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Studying a lateral approach of plating of the lower 2/3rd diaphyseal fractures of the radius

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Abstract
Introduction: Present study was conducting for evaluation of lateral approach for plating of the lower 2/3rd diaphyseal fractures of the Radius in terms of surgical exposure, Intra- operative problems and Radiological and functional outcome.
Methodology: The study included 25 cases of lower 2/3rd diaphyseal fractures of the Radius with or without fracture of the Ulna. Cases were selected randomly.
Inclusion Criteria: All adult patients of either sex**;** Fractures involving lower 2/3rd diaphysis of the Radius with or without fracture Ulna**;** Transverse/oblique/spiral/comminuted (<50% diameter) fracture pattern.
Exclusion Criteria: Open fractures, Damaged or infected skin or soft tissue around the fracture, Pre-existing deformity of forearm due to any disease, Proximal diaphyseal fractures, Pathological fractures, Fractures with comminution >50% of diameter**,** and Fracture with neurovascular injury.
Results: Present study was conducted on 25 patients were followed Majority of patients were < 55 years of age. Most common mode of injury in this study was RTA, having 12 patients, which was 48% of total followed by assault (28%). In majority of cases (72%) lateral cutaneous nerve of forearm was not encountered during surgical dissection. In maximum number of cases Small DCP was used in 88% for fracture fixation.
Conclusion: The lateral approach is recommended as an alternative for lateral plating of fractures of the lower two thirds of the radius. It is safe, follows biological principles, has a low risk and is easy to do.

Keywords: Radial, diaphyseal, lateral

Introduction
The incidence of forearm fractures are increasing faster than the predicted rate due to increase in population, increasing number of vehicles, rapid industrialization, increased incidence of violence and various sports activities.
The radial bow should be restored for the good functional outcome. It is important to regain the length of the bones, good opposition and alignment without any malrotation.
The reasons for higher rate of non-union and malunion as well as poor functional outcome, are due to complex anatomical structure with a coordination between muscles, tendon, bones and joints which is responsible for the multi-fold functions of the arm and hand including pronation and supination where the radius rotates around the ulna because the radius has a lateral curvature called bow.
The current standard treatment for the forearm bone fractures in adults is open reduction and internal fixation with plating in compression mode [1]. Various types of plates are available for fixation. Small dynamic compression plates and 1/3rd tubular plates are generally preferred for the distal 2/3rd radial diaphyseal fractures, as they suit the profile of the bone. The plates are applied usually anteriorly on the radius, sometimes posteriorly.
Anterior or posterior plate placement besides losing a mechanical advantage (as per the tensile principal) also have certain disadvantages.
1. Definite stripping of bone soft tissue is required in both, compromising bone viability.
2. Impingment by plate presence on one aspect and screw projection in the opposite is seen and may cause painful obstruction to tendons crossing over.

There are two standard approaches to expose the distal radius [2], namely,

a) Anterior approach (Henry)
b) Posterior approach (Thompson)

Each of the above approaches has its own advantages and disadvantages. Advantages of the volar approach include potential for extensive exposure of the entire radius and decompression of the volar forearm fascia. One important disadvantage of this approach is a possible mechanical limitation of pronation [3]. When using the anterior approach, care has to be taken to protect the superficial branch of the radial nerve and also the radial artery which is directly exposed through this approach and sometime may cause dangerous bleeding [4]. In the "Henry approach", neurovascular structures need to be dissected, isolated and retracted, viz. the Radial nerve cutaneous branch in the upper part and the radial artery all along, especially in the lower fourth; the Median nerve has to be kept free from retractor pressure all through.

The A.O. group describes a dorsolateral approach [5], where the incision is lateral but deeper dissection posterior as per the "Thompson approach".

Advantages of the dorsal approach are few and limited to cases which require exploration of the posterior interosseus nerve.

