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A Clinical and Functional Outcome of Operatively Managed Cases of Both-Bone Forearm Fractures: By Hybrid Fixation: A Study of 25 Cases

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ABSTRACT:
Background: the study was to evaluate result of hybrid fixation of both radius and ulna in both bone forearm fractures operated in form of radius plating and ulna nailing or radius nailing and ulna plating. As both the options has its prose and cones of operating procedure and post operative complications.
Aim: To study "A Clinical and Functional Outcome of Operatively Managed Cases of Both-Bone Forearm Fractures: By hybrid Fixation
Materials and methods: A prospective study of twenty-five (25) patients in the age group of 18-70 years with diaphyseal fractures of both bones forearm admitted in orthopaedic department in Guru Govind Singh hospital and Shri. M. P. Shah Government Medical College , Jamnagar during the period of 18 month, meeting the inclusion criterion are the subjects for the present study. The complete data was collected by taking the history of illness and by doing detailed clinical examinations and relevant investigations.
Result: Among 25 patients 3 (12%) patients gone in to complete failure and currently under treatment.5(20%) patients gone for secondary procedure and debridement and recovered well. 2 (4%) patients had complaint of implant impingement and implant was removed and recovered with excellent result. There was 17 (68%) patients with excellent results without any complications.
Conclusion: This study found that failure of the hybrid fixation is commonly associated with patients operated with open fractures of radius operated in form of radius plating and the reason is complications associated with infective non-union in radius operated with dorsal Thompson approach.
Patients operated with combination of radius nailing and ulna plating gives excellent results in all patients so this combination of hybrid fixation is reliable option in radius ulna diaphyseal fracture as there is less tissue damage , less chances of PIN palsy ,less chance of infection and better functional outcome as compared to radius-ulna plating and radius ulna nailing.

KEYWORDS: both bone forearm fracture, hybrid fixation, titanium elastic nailing system, limited contact dynamic compression plating, posterior interosseous nerve, intramedullary nailing, extensor pollic

Is longus

INTRODUCTION:

The forearm is a crucial segment of the upper limb, plays a significant role in daily activities through its ability to facilitate various movements around proximal and distal radio-ulnar joints enables both pronation and supination, allowing for multi-axial motion of the hand and forearm. Forearm fractures are relatively common, with an incidence rate estimated between 1 to 10 per 10,000 individuals annually. In adults, surgical intervention is typically the preferred treatment method. the choice of method is determined by the treating surgeon. However, a notable complication associated with proximal radius plating is posterior interosseous nerve injury is a significant concern .Plate osteosynthesis is widely used for treating forearm fractures in adults While intramedullary nailing is commonly used in open fractures, combining radius nailing with ulna plating or vice versa represents a newer approach in orthopaedic trauma for closed fractures. Intramedullary nailing has advantages, such as reduced infection rates due to its closed nature and lack of periosteal stripping, minimising the risk of nerve injury.

Meanwhile, plating provides rigid fixation, enhancing forearm rotational stability. Diaphyseal fractures of the radius and ulna present specific problems in addition to the problems common to all fractures of the shafts of long bones. In addition to regaining length, apposition, and axial alignment. It is recommended that the shaft fractures of both forearm bones in adults should be treated surgically because of unsatisfactory outcomes of conservative management. The gold standard of operative treatment is anatomical reduction with open reduction and stable internal fixation using the dynamic compression plate (DCP). However, the disadvantages of plate fixation include a relatively large skin incision, interruption of blood supply due to wide periosteal dissection of the forearm bone. extensive soft tissue damage, severe swelling, open fracture, segmental fracture, or a limited operation time due to associated injuries. In order to overcome these problems, intramedullary (IM) nail fixation can be used as an alternative method for treating radius and ulna. Hybrid fixation, which involves a combination of radius plating with ulna nailing or vice versa, is typically used in the scenarios like Compound fractures, Segmental fractures.

