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## A comparative study of distal third radius and ulna fractures treated with locking plate and non-locking plate in geriatric age group

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### Abstract

**Background:** Fractures of radius and ulna are amongst the leading injuries in upper extremity in geriatric age group. Associated rotational instability of forearm bones in such fractures renders them suitable for operative fixation. Non-the less conservative management has also been employed in such injuries. We conducted this study to analyze and compare the outcomes of using Locking plate and Non-locking plates for internal fixation in geriatric population for distal 1/3<sup>rd</sup> shaft radius and ulna fractures in terms of fracture union, range of motion and functional outcome.

**Methods:** A prospective study of 20 patients with distal third radius and ulna fracture was conducted with 10 patients managed with locking 3.5 mm Dynamic Compression Plate and 10 with non-locking 3.5 mm Dynamic Compression Plate. All patients with extra-articular fractures were selected for this study and were randomly chosen for each procedure. They were followed up regularly at 3 weeks, 6 weeks and 12 weeks for time of union, wrist flexion, elbow flexion, supination, pronation and functional outcome.

**Results:** There were a total of 13 males and 7 females. Mean time for radiological union was 5.8 weeks for Locking plate, 8 weeks for non-locking plate. Mean Flexion/Extension at elbow was 134°/140° for locking plate, 132°/139° for non-locking plate. Average supination/pronation was 61°/66.4° for locking plate, 57°/61.8° for non-locking plate. Mean duration for surgery was 75.25 minutes for locking plate, 75.70 minutes for non-locking plate.

**Conclusion:** Open reduction and internal fixation with locking plating can be considered as the treatment of choice when considering fixation of distal third Radius and Ulna fractures in geriatric age group.

**Keywords:** Locking plate, Non-locking plate, DCP, Anderson criteria, distal third Radius and Ulna fractures

### 1. Introduction

Whenever we consider fractures of upper extremity in aged individuals, fractures of radius and ulna are always in the lead. Despite the commonality of radius and ulnar shaft fractures, studies that define the epidemiology are scarce. It appears that there is bimodal age distribution with peaks before age 40 and after age 60. Men have similar rates of both bone fractures compared to women early in life. However, women experience a higher proportion of fractures after the age of 60<sup>[1]</sup>. In the geriatric age group i.e. >65 years trivial trauma could cause them as many have preexisting osteoporosis. Slight deviation in the orientation of the radius and ulna drastically decreases the forearm's arc of motion and thereby impairs the positioning and function of the hand. When these are managed with closed reduction they heal reliably well, however Malunion with decreased rotation of forearm is inevitable and it is associated with poor outcomes<sup>[2, 3]</sup>. With a complex interaction between the radius and ulna their rotation relies on accurate reduction as well as early initiation of post-operative movement<sup>[4]</sup>. Majority of these fractures are managed with operative fixation and with the various modalities available the choice of procedure lies solely on the operating surgeon<sup>[5]</sup>.

The aim of management is to regain anatomical length, axial alignment, and rotational alignment in order to gain good range of supination and pronation. Complications like Malunion and non-union occur because of difficulties in maintaining reduction of 2 parallel bones due to presence of supinating and pronating muscle which have rotatory action, so internal fixation is necessary.

Open reduction and internal fixation with plating is the most widely used technique. However, application of a plate can hamper the periosteal blood supply and could lead to delayed fracture union [6, 7]. Plating is also associated with refracture with implant removal [8]. However for a more anatomic repair plating is essential [9], this may result in more accurate restoration of radial bow, may completely restore forearm pronosupination. The aim and objective of this prospective study was to analyze and compare the outcomes of using Locking plate and Non locking plates for internal fixation in geriatric distal third shaft radius and ulna fractures in terms of fracture union, range of motion and functional outcome.

## 2. Materials and Methods

This is a prospective study of 20 patients with distal third radius and ulna fracture conducted at Krishna Institute of Medical sciences, Karad from 2018 to 2019. Patients presenting to the OPD and Casualty with history of trauma to forearm and diagnosed as having fracture of distal third shaft of radius and ulna on X-ray were considered for the study. 15 patients with distal third fractures of both bones forearm who met the inclusion and exclusion criteria were randomly chosen for a prospective study. On random basis, 10 patients were treated by Locking plating and 10 by Non locking plating.