The chief purpose of exposing the lateral cortex of the radius is to enable application of a contoured plate on the lateral surface to maintain natural bowing of the radius. The radius is a curved bone and its concavity faces the ulna. When the radius fracture is reduced, the arc on ulnar side must be maintained because any deviation in changes of length of bone involves the interosseus membrane, affects the distal radioulnar joint, and produces restriction of pronation and supination [6].

It is for this reason that the lateral approach was being used for some time at our department, with certain advantages both during surgery and in applying a plate on the lateral convex surface which is the tensile side and therefore mechanically logical.

Methodology

This study was conducted in the Department of Orthopedics at S.P. Medical College & Associated group of Hospitals, Bikaner. The study included 25 cases of lower 2/3rd diaphyseal fractures of the Radius with or without fracture of the Ulna. Cases were selected randomly.

Inclusion criteria: All adult patients of either sex**;** Fractures involving lower 2/3rd diaphysis of the Radius with or without fracture Ulna**;** Transverse /oblique/ spiral / comminuted (<50% diameter) fracture pattern.

Exclusion criteria: Open fractures, Damaged or infected skin or soft tissue around the fracture, Pre-existing deformity of forearm due to any disease, Proximal diaphyseal fractures, Pathological fractures, Fractures with comminution >50% of diameter**,** and Fracture with neurovascular injury

Pre-operative assessment

Cases were selected and posted for surgery as per inclusion criteria. Routine preoperative investigations were done for all patients for pre-anesthetic check-up. Patients with associated medical problems (hypertension, asthma, diabetes, anemia, COPD etc.) were evaluated and necessary treatment given before surgery. The patients were prepared neck to toe including perineum before being sent to the operation theatre. Prophylactic intravenous injection ceftazidime 1gm was given to every case an hour before the surgery.

Surgical procedure

All surgeries were performed on an elective basis under standard aseptic precautions. Surgery was performed under regional or general anesthesia under tourniquet control.

Position of the patient

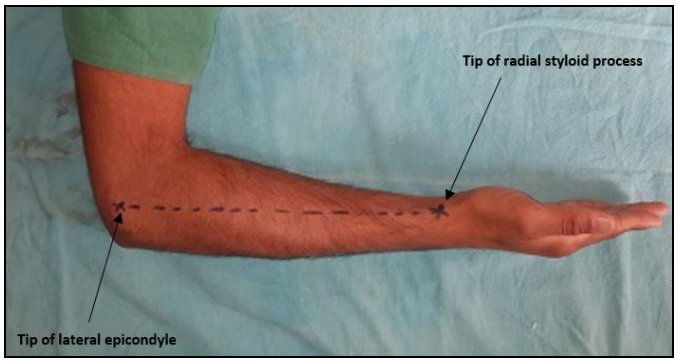
Standard position was supine with the affected limb supported on a hand table. A tourniquet was applied after elevating the limb for about a minute.

Approach

Lateral approach

Incision and exposure

Keeping the elbow flexed 90 degrees and the forearm in supination, a direct lateral incision was given on a line from the tip of the lateral epicondyle to the radial styloid.



Position of limb line showing incision to lateral approach

The optimal level of the incision was determined by evaluating the pre-operative radiographs and level of the fracture and the skin incision was centered over the fracture site. Skin and subcutaneous tissue was dissected properly. The lateral cutaneous nerve of forearm and superficial branch of radial nerve, were preserved and retracted as and when encountered. The Brachioradialis and Extensor Carpi Radialis were identified and further plane of dissection was between these two

(Fig. 12). The fracture site was exposed and fracture ends cleared of soft tissue. Dissection was musculo-periosteal. No periosteal stripping was done and the plate was placed spanning the fracture site. Reduction was usually achieved indirectly or if needed, with help of bone holders. Plate length was selected as per fracture type and site. The plate was contoured with the help of plate benders and then put over the lateral aspect of the radius across the fracture site, maintaining the contour of the Radius laterally. Degree of contouring required was assessed, by placing the plate repeatedly over the reduced fracture fragment and step wise bending was done in small increments guided by using malleable aluminium templates. The plate was fixed with cortical screws of required length. For the lower 1/4th fractures, a 1/3 tubular plate was used, since they have the advantage of a thinner profile and mouldability, which allows for spontaneous contouring with tightening of screws. These features are needed for the lower 1/4th fractures to avoid friction with the overlying Brachioradialis tendon and to enable/ accommodate

contouring for the distal flaring of the bone. The distal most screw was cancellous. Cases with fracture ulna were also fixed with an appropriate plate through subcutaneous approach between Flexor Carpi Ulnaris and Extensor Carpi Ulnaris.

