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A Study on Management Of FractureBoth Bone of Forearm by Dynamic Compression Plating

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Abstract

Introduction

The forearm, being a component of upper limb serves important movements that are important in activities of daily living. The forearm, in combination with the proximal and distal radioulnar joints, allows pronation and supination which in turn helps hand,to perform multi axial movements. Closed reduction which was employed in earlier days yielded unsatisfactory results from either non union or loss of motion. Also there are complex forces acting on the forearm bone that makes reduction and its maintenance of displaced fracture fragments difficult. With the development of compression plate osteo-synthesis which providesa good treatment option and predictable outcome, there is an important change in the treatment of forearm fractures.

Material and Methods

This is a prospective study was conducted in the Department of Orthopedics at Gayatri Vidya Parishad Institute of Healthcare and Medical Technology from October 2023 to March 2024. In this study 30 patients with forearm fractures, were treated by open reduction and internal fixation with 3.5 mm dynamic compression plate (DCP) and screws, in patients with displaced fractures of the shaft of both bone forearm. All patients admitted with both bone fractures of the forearm, a careful history was elicited from the patient and/or attendants to reveal the mechanism of injury and theseverity of trauma.

Results

Majority of the fractures were seen in the mid diaphysis of both bones of forearm.17 (56.33%) patients had mid diaphysial fractures, 8 (26.66%) had proximal thirdfractures and 5 (16.66%) patients had lower third fracture of both bones of forearm. As we had included diaphyseal fractures of both bones, in our study, in total we had total of 30 radius shaft fractures and 30 ulna fractures. Among 30 radius fractures, 7(23.33%) were Transverse

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and 15 (50%) were shortoblique type and 8(26.66%) were comminuted variety. Among 30 ulna fractures, 3(66.66%) were Transverse and 19 were short oblique type and 8 (33.33%) were comminuted variety. 5 (16.66%) of the patients had associated injuries of which only one patient had fractures of shaft of humerus and femur and head injury. 28 (93.33%) patients had sound union in less than 6 months, 1 (3.33%) patient haddelayed union, and 1 patient (3.33%) had a non-union of ulna.

Conclusion

Radial bowing is very important for normal supination and pronation. This can be maintained very well with compression plates. A minimum of 6 cortices should engage in each fracture fragment. It is better to use longer plates like a bridge plate in case of comminuted oblique fractures. Radius and Ulna are approached separately to avoid extensive soft tissue dissection and resulting complication. Post operatively with DCP fixation additional supportive measures may not be required after soft tissue healing and shoulder, elbow and wrist movements can be started early. This helps prevent muscle atrophy and joint stiffness.

Keywords: Dynamic compression plate, Fractures, Non-union.

INTRODUCTION

The forearm, being a component of upper limb serves important movements that are important in activities of daily living. The forearm, in combination with the proximal and distal radioulnar joints, allows pronation and supination which in turn helps hand,to perform multi axial movements. [1]

With mechanized farming in India and industrialization, fractures of forearm bones have become more common. Fracture of the forearm bones may result in severe loss of function unless adequately treated. Hence good anatomical reduction and internal fixation of these fractures is necessary to restore function. [2]

Closed reduction which was employed in earlier days yielded unsatisfactory results from either non union or loss of motion. Also there are complex forces acting on the forearm bone that makes reduction and its maintenance of displaced fracture fragments difficult. [3]

Union may be achieved with any of the methods available however severe loss of function may be the end result unless adequately treated with proper technique and implants. With the development of compression plate osteo-synthesis which providesa good treatment option and predictable outcome, there is an important change in thetreatment of forearm fractures. [4] This method helps in perfect reduction of fracture fragments in anatomical position by rigid fixation and early mobilization, the normal functions of the hand can be achieved at the

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earliest. [5]

Bagby and Denham were the first to describe Dynamic compression plate and morerecently developed by the AO school has an intrinsic compression device making extensive dissection unnecessary. The plate depends upon the obliquity of cylindrical screw holes for compression which is produced as the screws are driven home. [6] The most effective method of producing rigid internal fixation is by the use of compressionplates developed by the AO School in Switzerland AO (Arbeitsgemeinschaft fur Osteosynthesefragen) / Association for the Study of internal fixation (AS IF), dynamic compression plate provides more secure fixation without cast protection. It produces sufficiently rigid fixation, impaction and compression of the fracture site. [7-11]

To conclude, satisfactory reduction of displaced fractures of the forearm bones is difficult to achieve by closed methods and if achieved, it is hard to maintain. So with open reduction and internal fixation using dynamic compression plate, it is possible to achieve perfect fracture reduction, rigid fixation, and better bone healing and early mobilization. Cancellous bone grafting can be used whenever there is bone loss.

