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Role of Dynamic Compression Plating (DCP) In Fractures of Forearm Bones

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Abstract: ***50 cases of fracture forearm bones treated by 3.5 mm dynamic compression platting were studied prospectively clinically and radiologically. The results were assessed in terms of union and movements at elbow, wrist and radioulnar joints. After follow up period of 6 to 10 months, 80% were graded excellent, 18% good and 2% as failure. External support was not used. ORIF with DCP still has a prospect in repair of forearm factures considering its low complication rate, cost and acceptable results in developing country like India where financial matter and non availability of C-arm image intensifier are to be considered.***

Keywords: facture both bone forearm, open reduction, DCP, Bone graft, comminuted facture

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1. Introduction

Forearm fractures have traditionally been treated with various methods. Closed reduction and cast immobilization often achieves good results in children where the normal limb fuction is achieved by remodeling. However, in adults, such remodeling is not possible and optimal functional recovery can seldom be achieved with closed reduction and cast immobilization. It is essential to regain length, apposition, axial alignment and normal rotational alignment while treating diaphyseal fractures of the radius and the ulna to gain good range of pronation and supination. The chances for the occurrence of malunion and non-union are greater because of the difficulties in reducing and maintaining the reduction of two parallel bones in the presence of the pronating and supinating muscles, which have angulatory as well as rotatory influences.[1] Also, due to the presence of interosseous membrane, these fractures are considered equivalent to intra-articular fractures. Open reduction and internal fixation with plating is generally accepted as the best method of treatment for displaced diaphyseal fractures of the forearm in the adult.[2] The value of compression in obtaining rigid internal fixation had been noted by various authors.[3–5]Compression techniques have a lower incidence of non-union and are found to hasten rehabilitation, with less joint stiffness.[6–11] The present study was conducted to study the role of the AO Dynamic Compression Plate in treating fractures of the forearm bones.

In the DCP, compression is applied by eccentric insertion of screws. Slot for compression has a sloping surface at one end. When the spherical head of the screw impinges on this surface, plate moves away from the fracture, thereby compressing fracture plane. If more compression is necessary, subsequent screws may be inserted in compression mode, but it is rarely necessary for more than two screws to be loaded.

Various advantages sited in favour of DCP include 1. It increases the stability of construct by anatomical reduction. 2. Medullary blood supple is not disturbed. 3. Factors responsible for non-union, like soft tissue interposition and gap, can be dealt with. 4. Minimal need of plaster immobilization. 5. Active exercises can be started early, therefore chances of joint stiffness are greatly reduced.

2. Materials and Methods

This prospective study was conducted on 50 consecutive patients of forearm bone fractures (radius or ulna or both) presenting to Rajindra hospital, Patiala, who gave informed consent. The ethical clearance was obtained from institutional ethics committee. Inclusion criteria were (i) age between 16 and 60 years, (ii) fresh (<21 days old) closed or Type I compound diaphyseal fracture of both bones of forearm, (iii) competent neurological and vascular status of the affected extremity, (iv) with good function of shoulder, elbow, wrist and finger joints and (v) without any other associated ipsilateral or contralateral major limb injury affecting treatment or rehabilitation protocol. Cases with pathological fracture, history of long-term steroid therapy and clinically detectable disease like rheumatoid arthritis were excluded from the study.

The fractures were classified according to the anatomical pattern of the fracture.

Regional or general anesthesia was used. Choice of anesthesia was left to the anesthetist. The surgical procedure was using the subcutaneous approach for ulna and Henry's or Thompson's approach for radius, depending on the site of fracture. Post-operatively, antibiotics, analgesics and anti-inflammatory drugs were given. Active movements of fingers, wrist and elbow were started immediate post-operative as comfortable to the

patient. Stitch removal was done on 11th-12th post-operative day.

Patients were followed up at 6 weeks, 12 weeks and then at 6 months. At each visit, clinical examination was done for movements at wrist, elbow and fingers and for infection or pain. Radiological examination was done for signs of union, displacement, angulation, infection or screw loosening. Active exercises were advocated.