Closure

After removal of tourniquet, haemostasis was achieved and wound was closed in layers except the deep fascia. Care was taken to preserve the nerves and avoid inadvertent entrapment. Sterile dressing was done. An above elbow slab was applied after checking for the radial pulse and nail bed circulation.

Intraoperative Problems

Intraoperative problems regarding superficial radial nerve and lateral cutaneous nerve of forearm, surgical dissection plane, plate contouring and wound closure were noted.

Postoperative Management

On evening ward round, the patients were assessed for pain, sensory loss and soakage. Post-op analgesic was given SOS. Active finger movement was encouraged.

Check X ray

Postoperative radiographs were taken in AP and Lateral views of both sides in similar position on 2nd post-operative day and they were assessed for:

1. Restoration of the curvature of the radius: by comparing with the normal side.
2. Accuracy of reduction, adequacy of screw size and plate length.

Post-operative dressing

A standard aseptic dressing of the suture site was done on the 5th day. Local skin and stitch line margins were noted for any erythema and signs of necrosis. If any collection or discharge was found from the suture site, a culture was taken and appropriate antibiotics were started.

Sutures were removed on the 10th - 14th day subject to suture line condition. If infection was not found to be resolving then thorough irrigation of the wound after opening the whole stitch line was done, all collection and necrotic tissue removed and wound was closed again in layers over a suction drain. Any sensory problems were recorded.

Follow up

At 2 weeks: The patient was asked to come for first follow up at 2 weeks to evaluate the suture line and sutures were removed if wound found healed. Sensory impairment if any was noted and documented. Above-elbow slab was removed and a removable splint was given to the patient with instructions to perform finger, elbow and shoulder exercises according to their level of comfort. A slab was reapplied in patients with comminuted fractures, old patients with poor bone stock and in those patients where fixation was not rigid due to any reason. These patients were asked to come again at 4 weeks follow-up for change of slab.

At 6 weeks: Follow-up X-ray was taken and the status of union was assessed based on obliteration of fracture line, bridging callus and extension of trabeculae across the fracture graded as (-) for unobliterated fracture line, (+) for less than 1/3rd obliteration of fracture line, (++) for >1/3rd but not complete union and (+++) for complete union. Patient was advised to continue physiotherapy as part of rehabilitation protocol. Any sensory impairment, if present previously in any patient, was evaluated and documented for any recovery or persistence.

Any implant related problems like pain on supination/pronation due to irritation by screw or plate were also noted. In patients with good bone stock and secure fixation, the detachable splint was discarded, and active limb excercises commenced. A sling was advised till the next follow up. Load bearing and strenous work was not allowed. For insecure fixations

(comminution, old age and porosis) the above elbow slab was discontinued but detachable splints put to use, with controlled exercises.

At 12 weeks: X-rays were again taken to assess union and document the final result. Functional outcome was noted and documented in the form of flexion-extension at the wrist and supination-pronation at forearm. Progression/ regression of sensory impairment was noted. Implant loosening was noted if any.

Final results were evaluated on the basis of "Anderson *et al.*[21] criteria for assessment of functional outcome of operative treatment of fractures of Radius and Ulna".