Material and Methods

This is a prospective study was conducted in the Department of Orthopedics at Gayatri Vidya Parishad Institute of Healthcare and Medical Technology from October 2023 to March 2024. In this study 30 patients with forearm fractures, were treated by open reduction and internal fixation with 3.5 mm dynamic compression plate (DCP) and screws, in patients with displaced fractures of the shaft of both bone forearm.

Inclusion and Exclusion criteriaInclusion Criteria:

- Patients with closed diaphyseal fractures of both bones of forearm.
- Patients in the age group of 10-65 years
- Patients fit for surgery

Exclusion criteria:

- Patient not willing for surgery
- Patient medically unfits for surgery
- Osteoporotic bones

All patients admitted with both bone fractures of the forearm, a careful history was elicited from the patient and/or attendants to reveal the mechanism of injury and the severity of trauma.

The patients were then assessed clinically to evaluate their general condition and the local

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injury. It was done in accordance to Acute Trauma Life Support protocol.

Vital parametres were recorded. Methodical examination was done to rule out fractures at other sites. Local examination of injured forearm and hand such as attitude and position of the affected upper limb compared with normal counterpart, any abnormal swelling and deformity, their level and direction.

Palpation to check any local rise of temperature, soft tissue tenderness, any palpable step, breach in continuity of bone, any revealed abnormal mobility, crepitusand shortening of the forearm.

Distal vascularity was assessed by radial artery pulsations, capillary filling, pallor and paraesthesia at finger tips.

Neurological examination: Sensory system was examined for pain and touch sensation in the radial, ulnar and median nerve innervated areas. Power including hand grip was tested in forearm and hand muscles

Movements: Flexion and extension of elbow. Supination and pronation of forearm. Abduction and adduction and palmar flexion and dorsiflexion of the wrist were performed and any restriction of motion and pain observed

Follow-up

The patients were followed regularly at monthly interval for first three months then every three months depending upon the outcome.

The patients were evaluated based on *"Anderson et al 1"* scoring system. Elbow movements and wrist movements were noted and the union was assessed radiologically.The fracture is said to be united when there was presence of periosteal callus bridging the fracture site and trabeculation extending across the fracture line.

RESULTS

In this study 30 patients with forearm fractures, were treated by open reduction and internal fixation with 3.5 mm dynamic compression plate (DCP) and screws, in patients with displaced fractures of the shaft of forearm bones.

Table-1: Age Distribution

Age	Number of Patients	Percentage
11 – 20	3	10.00
21 – 30	10	33.33

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31 – 40	5	16.67
41 – 50	5	16.67
51 – 60	7	23.33
Total	30	100

The age of these patients ranged from 11-65 years and an average age of 38years.

Table-2: Sex Distribution

Sex	Number of Patients	Percentage
Male	22	73.33
Female	8	26.66
Total	30	100

Out of 30 patients, 22 patients were males and 8 patients were females showing male preponderance because of working in fields, travelling, factories, and sports.

Table-3: Side Affected

Side affected	Number of Patients	Percentage
Right forearm	15	50
Left forearm	15	50
Total	30	100

There were 15 (50%) patients with right forearm fracture and 15 patients (50%) with left forearm fracture.

Table - 4: Mode of Injury

Mode of injury	Number of Patients	Percentage
RTA	11	36.66
Fall on out stretched hand	15	50
Assault	4	13.33
Total	30	100

In our study, there were 11(36.66%) patients with road traffic accidents, 15(50%) patients with fall, and 4(13.33%) patients with assault

Table - 5: Level of Fracture

Level of fracture	Number of Patients	Percentage
Proximal third	8	26.66

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Middle third	17	56.33
Distal third	5	16.66
Total	30	100

Majority of the fractures were seen in the mid diaphysis of both bones of forearm.17 (56.33%) patients had mid diaphysial fractures, 8 (26.66%) had proximal thirdfractures and 5 (16.66%) patients had lower third fracture of both bones of forearm

Table -6: Type of the Fracture (Radius)

Type of fracture	Radius	Percentage
Transverse	7	23.33
Short oblique	15	50
Comminuted	8	26.66
Segmental	0	0
Total	30	100

As we had included diaphyseal fractures of both bones, in our study, in total we hadtotal of 30 radius shaft fractures and 30 ulna fractures. Among 30 radius fractures, 7(23.33%) were Transverse and 15 (50%) were shortoblique type and 8(26.66%) were comminuted variety.