MATERIALS AND METHODS :

A prospective study of twenty-five (25) patients in the age group of 18-70 years with diaphyseal fractures of both bones forearm admitted in orthopaedic department in Guru Govind Singh hospital and Shri. M. P. Shah Government Medical College , Jamnagar during the period of 18 month, meeting the inclusion criterion are the subjects for the present study. The complete data was collected by taking the history of illness and by doing detailed clinical examinations and relevant investigations.

Inclusion criteria:

- Patients with closed diaphyseal fractures of both bones of the forearm.
- Patients above the age of 18 years and below 70.
- Patients who have completed minimum of 6 months after surgery are included.

Exclusion criteria:

- Compound fractures of forearm bones.
- Patients medically unfit for surgery.

Implants :

- Titanium elastic nails/radius ulna square nails were used for all patients for nailing,
- Stainless steel 3.5 mm limited contact dynamic compressions plate for open fixation.

- Nail diameters were 2.0mm, 2.5mm, 3.0mm with nail lengths from 16cms to 25 cm. The
- plate with 7-8 holes were used .

Summery of patients:

No of patients	25
Sex (male:female)	3:1
Average age	30yrs
Fracture site(right:left)	14:11
Mode of injury	
Road traffic accident	14
Domestic fall	8
Sports Injury	1
Industrial	1
Assault	1
Type of fractures	
Short oblique (radius: ulna)	16:14
Transverse	2:7
Comminuted	7:4
Local conditions	
Open : closed	7:18
Open radius :open ulna	1:6
A.O. Classified	
A3.1	5
A3.2	9
A3.3	6
B3.1	3
C1.3	1
C2.3	1

Table 1: patients summery

Preoperative planning:

- The appropriate length of the plate and nail to be used was assessed with the help of plain radiographs.
- If evidence of compartment syndrome, surgery must be done as soon as possible.
- Skin condition and any soft tissue injuries should be assist.

Operative procedure:

Position: Patient in the supine position.

Approaches:

Henry's approach- elbow straight and forearm in supination.

Thompson approach - Elbow flexed and forearm in mid pronation.

Dorsal approach for ulna - Elbow flexed and forearm in mid pronation.

procedure:

Usually, plating was fixed first, however, the fracture which was more stable was fixed first and later the other bone was fixed with intramedullary nailing .The fracture site was identified, the periosteum was not elevated, and fracture ends were cleaned. The fracture was reduced. The plate is applied to the bone with the middle portion placed over the fracture and held with plate holding clamps , A plate hole is left vacant for lag screw through the plate in case of oblique fractures. This hole is used for inter fragmentary compression using lag screw. Usually 7-hole LCDCP was chosen but longer plates were used in spiral, segmental and comminuted fractures. For proximal radial fractures, the plate was dorsally applied. For middle third, the plate was fixed dorsolateral and for distal radial fractures the plate was fixed on the volar aspect.

In ulnar fractures, plate was applied over the posterior surface . Haemostasis is maintained, and the wound is closed in layers. Anterograde nailing is used for fixing ulna. The entry point is 2 cm from the olecranon tip over the dorso-medial surface of ulna. Alternatively direct entry through olecranon tip may be used. Once the entry is made, ulna is reduced and tens of selected size is used to fix fracture. Here the ulnar nail tip is anchored in the distal metaphyseal region of ulna. Before anchoring the nail tip, the nail is independently rotated so that maximum interosseous space is obtained. After adequate anchoring the tens nail is cut approximately 1cm from the bone surface. Using the impactor the cut ends are gently hammered so that finally only 5 mm of nail end is protruding which helps in easy implant exit. The cut ends checked for sharp edges and the ends is buried in skin and skin closure is done after adequate wound irrigation.

Retrograde nailing is used for fixing radius. The entry point is 0.5cm medial from the listers tubercle over the dorsal surface of radius while taking entry EPL tendon should be retracted. Alternatively direct entry through radial styloid may be used. Once the entry is made, radius is reduced and tens of selected size is used to fix fracture. Here the radial nail tip is anchored in the proximal metaphyseal region of radius. Before anchoring the nail tip, the nail is independently rotated so that maximum interosseous space is obtained. After adequate anchoring the tens nail is cut approximately 1cm from the bone surface. Using the impactor the cut ends are gently hammered so that finally only 5 mm of nail end is protruding which helps in easy implant exit. The cut ends checked for sharp edges and the ends is buried in skin and skin closure is done after adequate wound irrigation.