Table 1: For assessment of functional outcome

Result	Union	Flexion and extension at wrist joint	Supination and pronation
Excellent	Present	$<10^0$ Loss	< 25% Loss
Good	Present	$<20^0$ Loss	< 50 % Loss
Fair	Present	$>30^0$ Loss	>50 % Loss
Poor	Nonunion with or without function loss		

Observations

Present study was conducted on 25 patients were followed Majority of patients were < 55 years of age. Maximum cases were recorded in the age group of 16-25 yrs (32%) and least were in age group 66-75 (4%).

Youngest patient was 18-year-old and oldest was 70-year-old. The mean age was 38.2 years. Mostly patients were males (76%) and females were 24%. Male to female ratio was 3.2:1. Mostly cases operated within 15 days.

Most common mode of injury in this study was RTA, having 12 patients, which was 48% of total followed by assault (28%) (Fig: 1).

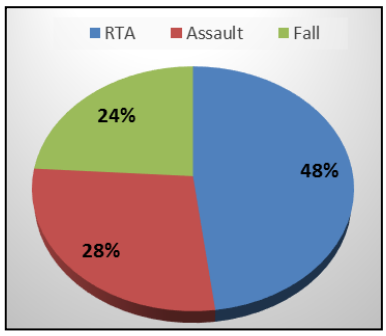


Fig 1: Distribution of cases according to mode of injury.

In this study, injuries on the left side were higher when compared to right. The reported data was 68% vs 32% favouring left side. Maximum number of cases had fractures in middle one third of radial shaft (72%). Transverse fracture was the most common pattern of fracture (48%) followed by oblique (24%), comminuted (16%) and spiral (12%). During the surgical dissection, superficial radial nerve was not encountered in majority of cases (80%).

Table 2: comparison on the basis of level of fracture, pattern of fracture and radial nerve injury

Distribution of cases according to side of injury		
Affected limb	Number	Percentage
Right	08	32
Left	17	68
Level of Fracture		
Middle Third	18	72
Lower Third	07	28
Pattern of Fracture		
Transverse	12	48
Oblique	06	24
Comminuted (<50%)	4	16
Spiral	3	12
Superficial Radial nerve interference		
Yes	05	20
No	20	80

In majority of cases (72%) lateral cutaneous nerve of forearm was not encountered during surgical dissection. In maximum number of cases Small DCP was used in 88% for fracture fixation (Table: 3).

Table 3: Status of lateral cutaneous nerve of forearm

	Number	**Percentage**
Lat. Cut. Nerve forearm interference		
Yes	07	28
No	18	72
Plate type		
SDCP	22	88
1/3rd tubular	03	12

Table: 3 shows the union sub-component of Anderson criteria at 6 and 12 weeks respectively. Incomplete obliteration was seen in 23 (92%) cases and complete obliteration was seen in 2 (8%) cases at 6 weeks. However, at 12 weeks there was complete obliteration of the fracture line was observed in 24 (96%) cases whereas incomplete obliteration was observed in only 1 (4%) case. Table also shows loss of flexion and extension movement at wrist (Degree) at 6 and 12 weeks. Less than 10^{o} loss of movement was observed in 4 cases, greater than 10^{O} loss was observed in 21 cases at 6 weeks. At 12 weeks, 19 cases had less than 10^{o} loss of movement whereas 6 cases had greater than 10^{o} loss of movement. At 6 and 12 weeks, less than 25% loss was seen in 4 and 19 cases, greater than 25% but less than 50% loss was seen in 16 and 4 cases and greater than 50% loss was seen in 5 and 2 cases respectively (Table: 4).

Table 4: Evaluation of fracture union and ROM at 6 and 12 weeks

	At 6 weeks	**At 12 weeks**
Union status		
<1/3rd fracture obliterated (+)	6 (24%)	1 (4%)
<2/3rd fracture obliterated(++)	17 (68%)	0 (0%)
Complete obliteration (+++)	2 (8%)	24 (96%)
Degrees of F/E loss		
<10	4	19
<20	15	4
<30	3	0
>30	3	2
Loss of supination and pronation		
<25%	4	19
>25% - <50%	16	4
>50%	5	2

Fig 2: shows outcome at 12 week follow-up in accordance with Andersons criteria. The results are as follows: excellent in 19 cases, good in 4, fair and poor in 1 case respectively.

