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Intra operative (per-operative) and postoperative complications in dynamic compression plate (DCP) and locking compression plate (LCP)

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Abstract
Introduction: The scientific observations of biomechanics and biology of bone lead to the new concept of biological plating. The newly designed LCP stands for a new approach for plate fixation, reduced trauma to bone, preservation of blood supply, avoidance of producing stress risers at implant removal, the fixed angle construct and excellent tissue tolerance were the goals to be realized
Methodology: On an average 60 cases were operated for plating of forearm bones in one year. Sample size was taken as 50 with equal distribution of cases (using randomization list) i.e. 25 cases with dynamic compression plating (DCP) (Group A) and 25 cases with locking compression plating (LCP) (Group B)
Results: A total of 98 bones were fixed in 50 patients of which 48 were both bones and isolated ulna in 1 each. In Group A there were 24 both bone (96%), 1 isolated ulna (4%). In Group B there were 24 both bone (96%), 1 isolated ulna (4%).
Conclusion: Complications, duration of surgery and surgical technique virtually remains unchanged

Keywords: dynamic compression plate, locking compression plate, complications

Introduction
The mechanisms of injury that cause fractures of the radius and ulna are myriad. By far the most common is some form of high-speed vehicular trauma**,** especially automobile and motorcycle accidents. Frequently the patient is unable to recount the exact mechanism of injury owing to the sudden nature of the accident. Probably most of these vehicular accidents result in some type of direct blow to the forearm [1]. Other causes of direct blow injuries include fights in which one of the adversaries is struck on the forearm with a stick. Monteggia and nightstick fractures frequently result from this kind of blow, but fractures of both bones are often caused by this mechanism as well. Gunshot wounds can cause fracture of both bones of the forearm. Such injuries are commonly associated with nerve or soft tissue deficits and frequently have significant bone loss [2, 3]. Pathologic fractures of the forearm bones are not common. If they are excluded, most of the rest of these fractures result from some type of fall. The force generated is usually much greater than the required to cause Colles fracture. Most forearm shaft fractures resulting from falls occur in athletics or in fall from height [4, 5].
The scientific observations of biomechanics and biology of bone lead to the new concept of biological plating. The newly designed LCP stands for a new approach for plate fixation, reduced trauma to bone, preservation of blood supply, avoidance of producing stress risers at implant removal, the fixed angle construct and excellent tissue tolerance were the goals to be realized. The LCP is technically a further development of the DCP (Perren *et al* 1979) [6]

The new concept aim at
1. Minimal surgical damage to blood supply.
2. Improved healing in the critical zone covered by plate.
3. Minimal damage to bone lining the plate to reduce the risk of re fracture following plate removal.
4. Optimal tissue tolerance of the implant by selection of pure titanium as an implant material.

The screws are locked in the plates. Due to the resulting angular stability, toggling of the

Screw is eliminated, thus reducing the risk of reduction loss. No compression of the plate onto the bone is required to achieve stability, this helps to preserve the bone blood supply.
With the unique combination hole it is possible to exploit and combine the advantages of both implant systems, standard plates and screws as well as locked internal fixator.
The combination hole gives compression and absolute stability as with other standard plates and screws. The other hole gives angular stability and better anchorage with locking head screws.
With the conventional plates and screws, anatomical fit between the plate and the bone is necessary in order to maintain an exact reduction. Lag screw technique can be performed to achieve optimal interface compression. Eccentric placement of standard screws allows for dynamic compression.

Methodology
The data was collected from patients with fracture of forearm bone advised to undergo open reduction and internal fixation with plates and screws at District Hospital GIMS, Gadag.

Sample size: 50
On an average 60 cases were operated for plating of forearm bones in one year. Sample size was taken as 50 with equal distribution of cases (using randomization list) i.e. 25 cases with dynamic compression plating (DCP) (Group A) and 25 cases with locking compression plating (LCP) (Group B). Here prospective randomized clinical trial was done using the sealed envelope technique.

Duration: Period of study and follow up was from May 2014 to May 2016.

Study Subjects: All patients who fulfill the selection criteria.

Inclusion Criteria
1. All diaphyseal fractures of forearm bone.
2. Patients more than 18 years of age.
3. Closed fractures.

Exclusion Criteria
1. Patients below 18 years of age.
2. Open fractures, segmental fractures and associated neuro vascular injuries.

Results
Age and Sex Distribution
Off 50 cases there were 32 males and 18 females with equal distribution in both the groups. The average age was 40 years in Group A range (19- 58 years) and was 35 years in Group B range (18- 56 years).

