

Results of ORIF with Extramedullary Plate Osteosynthesis and Intramedullary Modified Ender Nailing in Humerus Diaphyseal fractures in Adult Indian Population.

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Abstract:

Introduction: Humerus shaft fractures happens in 3% of all fractures. Most of them are treated conservatively. Various surgical techniques are described in literature for surgical intervention of diaphyseal humerus fractures. In our study we have done new modified ender nailing for humerus diaphyseal fractures.

Materials and Methods: Total 48 Humerus shaft fractures were treated by operative management in tertiary care centre from July 2020 to May 2022 including both open and closed injuries, of which 22 patients underwent Intramedullary fixation with Modified Enders nailing and 26 patients were treated with Extramedullary fixation with plating. The clinical examination was done by two examiners independently followed by functional scoring with RODRIGUEZ MERCHAN CRITERIA and radiological scoring with RHUM (Radiographic Humerus Union Measurement).

Results: Out of total 48 patients, 8 patients were lost to follow up. Out of the 40 patients there were 25 males and 15 female patients. The mean age of the patients at the time of injury is 38.10 years. Average time of union was 12 weeks in intramedullary enders fixation and 13 weeks in extramedullary fixation. Average RHUM score at the end of 3 months in intramedullary fixation is 9.15 and in extra medullary fixation is 8.45 and after 6 months is 11.45 and 10.8 respectively. Union rate was 100% in both type of fixation.

Conclusion: The effectiveness of intramedullary fixation with modified Enders nailing and extramedullary fixation with plate osteosynthesis is comparable in viewpoints of radiological and functional outcomes with no significant differences. The intramedullary fixation with modified ender nailing is a better choice than extramedullary fixation with plate osteosynthesis in view of less soft tissue damage, less soft tissue irritation, and fewer chances of iatrogenic radial nerve palsy.

Keywords: Humerus diaphyseal fractures, modified ender nailing, plate osteosynthesis,

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Introduction

Humerus shaft fractures happens in 3% of all fractures.¹ Mostly these fractures are treated non surgically but in polytrauma patients, floating elbow injuries open injuries & cases of failed nonsurgical intervention surgical management of humerus fractures becomes necessity. Various surgical techniques are described in literature for surgical intervention of diaphysial humerus fractures like external fixation, ORIF with plating, Bridge plate, antegrade intramedullary nails, antegrade & retrograde flexible nails like ender & TEN nail. All these techniques have advantages & disadvantages of different types. [1]

Though high rates of union have been given by plate osteosynthesis, it involves extensive soft tissue stripping, potential injury to radial nerve, and poor fixation in osteoporotic bone. [2] The advantages of intramedullary nailing are minimal surgical exposure, better biological fixation, and minimal disturbances of soft tissues, least chance for radial nerve injury and early mobilization of neighbouring joints. [3] The conventional old technique of Ender nailing for diaphyseal fracture had many limitations and complications. Therefore, we have done new modified ender nailing for humerus diaphyseal fractures which has less chances of infection, iatrogenic radial nerve palsy, less invasive to tissues, no chances of nail migration, prevents rotational malalignment, provides micromotion & allows mobilization without bracing.

Materials and Methods

Total 48 Humerus shaft fractures were treated by operative management in the Department of Orthopaedics of Narendra Modi Medical College, Gujarat, India, from JULY 2020 to MAY 2022 including both open and closed injuries, of which 22 patients underwent Intramedullary fixation with Modified Enders nailing and 26 patients were treated with Extramedullary

fixation with plating. Our inclusion criteria were above 18 years of age, 2 cm below surgical neck of humerus and 3 cm above the olecranon fossa of humerus fresh fractures. Exclusion criteria were pediatrics fractures, old fractures, intraarticular fractures, pathological and metabolic bone disease fractures. Out of these 48 patients, 40 patients had a minimum of 6 months follow-up and were included in our study. At follow up, consent was obtained from the patients and the clinical examination was done by two examiners independently followed by functional scoring with RODRIGUEZ MERCHAN CRITERIA and radiological scoring with RHUM (Radiographic Humerus Union Measurement). All the study patients were taken up for the surgical procedure between the 2nd and 7th day after the trauma. The duration of surgery was minimum 60 min and maximum 120 minutes. The average duration of surgery was 90 min.

Surgical techniques for extramedullary fixation with plating: Surgical procedures were performed under regional anaesthesia or general anaesthesia. The plate osteosynthesis was done using either posterior approach or anterolateral approach and with 4.5 mm DCP or LC-DCP under aseptic precautions and proper painting and sterile draping. The posterior approach was performed with the patient in the lateral position with the shoulder flexed and abducted and the elbow flexed over a support. The incision was longitudinal in the midline of the posterior aspect of the arm from the tip of the olecranon to about 5 to 10 cm distal to the acromion. The dissection began at the proximal end of the incision where the interval between the long and lateral head of the triceps was identified and developed by blunt dissection. The common tendon of the triceps muscle incised sharply in the midline, as it run distally and inserts into the olecranon. Retraction of the lateral head of