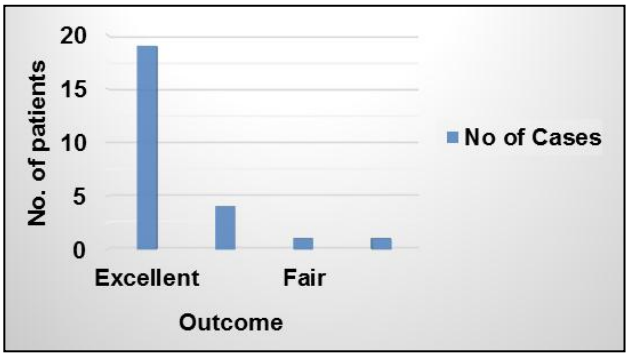


Fig 2: Outcome at 12 week follow-up

Discussion

In any surgical operation, the approach is the route through which a desired body structure is made visible for the procedure. The approach is chosen considering various factors; firstly it should provide a good view of the structures, in a convenient position for both patient and surgeon and in the process, minimal damage be caused to other adjacent structures, while keeping away from critical structures [7].

In fracture of the radius, for plating the current preferred approach is the "Henry approach" for all levels, and is anterior.

The second traditional approach is posterior by "Thompson", in which the incision basically is applied over the dorsal aspect of the forearm and plane of dissection is between ECRB and ED. Radial nerve motor branches have to be taken care of in the proximal third and cutaneous branch in the lower third.

The A.O. group describes a dorsolateral approach, where the incision is lateral but deeper dissection posterior as per the "Thompson approach".

In all these incisions, a certain amount of muscle stripping is necessary to expose the bone. In the "Henry approach",

neurovascular structures need to be dissected, isolated and retracted, viz. the Radial nerve cutaneous branch in the upper part and the Radial artery all along, especially in the lower fourth; the Median nerve has to be kept free from retractor pressure all through.

In Thompson and A.O. approaches, also the muscles have to be stripped off from the bone significantly and the Radial nerve motor branch in the proximal part and cutaneous branch in the distal part taken care of.

Conventionally a plate for the Radius is applied on the anterior surface, which being flat allows ready application.

However, application of a plate on the lateral surface of the radius is a recognized option as observed by Tile M [8], who says that radial plate application will depend on the surgeon's choice of incision, though he has not elaborated on the reasons for the choice. Tile also observed that a lateral plate application is difficult through the anterior incision and that a lateral plate can be applied through a dorsal approach.

The chief purpose of exposing the lateral cortex of radius is to enable application of a contoured plate on the lateral surface to maintain natural bowing of the radius. The radius is a curved bone and its concavity faces the ulna. When the radius fracture is reduced, the arc on the ulnar side must be maintained because any deviation in changes of length of bone involves the interosseus membrane, affects the distal radioulnar joint, and produces restriction of pronation and supination [6].

Rockwood and Green[41] has recognized the role of radial bow in regaining pronation and supination. It has also been noted that in the Henry volar approach, the ends of the plate will sit on the concave aspect of the radial bow and also the central plate segment will be on the concave aspect of the bone, away from contact with the bone.

In 1992, Schemitsch and Richard [9], published a study of 55 patients of fracture forearm. The focus was measuring the radial bowing after operation. They developed a method for quantification of radial bow. The purpose of the study was to determine the correlation between accuracy of reduction of fracture of the radius with restoration of forearm motion. In their study, a radial plate was applied on either the volar or lateral aspects but through a volar approach. They concluded, that the restoration of radial bow at the time of operation is important in the reconstitution of the normal architecture of the forearm and in turn in restoring rotation of the forearm and grip strength towards normal.

Regarding biomechanical stability and strength of fixation of a lateral plate over the radius, a study was done by W. Andrew Eglseder *et al.* [10], who found equal strength of fixation in both anterior and lateral plate applications.