The results were evaluated on the basis of fracture union, range of movements, muscle (grip) strength and complications. Union was assessed based on the criteria of Anderson *et al*.[3] Fractures which healed in less than 6 months were classified as unions; those which required more than 6 months to unite but without any additional operative procedure were classified as delayed unions; and those which failed to unite without further operative intervention were classified as non unions. The functional outcome was assessed using the criteria [Table 1] of Anderson *et al*.[3]

3. Results

In the present study, forearm fractures were found to be commonest in age group 21-30 years and included 20 (40%) of all patients.[TABLE 1]

Table 1: Age Distribution

Age group in years	*No. of cases*	*Percentage*
15-20	5	10
21-30	20	40
31-40	10	20
41-50	10	20
51 and above	5	10
Total	50	100

40 (80%) of the patients included were male and 10 (20%) were females.[TABLE 2]

Table 2: Anderson *et al*.[3] 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	Non-union with or without loss of motion		

Forearm fractures were found to be most common in employees (46%) and labourers (26%).[TABLE 3]

Table 3: Occupation

Occupation	*No. of cases*	*Percentage*
Businessman	10	20
Employee	23	46
Labourer	13	26
Shopkeeper	2	4
Other	2	4
Total	50	100

The most common mode of injury was a Road Traffic Accident, affecting 30 (60%) of all patients. Other modes of injury included falls (26%), industrial accident (10%) and direct blow/ assault (4%).[TABLE 4]

Table 4: Mode of Injury

Mode of Injury	*No. of cases*	*Percentage*
Road side accident	30	60
Falls	13	26
Industrial accident	5	10
Gun shot	-	-
Lathi blow	2	4
Total	50	100

The most common pattern of fracture was transverse (50%) followed by oblique (40%), spiral (6%) and comminuted (4%).[TABLE 5]

Table 5: Fracture Pattern

Type of fracture	*No. of cases*	*Percentage*
Oblique	20	40
Spiral	3	6
Tranverse	25	50
Comminuted	2	4
Total	50	100

Fractures of the radius were found to be more common in distal third and that of ulna were found to be more common in middle third.[TABLE 6] 3 (6%) of the patients had an associated fracture of the ipsilateral humerus.

Table 6: Fracture Site

Fracture site	*Radius*	*Ulna*	*Total*
Upper third	4	7	11
Middle third	8	8	16
Lower third	18	5	23
Total	30	20	50

Radiological union was observed at 8 weeks in majority of the patients. Average time for union was 8 weeks with minimum of 7 weeks and maximum of 12 weeks.[TABLE 7] By the end of study, union was achieved in 48 (96%) of the cases.[TABLE8] There was 1 case of delayed union and 1 case of non union associated with osteomyelitis.

Table 7: Period of Radiological Union

Time in weeks	*Radius*		*Ulna*	
	No. of cases	*%age*	*No. of cases*	*%age*
6	0	0.0	2	4
7	10	20	3	6
8	13	26	10	20
9	5	10	3	6
10 or >	2	4	2	4
Total	30	60	20	40

Table 8: Rate of Union

Rate of union	*No. of cases*	*Percentage*
United	48	96
Delayed union	1	2
Non-union	1	2
Total	50	100

Activities of daily living means able to perform non exertional normal routine work like bathing, eating, drinking and office works. Majority of the patients (80%) were able to return to activities of daily living by 8-12 weeks.[TABLE 9]

Table 9: Return to Activities of Daily Living

Time in weeks	*No. of cases*	*Percentage*
0-6	-	-
6-8	5	10
8-12	40	80
>12	5	10
Total	50	100

Superficial wound infection was noted in 2 (4%) patients who was treated with debridement and culture guided antibiotics. Deep infection was seen in 1 patient, which resulted in osteomyelitis and non-union. None of the cases in this study had cross-union, metal reaction, aseptic loosening or post-operative nerve palsy.[TABLE 10]

Table 10: Complications

Complications	*No. of cases*
Superficial infection	2
Deep infection	1
Delayed union	1
Non-union	1
Cross-union	-
Metal reaction	-
Aspetic loosening of plate and screws	-
Post-operative nerve injury	-
Total	5