POST-OPERATIVE CARE:

Day 1:

- Apply an above-elbow slab immediately following surgery.
- Administer intravenous (IV) antibiotics, analgesics, and fluids.

Elevate the limb.

- Monitor for signs of compartment syndrome.
- Track vital signs.

Day 2:

- Conduct post-operative radiography..
- Begin finger mobilization exercises.

Day 3:

- start oral antibiotics, analgesics, and limb elevation. Perform the first inspection of the surgical wound and change the dressing if necessary.
- Discharge the patient with the above-elbow slab in place.

Day 14:

- Remove sutures and change the wound dressing.
- Maintain the above-elbow slab.

Day 28 (Four Weeks):

- Remove the above-elbow slab and encourage elbow mobilization while avoiding pronation and supination.
- Advise against lifting weights.

6-12 Weeks:

- Following clinical and radiological evaluation, start introducing pronation and supination movements.
- Gradually initiate weight lifting.

12-16 Weeks:

- After clinical and radiological examination, if the X-rays show union, commence full weightlifting.
- Schedule follow-up assessments every six months to evaluate the functional outcome.

The patients were followed regularly at monthly intervals for the first three months then every three months depending upon the outcome. The patients were evaluated based on **"Anderson et al" scoring system**.

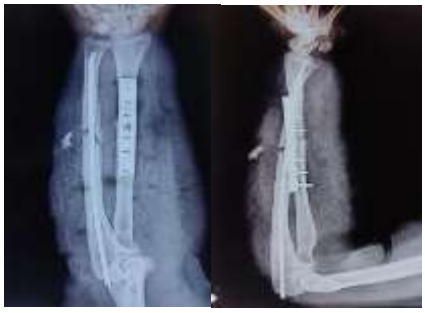
•Anderson forearm fractures outcome classification:

RESULT	**CRITERIA**
Excellent	**Fracture union** **Loss of flexion/extension of <10°** **Loss pronation/supination of < 20°**
Satisfactory	**Fracture union** **Loss of flexion/extension of <20°** **Loss pronation/supination of < 50°**
Unsatisfactory	**Fracture union** **Loss of flexion/extension of >20°** **Loss of pronation/supination of >50°**
Failure	**Fracture non-union/** **Unresolved chronic osteomyelitis**

Table 2 :**Anderson et al scoring system**

ILLUSTRATIVE CASES:

Pre-operative



Immediate post-operative

6 months follow-up

Case 1


Preoperative


immediate post-op


6 month follow up

Case 2

OBSERVATIONS:

Status of hybrid	
Radius plate +ulna nail	15
Radius nail+ulna plate	10
Approaches taken for radius plate	
Thompson approach	9
Volar henry approach	6
Duration of procedure	
<90 mins :>90 mins	17:8
Complications	
Superficial infections	5
Deep infections with non union	3
Implant impingement	2
Revision procedure	
Debridement	5
Debridement+implant removal	3
Implant removal	2
Duration of union	
Within 6 week	5
6 week to 12 week	12
3 month to 6 month	4
6month to 9 month	1
More than 9 month	3

Table 3 : Statistical observations

RESULT:

The results were evaluated with Anderson et al scoring system there were 17 (68%) patients with excellent result 4(16%) patients with satisfactory result and 1(4%) patient with unsatisfactory result and 3(12 %) patients with failure.