With these aforementioned concepts in mind, the proposals for plating on the radius over the lateral cortex for fractures of the lower two thirds of the diaphysis were made for which the most appropriate incision was a lateral one, as described by AO [5], for their dorsolateral approach, the difference being only in the deeper dissection where we have opted for the plane between BR and ECR. This plane allows exposure of the lateral aspect of the lower two thirds of the radius which is essentially not covered by any muscle, there-by avoiding stripping of the bone cover as apposed to the other approaches where in the anterior approach the Pronator teres, Flexor policis longus and Pronator quadratus and in the dorsal approach stripping of EPB and APL are required [11]. The lateral aspect of the radius in the lower two thirds has no muscle cover except for the aponeurotic Pronater teres in the middle third and tendinous BR at the radial styloid tip. So the bone is practically bare along this length.

This lateral approach does not encounter vessels anywhere unlike the anterior approach where the radial artery has to be identified and its lateral branches to BR ligated, failure of which can result in dangerous bleeding as observed by Flatow and Colvin [4]. Neural structures are encountered, chiefly the cutaneous branch of the radial nerve but that also is found in anterior as well as dorsal approaches, where it has to be identified, isolated and retracted, since lesser precautions can result in injury [9]. The lateral cutaneous nerve of the forearm is encountered in the lateral incision but does not pose a problem as evident by the fact that A.O. makes no mention of the presence of this cutaneous nerve in their description.

The present study was done on 25 cases of fractures of the distal two thirds of the radius, where a lateral incision was applied on a line between the lateral epicondyle and styloid process with limb position being 90 degree flexed at the elbow and forearm fully supinated. Deeper dissection was between the BR and ECR which were retracted without stripping of the radius. The lateral cutaneous nerve forearm branches if encountered were preserved and retracted medially or laterally as needed and the radial cutaneous nerve identified and preserved. There-after a lateral plating was done with a contoured small DCP or 1/3 tubular plate. The plate was placed by sliding under traversing nerve branches if they were found interfering- as also done by Anderson *et al.* The Pronaterteres in some cases needed to be reflected slightly anteriorly if at all, because its flat aponeurotic profile allows for placing the plate over it. For the distal end, a 1/3 tubular plate was used because of its low profile, and because of its spontaneous contouring during the process of screw tightening along the flare of the lateral cortex of the distal radius.

During lateral plating all the screws were oriented coronally where-by the tips of the screws projected towards the interosseus membrane

unlike anterior or posterior as in volar/dorsal plating, where screw tips can create friction or attrition problems with traversing tendons if they are left longer than desired. The coronal orientation of screws has a special advantage in the lower fourth fractures, where the distal screws have a longer purchase and better grip if they are coronally aligned rather than antero posterior and also antero posterior screw tips are specially liable to project into tendons and nerves close to the wrist in this narrow circumference of the forearm.

Also in the lower fourth, the Pronator quadratus need not be stripped off (as happens in anterior plating) through this approach nor the extensor tendon dissected and mobilized as would be needed in dorsal plating. In lateral plating, the BR tendon near its insertion as not subjected to impingement by the plate because we used a thin profile 1/3rd tubular plate which could be contoured and accommodated in the concave flare of the distal radius.

The periosteum was never incised or retracted and plates were placed over the periosteum, rather than subperiosteal. This was in accordance with Anderson *et al.*, who dissected muscle carefully away from the periosteum, and placed the plate on the periosteum since it produces less injury to the bone blood supply. In our cases, on the lateral aspect, there was essentially no muscle cover and very little stripping of soft tissue was needed.

Our analysis is as follows

In our study maximum patients were in age group 16-25 years. Mean age of patients were 38.2 years. This finding is

due to the fact that this is the earning age group and maximum mobility of population is observed during the age of 22-50 years. We observed that maximum patients were males in (76%) This is because in our society male are responsible for earning for the family and females are generally stay at home. Chapman *et al.* [12] *et al.* found mean age of 33 years with male predominance.