triceps laterally and the long head medially, at the proximal part of the incision, revealed the radial nerve and the profunda brachii artery as they run together in the spiral groove. The radial nerve was identified and tagged. The medial head of the triceps was deep to the lateral and long heads and originates just distal to the spiral groove. Longitudinal midline dissection revealed the periosteum of the posterior humeral shaft. Incision of the periosteum and its retraction gave access to the distal humerus and will protect the radial, ulnar, and the lateral brachial cutaneous Nerves. Anterolateral approach was done in supine position. The skin incision starts at the tip of the coracoid process and runs distally in line with the deltopectoral groove to the lateral aspect of the humerus at the deltoid insertion. From there, the incision continues distally following the lateral border of the biceps until about 5 cm proximal to the flexion crease of the elbow joint. At the proximal part of the approach, division of the superficial fascia revealed the cephalic vein which runs within the deltopectoral groove. The humerus was then approached by retracting the deltoid laterally and the pectoralis major medially. Care must be taken not to apply excessive retraction to the deltoid as this may cause compression injury to the axillary nerve and paralyze the anterior half of the muscle. The periosteum lateral to the tendon of the long head of biceps was then incised and the insertion of the pectoralis major was detached from the lateral aspect of the bicipital groove. The anterior circumflex artery was encountered during the deep dissection and should be ligated. In the middle third the deep fascia was incised in line with the skin incision and the biceps was mobilized medially to expose the brachialis muscle that covers the anterior humerus. The brachialis was split longitudinally in the midline to expose the anterior humeral diaphysis. A midline incision in brachialis protects the innervation of the muscle provided by the radial nerve laterally and

musculocutaneous nerve medially. Exposure could be facilitated by flexion of the elbow. Immediate post operative radiographs was taken. Wound inspection was done on 2nd post operative day. Suture removal was done on 15th post operative day. Active shoulder and elbow range of motion started on 2nd post operative day once the pain level decreases under physiotherapist guidance and tolerability of the patient. The patients were given IV antibiotics for 3 days and then patients were discharged. Regular dressing was done and post-operative calcium supplements were given.

Surgical techniques for intramedullary fixation with modified ender nailing: The modified ender nailing was done in supine position with fractured limb over side arm support and abducted to 90 degrees. The 3.5 mm ender nails are most used in humerus diaphyseal fractures. A 2-3 cm incision was taken over the lateral condylar ridge, soft tissue dissected, and bone exposed. Lateral entry made through fully cortical lateral condylar ridge by 3.2 mm stiff drill pin under the image intensifier guidance in AP view. This lateral entry is confirmed in lateral view and widened by its cannulated 4 mm drill. A proper sized 3.5 mm ender nail taken and gentle 'S' contour given to it. This 'S' shaped ender passed through the entry site and negotiated into proximal fragment. The path of the nail checked with the help of image intensifier. The nail is advanced ahead with rotation on each stroke. The 'S' contour de-rotated while pounding the tip proximally, while tip is pointing to calcar and reduction achieved. The passed in the neck and good reduction achieved. A 2-3 cm skin incision taken just below the greater tubercle. Soft tissue dissection done and entry taken with entry owl. Second 3.5 mm ender nail taken and C shape curve given and about 5 mm proximal to distal tip bend given which gives press fit in distal humerus canal. Nail was inserted through entry and negotiated through fracture site under image

intensifier. Distal tip passed into the narrow canal in the distal humerus. If canal is wide another nail can be inserted by the same manner. Elbow and shoulder movement checked and closure done. Postoperative protocol is same as plating except IV antibiotics given for a shorter period of time.

Results

Out of total 48 patients, 40 Patients who were followed up were included in the study for assessment of functional and radiological outcome of humerus diaphyseal fractures. Eight patients were lost to follow up. Hence a total of 40 patients were included for final analysis. Out of the 40 patients there were 25 males and 15 female patients. The mean age of the patients at the time of injury is 38.10 years (range of 18 to 78 years). The period of follow up period was minimum 6 months to

maximum 20 months. The age groups varied from 18 years to 78 years with the mean age of 38.10 years. Almost 50% patients were observed between 31- 50 years of age. 38 patients having road traffic accidents, 9 having low energy injury, 1 having direct blow and 8 having household fall. left side was most common in our study. We have classified according to AO classification. 2 patients have A1, 11 have A2, 12 have A3, 3 have B1, 8 have B2, 1 have B3, 1 have C1, 1 have C2, 1 have C3. Average time of union was 12 weeks in intramedullary enders fixation and 13 weeks in extramedullary fixation. Average RHUM score at the end of 3 months in intramedullary fixation is 9.15 and in extra medullary fixation is 8.45 and after 6 months is 11.45 and 10.8 respectively. Functional scoring done according to RODRIGUEZ MERCHAN CRITERIA at the end of 6 months.

