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The efficacy of dynamic compression plate versus locking compression plate with regards to fracture fixation, implant fixation and bone reaction

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Abstract
Introduction: Fracture of the forearm bones may result in severe loss of function unless adequately treated. Severe loss of function may result even though adequate healing of the fracture occurs. Hence a proper method of treatment is necessary to get back stability as well as normal range of function
Methodology: All the 50 patients were followed up at 6-8 weeks, 11-14 weeks and 6 months for functional and radiological review
Results: In group A the average time for radiological union was 8.0 weeks (6- 15 weeks) and in Group B the average time was 6.0 weeks (4- 12 weeks).
Conclusion: The locking compression plating of diaphyseal bones produced excellent results, the advantages being early mobilization, early union and hence prevention of fracture disease. The only disadvantage is that it is more expensive than the DCP.

Keywords: dynamic compression plate, locking compression plate, fracture of forearm

1. Introduction
Fracture of forearm bone are one of the most common injuries seen in day to day practice.
The forearm, in combination with the proximal and distal radioulnar joints, allows pronation and supination movements that are important to all of us in the usual activities of daily living.
The forearm serves an important role in upper extremity function facilitating positioning the hand in space, thus helping to provide the upper extremity with its unique mobility. Exacting and decisive management is required after fractures of the shafts of the radius and ulna if function is to be restored. Many chronically disabling disorders of the forearm can be prevented by the competent initial management of diaphyseal fractures of the radius and/or ulna [1].
The fracture of the shaft of the ulna with associated dislocation of the radial head was first described by Monteggia in 1814 and has been known as the monteggia fracture since then. The single bone fracture of the ulna without dislocation of the radial head is often called a nightstick fracture, an obvious reference to one of the mechanism of injury. The single bone fracture of the radius in the distal third associated with dislocation of the radioulnar joint has several eponyms. Galeazzi, of Italy, called attention to this treacherous injury in 1934 and since then it has been referred to as galeazzi's fracture [2].
Fracture of the forearm bones may result in severe loss of function unless adequately treated. Severe loss of function may result even though adequate healing of the fracture occurs. Hence a proper method of treatment is necessary to get back stability as well as normal range of function. It is difficult to achieve a satisfactory closed reduction of displaced fractures of the forearm bones and if achieved, it is hard to maintain. Unsatisfactory results of closed treatment have been reported to range from 38% to 74%. For this reason, open reduction with internal fixation is routine except for undisplaced fractures. Undisplaced single bone fractures should be treated in a long-arm cast until there is roentgenographic evidence of union or definitive evidence of delayed union [3].
Fractures of both bones or a displaced isolated fracture of the radius or ulna should be treated by open reduction, plate fixation and cancellous bone grafting whenever there is bone loss. This treatment is carried out as a semi-elective procedure as soon as the patient's condition

Warrants, reduction is easiest when the fracture is treated within the first 48 hours. AO (Arbeitsgemeinschaft fur Osteosynthesefragen) / Association for the study of internal fixation (ASIF), dynamic and locking compression plate provides more secure fixation without cast protection. It produces sufficiently rigid fixation, impaction and compression of the fracture site. It can be inserted through a smaller incision than the standard plate because no external compression device is required [4].

The dynamic compression plate (DCP) first described by Bagby and Denham and more recently 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. The most effective method of producing rigid internal fixation is by the use of compression plates developed by the AO School in Switzerland. The authors concluded that the use of ASIF compression plates for acute diaphyseal fractures of the forearm is a very successful method of obtaining union and restoring optimum functional use of the extremity.

2. Methodology

With the patient under suitable anesthesia, tourniquet was applied to the affected limb in all the patients. The ulna was directly approached over the subcutaneous border the radius was approached depending on the level of fracture. For upper third Thompson's posterior approach was used and for lower third Henry's anterior approach was used. For middle third either of the both was taken.

When either one bone was fractured, it was approached directly by any of the above- mentioned approaches. But when both bones were fractured, the fracture site was approached one after the other and a trial reduction was done and then fracture ends were cleaned. Later the periosteum was elevated, the fracture reduction was held with reduction forceps. The plate was then applied with lowman's clamp. A plate with at least six holes was chosen, but for spiral and comminuted fractures longer plates with more number of holes was taken.

The fracture that was unstable or comminuted was fixed first followed by

Stable fracture. The contoured plate was centered across the dorsal side of radial

Fracture (i.e tensile side of bone). In ulna the plate was applied either posterolateral or

Posteromedial side. The neutral guide directs the drill into the exact center of the plate hole and

Does not impart any compression. A hole is drilled through both the cortex using

2.8mm drill. Appropriate 3.5 mm screw width was taken and after tapping with

3.5mm tap, the screw was inserted but was not completely tightened.

Next the nearest available hole was drilled on the opposite side of the fracture with the eccentric drill guide with the arrow on the guide pointing towards the fracture. A 3.5 mm screw of appropriate length was put using the mentioned technique.

The contour between the plate and the screw of eccentrically placed screw moves the screw head towards the center of the plate. Locking screw was fixed to the locking plate.

After stable fixation has been achieved, haemostasis was secured meticulously and suction drain was kept before closing the wound.

2.1 Post-operative management

Postoperative x- ray were taken, intravenous antibiotics was given for 5 days and later oral antibiotics was given till suture removal. Analgesics were given for 5 days postoperatively, posterior above elbow slab given and limb was elevated for 48 hours and was advised active finger movements. The drain was removed after 48 hours. Sutures were removed on 10-13thday.