We observed that most of patients were operated within 15 days of injury because these patients presented to us early. Two patients previously refused for surgery and other presented late. The cause may be previous treatment elsewhere or other comorbid condition were present that may took time for pre-anaesthetic fitness.

In our study the most common mode of injury was road traffic accident (12 patients) followed by almost equal number of cases due to fall and assaults. Due to rapid industrialization and increase in the mean of transportation, the incidence of road traffic accident has been on the rise. Same findings were found in the study done by C.A. Gold Farb *et al.* [13] (13 patients out of 20).

In our study maximum number of cases had injury on left side (68%). Similar findings were study done by C.A. Gold Farb [13] (56.52).

We observed that maximum cases had fracture of middle 3rd of the radius (72%) and rest of patients were having fracture lower 3rd of radius. As our study included only the fracture of the lower 2/3rd diaphysis of the radius, these findings correlated with our patients selection criteria. Similar observation were made in the study done by Chapman *et al.* [12] (61%).

In our study maximum patients were having transverse fracture pattern [12 patients (48%)] followed by oblique in 6 patients and almost equal number of spiral and comminuted. This finding may be due to random selection of cases and the criteria that comminuted fractures involved more than 50% diameter of shaft were not included.

During the majority of cases we did not directly encounter the superficial radial nerve at the time of dissection [20 patients (80%)]. This may be due to the fact that maximum fractures were middle 3rd level. This nerve was encountered only in a single case of middle 3rd fracture level. Which was spiral pattern and required long exposure during surgical dissection. Out of the seven fractures of the lower 3rd level, this nerve was exposed in 4 patients and not in 3, this may be due to variable course. This parameter was not mentioned in any other study reviewed.

In our study, in the majority of cases we did not encounter the Lateral cutaneous nerve of the forearm [17 patients (68%)]. As per the anatomy of this nerve, it lies superficial to the BR and the surgical dissection generally does not involve dissection between skin flap and BR. Most of the cases in which this nerve was exposed during surgery were spiral and oblique fractures, requiring long exposure.

This parameter was not mentioned in any other study that we reviewed and in the description given in the A.O. manual also the nerve has been not mentioned.

In our study small DCP used in maximum patients [22 patients (88%)]. Only in three cases we used 1/3rd tuber plate. This parameter generally depends on the discretion of the operating surgeon. 1/3rd tubular plate were used in lower 4th fracture level, due to the fact that, this plate has a thin profile and is thought to be nonirritant to the gliding tendons during supination pronation movement of the forearm.

At the time of follow up we observed that at 6 weeks maximum patients had 1/3rd to 2/3rd obliteration of fracture line [18 patient (72%)]. At 12 weeks all but one (Case no-7), patients went into complete union. The single patient was still in the process of union was 70 years old male with poor bone stock, comminution at fracture site, and also, this patient presented late. Overall union rate was 96% in our study. Similar findings were observed in Schemitsch *et al.* [9] (98%), Chapman *et al.* [12] (98%), Anderson *et al.* [14] (97%), Hadden [15] *et al.* (97%) and Hartel *et al.* [16] (96%)

In our study when patients were followed at 6 weeks maximum patients had $>10^0$ but $<20^0$ loss of flexion Extension movement at wrist. At 12 weeks maximum patient had $<10^0$ flexion extension loss. So there was a constant improvement in range of motion because of the early start of active physiotherapy protocol. This could be achieved because of secure fixation of the fractures. Similar were the finding observed in the study done by Anderson *et al.* ($<20^0$ loss in 85 % patients), Chapman *et al.* [12] (93%) and Gold Farb *et al.* [13] (80% with $<20^0$ loss).