Mode of Injury
There were 35 RTAs (70%) 10 Falls (20%) and 5 Assault (10%).

Distribution of Side, Site and Classification
The left side was involved in 24 patients and 26 had right side involvement with equal distribution in both the groups. A total of 98 bones were fixed in 50 patients of which 48 were both bones and isolated ulna in 1 each. In Group A there were 24 both bone (96%), 1 isolated ulna (4%). In Group B there were 24 both bone (96%), 1 isolated ulna (4%).
The AO classification was used to know the type of fracture in both the groups. In Group A there were 15-C, 6-B, 4-A. In Group B there were 15-C, 10-B fractures.
Type of anesthesia used in both groups were as follows: Brachial block was used in 40 patients (Gr A- 20, Gr B- 20) and general anesthesia was used in 10 patients (Gr A- 05, Gr B – 05)
All the 25 in each group ulnas were approached directly through the subcutaneous approach. The 24 radius in each group was approached by Henry's anterior approach in 30 patients and Thompson's posterior approach in 18 patients. The average duration of surgery was 75.00 minutes in Group A and 60.00 minutes in Group B.
All patients on admission underwent a thorough clinical examination with regards to site of injury, presence of swelling and effusion in adjacent joints, neurovascular deficits and other associated injuries.
An x-ray in AP and lateral view with both the elbow and wrist joints were taken. The patients was then given a posterior slab. All patients were given injectable analgesics on arrival and continued on oral analgesics and intravenous antibiotics was given prior to the operation and continued for 5 days postoperative. Routine blood and urine investigation were done.

Table 1: Complications

Complication	Group A No of Cases	%	Group B No of cases	%
Non union	2	8	-	-
Superficial infection	2	8	2	8
Loss of Movement	1	4	-	-
Post. Int.N.Palsy	-	-	-	-
Synostosis	-	-	-	-
	5	20	2	8

1. **Non union:** There were 2 non-unions in Group A with overall rate of 8%. The non-union was due to type of fracture. In both the cases it was type C3 comminuted fracture according to the AO classification, was fixed with 8 holed plate for both radius and ulna. After 6 months of radiological review, the fracture did not show signs of union. So after 8 months bone grafting was done and union was attained at 4 months.
2. **Superficial Infection:** There was 2 superficial infection both in group A and group B, each with overall rate of 8%. In group A one case had mild superficial infection for which early suture removal with appropriate antibiotic cover, the wound was secondarily closed after two weeks. The fracture healed at 10^{th} week radiologically and had excellent result functionally. In Group B, there was a similar problem and treated amicably under antibiotic cover and had radiological union at 8 weeks and had excellent functional results.
3. **Loss of Movement:** It accounted for 4% in 1 case of group A. The patient had loss of more than 30˚ flexion-extension and more than 50˚ pronation-supination due to prolonged immobilization by the patient himself.

Discussion
In our present study we had 2 nonunion (8%), 4 superficial infection (2 in each group) (8%), 1 loss of movement (4%). Bone grafting for nonunion was done, superficial infection was managed by removing the sutures and thorough cleaning was done and thereafter 3 months of physiotherapy.
In our series, we had an overall infection rate of 8%, which is higher compared to Anderson's 2.9% and Chapman's 2.3 % but all 2 cases had superficial infection which promptly treated with intravenous antibiotics and had good bony union.

Table 2: Comparison of Complication (%)

Series	Rate of infection	Non union
ANDERSON [7]	2.9	3.7
CHAPMAN [8]	2.3	1.6
Group A	2	2
Group B	2	-

Anderson et at believed that the fracture gap was obliterated or greatly diminished by compression plate and capillaries are able to grow into the medullary callus at an early stage in the healing process. Their integrity is protected by rigidity of the fixation and thus the mesenchymal cells in a well oxygenated environment may readily differentiate directly into osteoblast.
Anderson *et al* in their study have not found any evidence of damage to the bone from compression produced by the ASIF technique. On the other hand they found no evidence of stimulation of osteogenesis. By compression they believe that major advantages of the ASIF technique are as follows:

1. Compression increases the rigidity of fracture stabilization by impacting the bone ends.
2. The developing or periosteal blood supply is protected by rigid fixation in case of locking plates.

Conclusion

The conclusion of our study is that locking compression plate (LCP) has a definite advantage over dynamic compression plating (DCP) with respect to the time of union and screw placement in comminuted fractures, but the complications, duration of surgery and surgical technique virtually remains unchanged.

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