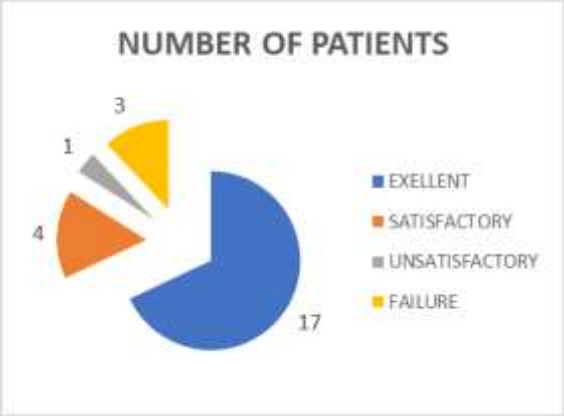


Chart 1: Results on the basis of Anderson et al scoring system

DISCUSSION:

In our study 25 patients with fractures of both bone forearms were treated with hybrid fixation by using LCDCP and screws and ELASTIC NAILING . most of the patients were of age from 18 years to 70 years with an average age of 30 years. 15(60%) patients operated with radius plate and ulna nail and 10(40%) patients operated with ulna plate and radius nail . About 17 patients operated within 90 min and other patients took 120 to 140 min .post operated patients given 3 days of intravenous antibiotics and then discharged on 4-5th day of procedure with average 7 to 10 days of hospital admission. And suture removal done between 10th to 12th day of procedure. On average follow up period of the patient were 14 months, the results were evaluated with Anderson et al scoring system there were 17 (68%) patients with excellent result 4(16%) patients with satisfactory result and 1(4%) patient with unsatisfactory result and 3(12 %) patients with failure. 3 Failure results are due to comminution of fracture delayed soft tissue healing and infective non-union in radius plating with Thompson approach.in which 2 patients was with open fractures. However, the problem occurs when the proximal third of the radial shaft is involved. muscle bulk in this region is more voluminous. When anterior Henry's approach is used there is damage to pronator teres and supinator muscles which are usually stripped off to gain exposure. is can affect the functional strength of the forearm. Although posterior Thompson approach is used, it carries a risk of injury to the posterior interosseous nerve this study didn't observe any PIN palsy .

An open procedure for ulnar fracture and a closed one for the proximal radius shaft fracture can effectively reduce these risks. The application of TENs for fixation of radial shaft fractures has been shown to have favourable functional outcomes in the studies. Our results support these results and indicate several advantages of TENs nailing over open fixation with plates. the procedure is so tissue friendly, avoids the risk of muscle and nerve damage and significantly reduces surgical time.

The only functional limitation observed in our results is related to the limited dorsiflexion of the wrist because of the protruding end of the radius nail. The same can be corrected and removal of the implant once a consolidated union at fracture has been obtained. . Although the union was delayed in 1 case in the hybrid fixation group, 3 of the patients developed non-union.

The complications related to hypertrophic scar and posterior interosseous nerve palsy, dorsal tendon rupture or Irritation, specially the extensor pollicis longus tendon, has not been observed in our study.

The entry point of titanium elastic nail was created over lister tubercle under direct vision, thus avoiding injury to surrounding tendons. However, the risk of delayed tendon rupture could not be assessed owing to the limited follow up of 6 months. A long term follow up would be needed to comment on the same.

The range of motion was determined and Anderson et al, scoring system was used as measure of functional outcome.

In **Subhash Patil et al** study of both bone forearm plating 16(86.7%) cases reported with excellent result, 3(10%) Cases appear as satisfactory and 1 (3.3%) cases appeared as unsatisfactory and no case of failure seen.

Mohd .K.N.Z. Khateeb et al reported that in both bone plating group 22(80%) cases with excellent, 2(6.6%) satisfactory and 3(13.4%) cases as failure with no unsatisfactory results noted In both bone nailing group 18 (68%) patients with excellent, 7(24.8%) cases satisfactory and 1(6.2%) case with unsatisfactory results noted.

Using Anderson et al scoring system our series had 17(68%) patients with excellent result, 4(16%) patient with satisfactory result and 1(4%) patient unsatisfactory and 3(12%) patients resulted as failure.

CONCLUSION:

- This study found that failure of the hybrid fixation is commonly associated with patients operated with open fractures of radius operated in form of radius plating and the reason is complications associated with infective non-union in radius operated with dorsal Thompson approach.
- Patients operated with combination of radius nailing and ulna plating gives excellent results in all patients so this combination of hybrid fixation is reliable option in radius ulna diaphyseal fracture as there is less tissue damage, less chances of PIN palsy, less chance of infection and better functional outcome as compared to radius-ulna plating and radius ulna nailing.

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