In our study when patient were followed at 6 weeks, maximum patients (60%) had supination pronation loss between 25-50%. At 12 week maximum patients (76%) had <25% loss of supination pronation and only 2 patients had loss >50%. (Case no- 7 and 8). The probable reason for restriction these two patients were that they presented late and consecutively pre-existing stiffness. However they followed beyond 12 weeks and movement recovered. No complain related to friction between brachioradialis and underlying plating. Similar findings were observed by Chapman *et al.*[12] (93% with <50% loss), Anderson *et al.*[14] (90% cases had <50% loss).

Final Outcome: (Based on Anderson's criteria) At 12 weeks, in our study, 19 patients had excellent (76%), 4 patients (16%) had good, one patient had fair and one had poor result. These findings comparable to study done by Chapman *et al.* (92% had excellent and satisfactory results), Scemitsch *et al.* [9] (69% had excellent and good results), Anderson *et al.* [14] (89.6% had excellent and good results)

Conclusion

The lateral approach to the radius for fracture of the lower two third diaphysis is a logical approach to enable lateral plating which in turn is a rational concept in terms of biomechanical principles of plating on a curved bone, where-in plates are to be applied on the tensile convex aspect of such bones. Additionally, the lateral plating after contouring the plate enables easy restoration of the radial bowing which is critical to preserving supination pronation movements. In the commonly popular anterior plating, the radial bowing can be difficult to maintain and end up with significant function loss. The lateral approach has a major biological advantage of not requiring stripping of muscle cover that is essential to preserve bone vascularity. It also obviates the need to mobilize the radial artery and its branches. The neurological structures encountered pose no more interference or risk than the conventional Henry or Thomson's approach, compared to which the difference being only the location of incision and deeper plane between BR and ECR. Thus the lateral approach is recommended as an alternative for lateral plating of fractures of the lower two thirds of the radius. It is safe, follows biological principles, has a low risk and is easy to do.

References

1. Edward A Perez. Campbell's operative orthopaedics 12 edt. 2013; 3:2887

2. Dominik Heim, John T Capo. AO principles of fracture management 2nd expd edt, 2013; 2:645.
3. Kevin J Reinfree. Hand surgery 1stedt, 2004, 578.
4. Evan Flatow *et al.* Atlas of essential orthopaedic procedures. AAOS. 2013; 2:373
5. Heim T, Capo JT. AO principles of fracture management. 2nd exd edt. 2013; 2:646.
6. Zelimir DJ, Mikic MD, Novi Sad. Galeazzi Fracture Dislocation. JBJS. 1975; 57(8):1071-79.
7. S Hoppenfeld. Preface to the First Edition. Surgical Exposures in orthopaedics 4 edt, 2009.
8. M. Tile *et al.* Fractures of Radius and Ulna. The rationale of operative fracture care, 2005, 151.
9. EH Schemitsch and RR Richards. The effect of malunion on functional outcome after plate fixation of fractures of both bones of the forearm in adults. J Bone Joint Surg Am. 1992; 74:1068-78.
10. W Andrew Eglseder, Louis E Jasper *et al.* A Biomechanical Evaluation of Lateral Plating of Distal Radial Shaft Fractures. JHS. 2003; 28(6):959-63.
11. Evan Flatow *et al.* Atlas of essential orthopaedic procedures. AAOS. 2013; 2:375.
12. Chapman *et al.* Compression-Plate fixation of acute fractures of diaphysis of Radius and Ulna. Jur. of Bone and Joint Surg. 1989; 71(2):159-69.
13. CA Goldfrab, WM Ricci *et al.* Functional outcome after fracture of both bones of the forearm. Th Jo Bone and Joint Surg. 2005; 87(3):374-79.
14. Anderson *et al.* Compression-Plate fixation of acute fractures of diaphysis of Radius and Ulna. Jur. Of Bone and Joint Surg. 1975; 57(3):287-97.
15. WA Hadden. Results of AO plate fixation of forearm shaft fractures in adults. Injury. 1983; 15:44-52.
16. R.Hertel, M Pisan *et al.* Plate Osteosynthesis of diaphyseal fractures of forearm. Injury. 1996; 27:545-48.