### 2.1 Inclusion Criteria

- Age more than 65 years
- Extra-articular distal third radius and ulna shaft fracture
- Patients fit for surgery
- Osteoporotic bone. (Bone density of 2.5 standard deviation below that of a young adult)

### 2.2 Exclusion Criteria

- Intra-articular fractures.
- Isolated radius or ulna fracture
- Presence of NVD
- Pathological fracture

Cases with closed fractures were immobilized in above elbow POP slab as the initial management. In the open cases wound was examined in detail for the injury and for the neurovascular status of the limb and washed with copious amount of normal saline and initial care was given in emergency including thorough debridement of wound. Prophylactic treatment for tetanus was given and broad spectrum antibiotic were prescribed to prevent infection. After the procedure the patients were evaluated for union time, wrist flexion, elbow flexion, supination, pronation and functional outcome at 3 weeks, 6 weeks and 12 weeks.

### 2.3 Surgical Procedure

Volar Henry approach was used for distal radius. Intermuscular plain between Brachioradialis and FCR was used to expose the fracture site. Ulna was approached directly over the subcutaneous border. Less comminuted/more stable fractured bone was fixed first.

Locking/non-locking 3.5 mm DCP was applied to the bone

after exposing the fracture site. Using a drill guide and a 2.7 mm drill bit a centric hole was made near the fracture site. Tapping was done for non-locking screws. Locking screws used were self-tapping hence no tapping was required. Measuring the length of screw using a depth gauge was done prior to tapping. 3.5 mm cortical screws of appropriate length were inserted under c-arm guidance.

An eccentric hole was drilled on the opposite side of the centric hole using a drill guide and 2.7 mm drill bit. 5.3 mm cortical screws of appropriate length were inserted. A total of 6 cortices were engaged on each side of fracture in similar manner.

In oblique fracture patterns, lag screws were employed. Lag screws were applied with over drilling (3.5 mm) of near cortex to create a gliding hole. Once stable fixation was achieved and hemostasis secured, completed final fixation was checked by image intensification. Elbow was stabilized at the epicondyles and forearm rotation was assessed. This was followed by assessment of distal radio-ulnar Joint.

### 2.3.1 Post-operative

Above elbow slab was given in midprone position and follow up was done at 3, 6, and 12, weeks to check for radiological union, forearm and elbow movements. When early signs of union were noticed, and active movement of elbow and wrist started. Heavy and the strenuous activities were avoided till solid union occurred in all cases. Patients were regularly followed up at 3,6,12 weeks. At every follow up clinical and the radiological examination was done and the movements of the elbow and forearm recorded.

Clinically union was considered when there was no tenderness at the fracture site on stressing. Radiological union of fracture was judged to be present when on x-ray there was obliteration of fracture line with the evidence of bridging callus. Those fractures which required more than 6 months to unite and had no additional operative procedure performed were classified as delayed union. Those fractures which failed to unite without another operative procedure were classified as non-unions [10]. POP slab was removed once union was achieved. Functional results were assessed by Anderson *et al.* [9] criteria.

## 3. Results

In the present study there were 5 patients in the age group 60-65 years, 5 in the age group 66-70 years, 4 in the age group 71-75 years and 7 in the age group 75-80 years.

There were 3 females and 7 male in locking plate, 4 females and 6 males in non-locking group. 5 patients in locking group had Road Traffic accidents and 5 had a fall, in non-locking group 8 patients had injuries due to fall and 2 were due to RTA

Average surgery time in Locking plating group was 71.25minutes. In non-locking plating group it was 75.70min.

5 patients had open fractures of grade III as per the Gustilo-Anderson classification. Amongst which 2 was from locking plate and 3 from non-locking plate. In locking plating group both radius and ulna showed union in 10(100%) patients whereas in non-locking 7 patients showed union.