Functional results (in accordance with Anderson's criteria) were found to be Excellent in 40 (80%) patients, Good in 9 (18%) patients and Failure in only 1 (2%) patients. [TABLE 11]

Table 11: Functional Results

Results	*No. of cases*	*Percentage*
Excellent	40	80
Good	9	18
Unsatisfactory	-	-
Failure	1	2
Total	50	100

4. Discussion

Open reduction and plate fixation is the standard treatment of adult diaphyseal forearm fractures. 50 patients of fractures of forearm bones were treated with open reduction and internal fixation using a 3.5mm Dynamic Compression Plate. The following basic principles of internal fixation were kept in mind 1. Anatomical reduction. 2. Preservation of vascularity. 3. Mechanical stable fixation. 4. Rapid mobilization of joints.

The forearm fractures we found to be commonest in males of 21-30 years age. This is explained by the fact that young active males are more involved in outdoor and heavy activities and are therefore more prone to injuries and falls.

Fractures of the radius were found to be more common in distal third and that of ulna were found to be more common in middle third. 3 (6%) of the patients had an associated fracture of the ipsilateral humerus.

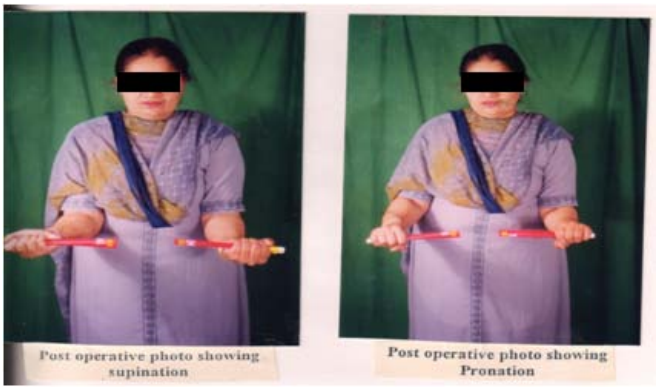

Figure 1: Showing post-operative clinical photographs, pre-operative and post-operative X-rays

Figure 2: Showing pre-operative X-rays and at time of union.

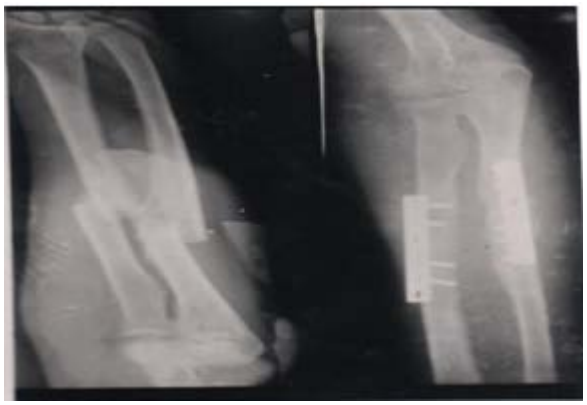

Figure 3: Showing pre-operative X-rays and at time of union

All the patients were operated within 2 days of presentation. Standard surgical approaches and techniques were used. Periosteal stripping was kept to minimum. Fractures were anatomically reduced. Minimum of 3 screws (6 cortices) were placed on either side of the fracture. Bone grafting was used in cases where there was comminution leading to a gap at fracture site. Tourniquet was released and haemostasis was achieved in all cases before skin closure.

In the post-operative period, no immobilization was used and patients were encouraged forphysiotherapy as early as possible.

Excellent or good results were achieved in 96% of the patients. There was 1 case of delayed union and 1 case who developed osteomyelitis which resulted in non-union.

Figure 4: Showing osteomyelitis and non-union

Considering the above discussion, we conclude that the treatment of choice for displaced forearm diaphyseal fractures is early open reduction and internal fixation with 3.5 mm DCP. It not only permits early mobilization of the limb which prevents stiffness, but also provides anatomical reduction and compression which leads to early union with minimum complications.

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