Table-7: Type of the Fracture (Ulna)

Type of fracture	Ulna	Percentage
Transverse	3	10
Short oblique	19	63.33
Comminuted	8	26.66
Total	30	100

Among 30 ulna fractures, 3(66.66%) were Transverse and 19 were short oblique typeand 8 (33.33%) were comminuted variety.

Table-8: Associated Injuries

Associated injuries	Number of cases	Percentage
Ipsi-lateral humerus shaft and scapula fracture	1	3.33
Fracture of the shaft of femur	1	3.33
Metacarpal fractures	2	6.66
Head injury 1	1	3.33

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Total	5	16.66

5 (16.66%) of the patients had associated injuries of which only one patient had fractures of shaft of humerus and femur and head injury.

Table-9: Duration of Radiological union of the fracture group

Bone involved	**Duration for union**
Both Radius & ulna	12.3wks
Only radius	10.3wks
Only Ulna	11.6wks

Table-10: Duration of Fracture Union

Time of union	**Number of patients**	**Percentage**
<6 months	28	93.33
6months – 1year	1	3.33
Non-union	1	3.33
Total	30	100

28 (93.33%) patients had sound union in less than 6 months, 1 (3.33%) patients haddelayed union, and 1 patient (3.33%) had a non-union of ulna.

DISCUSSION

Our series had male preponderance with (73.33 %) 22 male patients and (26.66%) 8 female patients which were comparable to previous studies. Michael Chapman noted about 78% males and 22% females. [12] William in his series had 67% of males and 33% of females. [13] H. Dodge in his study noted about 89% males and 11% females[12]Talwalkar in his series had 80% males and 20% females. [14]

In our series 36.66% of cases (11) had road traffic accidents, **50%** (15) had **fall**, and13.33% (4) with history of assault. Thomas Grace et al. noted about 29 (45%) patients with automobile or motorcycle accident, 14 (22%), in falls 2 (3%), had gunshot wounds and remainder had other miscellaneous types of injuries.

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Moed B. R. et al. accounted 50% of his cases to road traffic accident, 20% due to industrial accident, 14% due to fall, 12% due to direct blow and 4% due to gunshot injuries. [15] Smith noted about 45% of his cases was due to RTA, 36% were due to fall and19% were due to industrial accidents8.50.

We had about 50% incidence of forearm fractures in right and left extremity, which is also comparable to the previous studies. M. W. Chapman reported about 55% incidence of fractures in right extremity. [16] H.N. Burwell & A.D. Charnley reported about 50% incidence of fracture in right arm.

As we had included diaphyseal fractures of both bones, in our study, in total we hadtotal of 30 radius shaft fractures and 30 ulna shaft fractures. Among 30 radius, 7(23.33%) were Transverse, 15(50%) were short oblique type and 8(26.66%) were comminuted variety. Among 30 ulna, 3(10%) were Transverse, 19(63.33%) were short oblique type and 8(26.66%) were comminuted variety. M.W. Chapman et al, series noted about 53% of fractures as comminuted and 47% were transverse/short oblique, on an average we had 65.33% with Transverse/shortoblique type and 33.66% were comminuted variety. Ours were not comparable to anyof the studies available.

M.W. Chapman et al noted about 59% and 61% of fractures in middle third of Radius and ulna, 13% and 21% in proximal third of radius and ulna and 28% and 12% in lower third of radius and ulna respectively. [17] A. Sarmiento et al, noted about 84.6% of fracture both bones were in middle third and 15.4% of cases had lower third fracture of both bones. [18]
H.S. Dodge and G.W. Cady documented 71.5% fracture both bones in middle third, 21.5% in distal third and 7% in proximal third. [19] Our study had 56.33% of fractures in middle third, 26.66% in proximal third and 16.66% in lower third, comparable to previous studies.

The present series had average union time of 11.5 weeks with a range of 8 to 16 weeks. Radius united in all cases we had Ulna union in 96.6% of cases. The results of our present studies are comparable to the previous studies. Anderson's criteria for evaluation of union were taken into account. In our study we had an average union time of 11.5 weeks. Anderson’s et al showed union time of around 7.4 weeks with range of 5 to 10 weeks, 97% of the cases united1. Chapman in a study had 98% union with range of 6 to 14 weeks union the average union time was 12 weeks. [20]

CONCLUSION

Radial bowing is very important for normal supination and pronation. This can be maintained very well with compression plates. A minimum of 6 cortices should engage in each fracture fragment. It is better to use longer plates like a bridge plate in case of comminuted oblique fractures. Radius and Ulna are approached separately to avoid extensive soft tissue dissection and resulting complication. Post operatively with DCP fixation

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additional supportive measures may not be required after soft tissue healing and shoulder, elbow and wrist movements can be started early. This helps prevent muscle atrophy and joint stiffness.

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