

With the understanding of that radius and ulna function as a unit, they come into contact at distal and proximal radioulnar joints. Interosseous membrane's fibers run in an oblique line from distal ulna to proximal Radius and accounts for adjust 70% of forearm bones stability. Rotation of the forearm depends on the ability of the radius to rotate around the ulna. Angulation of 10 degree in radius or ulna can results in a loss of 20 degrees of forearm rotation. With 20 degree of angulation, significant restriction in passive movement of the forearm will occur. This is the reason that anatomic reduction with restoration of the normal curve of the radius and rigid fixation can provide the best result in forearm fractures.¹⁻³

Although DCP is still the most common plate being used but LCDCP, LCP and biologic plating have been advocated as newer implants for these fractures. The main advantage of these plates is better fixation in osteoporotic bone and in cancellous bone of the metaphyseal region.^{13,14} These newer implants theoretically allows more rapid bone healing but reports on the result or superiority over conventional plates are few. In conventional DCP the stability depends on friction between the plate and bone, which in theory may damage periosteal circulation.¹⁵

Steven et al in a comparative study between DCP and LCP in simple forearm fractures reported that time to union was not depended on type of plate.⁰⁶ Sushil et al concluded that LCP was effective for comminuted forearm diaphyseal fractures but its superiority over conventional DCP treatment of simple fractures is yet not proven.¹⁵ Anderson has reported that plating is the most physiologic type of fixation for forearm shaft fractures. He observed a union rate of 96.3% in ulnar and 97.8% in radial fracture treatment by compression plate.¹⁶ Hertel et al reported results of 132 patients who were treated with small DCP and only 2 case of nonunion and 2 other cases of delayed were close to our study.¹⁷ Goldfarb et al analyzed the DASH and MFA score after both bone forearm fractures in 32 patients and found a mean 10 degrees reduction in pronation and grip strength in the forearm and their result was close to our patients that were evaluated with a modified

scoring system of Price and Daruwalla.¹⁸ Henle et al in their study reported that clinical and functional outcomes of LCP plating of diaphyseal forearm fractures were comparable to the use of conventional DCP implants.¹⁹ Droll et al investigated functional outcome after plating of 30 patients and reported a loss of 30% strength by DASH and SF-36 patient based score.²⁰ Martinz et al reported no significant difference between LCP and DCP in 22 patients with forearm fractures.²¹ Results in our study with 3.5mm DCP are comparable with LCP result reported elsewhere which is more expensive than conventional plating. We observed four case of neuropraxia of deep branch of radial nerve that occurred after dorsal (Thompson) approach for radius fractures. But no nerve injury was seen with volar approach. Though it may be the surgeon's experience in surgical exposure, the volar approach may be safer for fixation of radial shaft fractures even in proximal third. Seyed Abdul hosseine & Coworker in their study reported that open reduction and internal fixation of adult's forearm fractures using small DCP was associated with high rate of success²².

CONCLUSION

Open reduction and internal fixation of adult forearm shaft fractures using small DCP was associated with a high rate of success. We conclude that the results with this type of plate are comparable with the newer and more expensive implants.

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