Later depending on the fracture pattern and fixation, patient was given above elbow slab and advised to do active shoulder exercises.

All the 50 patients were followed up at 6-8 weeks, 11-14 weeks and 6 months for functional and radiological review.

2.2 Criteria for Evaluation of Radiological and Clinical Results

Anderson *et al* (1975) criteria were used to evaluate radiological and functional results [20]

2.3 Radiological Criteria

A fracture was designated healed radiologically when there was presence of periosteal callus bridging the fracture site or trabeculation extending across it and when there was obliteration of fracture when rigidly compressed.

3. Results

In a study of 50 cases of forearm bone fractures, 25 (Group A) were treated with DCP and 25 (Group B) were treated with LCP.

All the 50 patients were followed up at 6-8 weeks, 11-14 weeks and 6 months for functional and radiological review.

In Group A the average follow up was 18 months range (6-20 months).

Group B the average follow up was 18 months range (6-20 months).

Criteria for Evaluation of results Radiological and clinical.

3.1 Radiological Criteria

Using the criteria of Anderson *et al* (1975). A fracture was considered healed radiologically when there was presence of periosteal callus bridging the fracture site or when there was obliteration of fracture gap, in rigidly compressed fractures**.**

3.2 Determination of union

Using the Criteria of Anderson *et al* [5]

1. Fractures which healed in less than 6 months were classified as unions.
2. Those, which required more than 6 months to unite and had no additional operative procedures, were classified as delayed unions.
3. Those, which failed to unite without another operative procedures were classified as non-unions.

Table 1: Using the criteria of Anderson *et al* [5]. (1975) the results were graded as

Results	Union	Flexion/Extension At Elbow Jt	Supination And Pronation
Excellent	Present	< 10° Loss	< 25° Loss
Good	Present	< 20° LOSS	< 50° LOSS
Fair	Present	> 20° Loss	>50°Loss
Poor	Nonunion	With Or Without Loss Of Motion	

Using the above criteria for radiological union. In group A the average time for radiological union was 8.0 weeks (6- 15 weeks) and in Group B the average time was 6.0 weeks (4- 12 weeks).

Table 2: Radiological findings

Results	Group A No of Cases	%	Group B No of cases	%
Excellent	20	80	23	92
Good	2	8	2	8
Fair	2	8	-	-
Poor	1	4	-	-

From the above study, Chi-square value is found significant.

4. Discussion

4.1 Determination of union

Chapman *et al* [6] included the periosteal callus bridging the fracture site as a radiographic criterion for union, in addition to muller's criteria. In our study we followed Anderson *et al* (1975) criteria to evaluate the union of fracture i.e. fracture line obliteration and bridging of trabeculae across fracture.

There has been a few clinical study available on comparing DCP (Group A) and LCP (Group B). So in our study we have done comparison between Group A and Group B and other studies of DCP.

In the present study, the average age was 36 years (19-58 years) in group A and in Group B it was 38.6 years (18-56 years) compared to Chapman's series where it was 33 years (13-79 years) which was almost the same and was higher compared to Dodge's [7] 24 years (13-59) in his study. In both the groups, 87.5% of cases in our study 64% were males and 36% were females which was almost same compared to dodge's series which was 89% and 11% respectively.

Table 3: Age group (in years) and Sex incidence (%):

Series	Minimum age	Maximum age	Average	males	Females
M.W. Chapman [6]	13	79	33	78	22
Group A	19	58	36	85	15
Group B	18	56	38.6	90	10
H.DODGE [7]	13	59	24	89	11

The average duration of hospital stay in our study was 14 days in Group A and majority being in 7-32 days and was 11 days in Group B and majority of it being in 5- 30 days, which has not been mentioned in any of the studies.

A total of 98 bones were fixed in 50 patients of which 48 were ulna and radius. In Group A there were 24 both bone (96%), 1 isolated ulna (4%), fractures compared to Chapman's series which had 42 both bones, 18 radius and 27 ulna in a total of 129 was almost the same, and in P.K. Rai series it was 16, 16 and 5 respectively, where both bones was the commonest type of injury. We had no monteggia and had 1 galeazzi fracture compared to Chapman's 10 and 14 respectively.

Table 4: Radiological Union (Weeks)

Series	Union	Range
Group A	9.0	6-22
Group B	7.1	4-12
Anderson[5]	7.4	5-10

Further using Anderson's *et al* criteria for functional results, we had 75% excellent, 10% good, 10% fair and 5% poor results in Group A and 90% excellent, 5% good and 5% fair results in Group B compared to Anderson's 59% excellent, 31% good, 7% fair and 3% poor and Chapman's 83%, 8%, 7% and 2% respectively. Here Group B had best results compared to others.

Table 5: Functional results (%)

Series	Excellent	Good	Fair	Poor
Group A	80	8	8	4
Group B	92	8	-	-
Anderson[5]	59	31	7	3
Chapman[6]	83	8	7	2

5. Conclusion

Due to road traffic accident antebrachium fractures **c**ommonly occur in young adults. Open reduction and internal fixation is the treatment of choice as closed methods invariably fail. The fracture fragments should be fixed as early as possible to ease the surgery and it is also important to achieve accurate anatomical reduction with rigid internal fixation. The quality of fixation has a definite bearing on the functional recovery. We observed that the fracture gap was obliterated or greatly diminished by compression plates. The 3.5 mm locking compression plating system provides very rigid fixation with compression.

6. References

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