**Table 1:** Anderson *et al.* [11] Criteria was used in grading the functional outcome

Results	Union	Flexion and extension at elbow joint	Supination and pronation
Excellent	Present	<10 degrees loss	<25% loss
Satisfactory	Present	<20 degrees loss	<50% loss
Unsatisfactory	Present	<20 degrees loss	>50% loss
Failure		Non-union or unresolved chronic osteomyelitis	

**Table 2: Demography**

Parameter		Locking plating group (10 Total)	Non locking plating (10 Total)	Total
Age	60-65 years	2	3	5
	66-70 years	1	4	5
	71-75 years	3	1	4
	75-80 years	4	2	6
Sex	Male	7	6	13
	Female	3	4	7
Side	Right	4	3	7
	Left	6	7	13
Mechanism of injury	RTA	5	2	7
	Fall	5	8	13
Closed or open	Closed	8	7	15
	Open	2	3	5



**Fig 1:** Pre-operative AP and Lateral views. Locking plate



**Fig 3:** Pre operative AP and Lateral views. Non locking plate



**Fig 2:** Immediate post-operative AP and Lateral views. Locking plate



**Fig 4:** Immediate post-operative AP and Lateral views. Non locking plate

**Table 3: Comparison of results**

	Locking	Non- Locking
Average Elbow flexion at 12 weeks (degrees)	134±3.67	132±4.1
Average Supination at 12 weeks (degrees)	61±5.5	57±6
Average pronation at 12 weeks (degrees)	66.4±5.7	61.8±6.2
Average Time of union (weeks)	5.8±0.37	8±0.56
Average surgery time (mins)	71.25±0.78	75.70±1.55
Outcome (Anderson <i>et al.</i> )		
Excellent	7	5
Satisfactory	3	1
Unsatisfactory	-	1
Failure	-	3

Functional results were assessed by Anderson *et al.* [9] criteria. Functional results in plating group were excellent 7 patients and satisfactory in 3. In non-locking plating the result were excellent in 5, satisfactory in 1, unsatisfactory in 1 and failure in 3.

### 3. Discussion

Fracture of both bones of the forearm are one of the most common injuries. Conservative management using closed reduction and cast immobilization has been employed especially in low-demand patients. We found operative management superior in this study. Conservative treatment results in decreased arc of motion of the forearm which is associated with poor outcome furthermore loss of rotation results in a hinderance to the function of the upper limb and activities of daily living [12]. Amongst the various available methods of treatment compression plate fixation has become the modality of choice for both bone forearm fractures and many studies have shown good results [13].

Droll *et al.* [14] compared injured arms with that of uninjured arms after internal fixation, he found out that injured arms had reduced strength of forearm pronation (70%) and supination (68%), wrist flexion (84%) and extension (63%), and also the grip strength (75%). Moreover, the injured arms had quite a significant reduced active range of forearm supination (90%) and pronation (91%) and wrist flexion (82%). We compared internal fixation with locking plate and non-locking plate.

Surgical duration was slightly longer in plating group 75.35 minutes for locking plate and 70.50 minutes for non-locking in this study. This was because operative technique for locking plating is more demanding due to adequate screw fixation within plate which consumes time. However the difference was not significant enough to affect the outcome of results of this study.

Locking plating had higher percentage of excellent results as compared to Non-locking according to Anderson *et al.* [9] scoring system. Restoration of pronation and supination movements depends on the anatomical realignment and restoration of the normal bow of bone. Regaining of the normal flexion and extension at elbow and wrist joint was not a problem in either case. Surgical treatment of diaphyseal fractures with plating which requires an extensive and delicate soft tissue dissection, can compromise the blood supply of healing fracture and atrophy of the cortical bone beneath the plate and placement of drill holes for the screw can weaken forearm bones. These factors might contribute to refracture of bones after removal of plate however in this study we had no cases of implant removal.

Possible complications might include delayed union or non-union, compartmental syndrome, and refractures which might happen after extraction of the plate [15, 16]. Intraoperatively nerve injuries has also been reported quite frequently. In present study we had no such complications with locking plate or Non locking plate. We did observe non-union in 3 cases of non-locking plate.

We observed an average union time of 8 weeks with non-locking plate and 5.8 weeks with locking. This could be contributed by the rigid fixation provided by locking plate in osteoporotic bones of geriatric population.

### 4. Conclusion

Open reduction and internal fixation with Locking plating can be considered as the treatment of choice as it helps in maintaining length, opposition, axial alignment and good range of motion can be restored and better functional outcome can be achieved early with locking plating as compared to non-locking group.

### Consent

As per international standard or university standard, patient's written consent has been collected and preserved by the author(s).

### Ethical Approval

The study was approved by Krishna Institute of Medical sciences, after acquiring permission from ethics committee.

### Competing interests

Author has declared that no competing interests exist.

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