Table 1: Comparison of functional outcome between two groups

RODRIGUEZ MERCHAN CRITERIA	Intra medullary fixation with enders nailing	Extra medullary fixation with plating
Excellent	15	11
Good	4	8
Fair	1	1
Poor	0	0

Out of 20 patients of intramedullary fixation with modified ender nailing, one patient had delayed union which healed after 23 weeks which eventually led to fair functional outcome at 6 months follow up. Out of 20 patients of extramedullary fixation with plating, one patient developed post operative radial nerve palsy which eventually recovered in 2 months with

conservative management, while one patient had delayed union which healed after 25 weeks which eventually led to fair functional outcome at 6 months follow up. No patients among the 40 patients of this study treated with either intramedullary fixation with modified ender nailing or extramedullary fixation with plating needed any secondary surgery.

Table 2: Comparison of variables between two groups

Variable	Intra medullary fixation with enders nailing	Extra medullary fixation with plating	Significant / Not significant
Age	35.40 ± 13.06	40.80 ± 15.19	Not significant
Time to union	12.25 ± 3.34	13.20 ± 3.41	Not significant
RHUM at 3 month	12.25 ± 3.34	8.45 ± 1.85	Not significant
RHUM at 6 month	11.45 ± 1.00	10.80 ± 1.36	Not significant

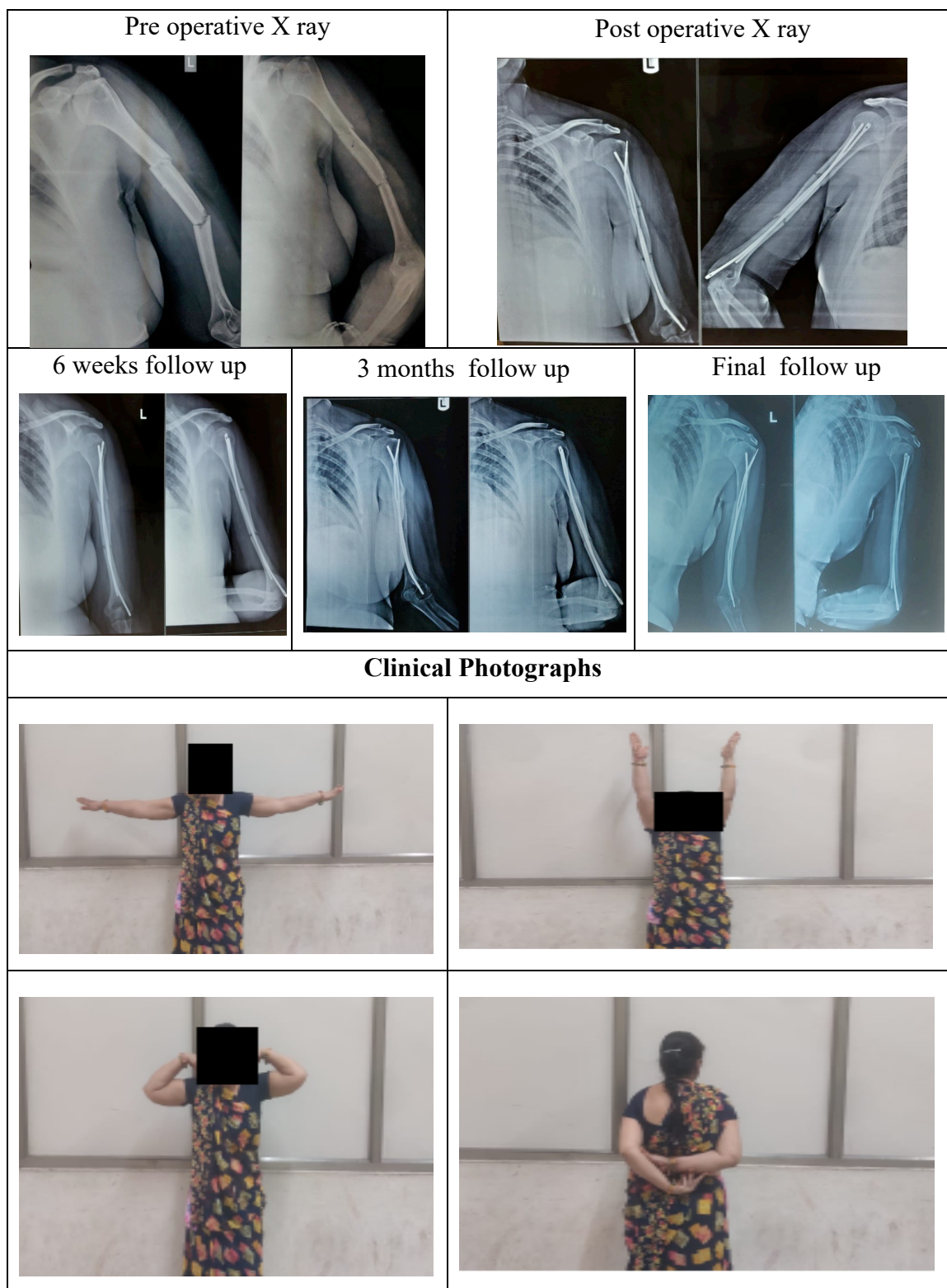


Figure 1: A 36 years old female with a closed left side segmental humerus shaft fracture, type 12-C2, stabilized with intramedullary fixation with modified ender nailing

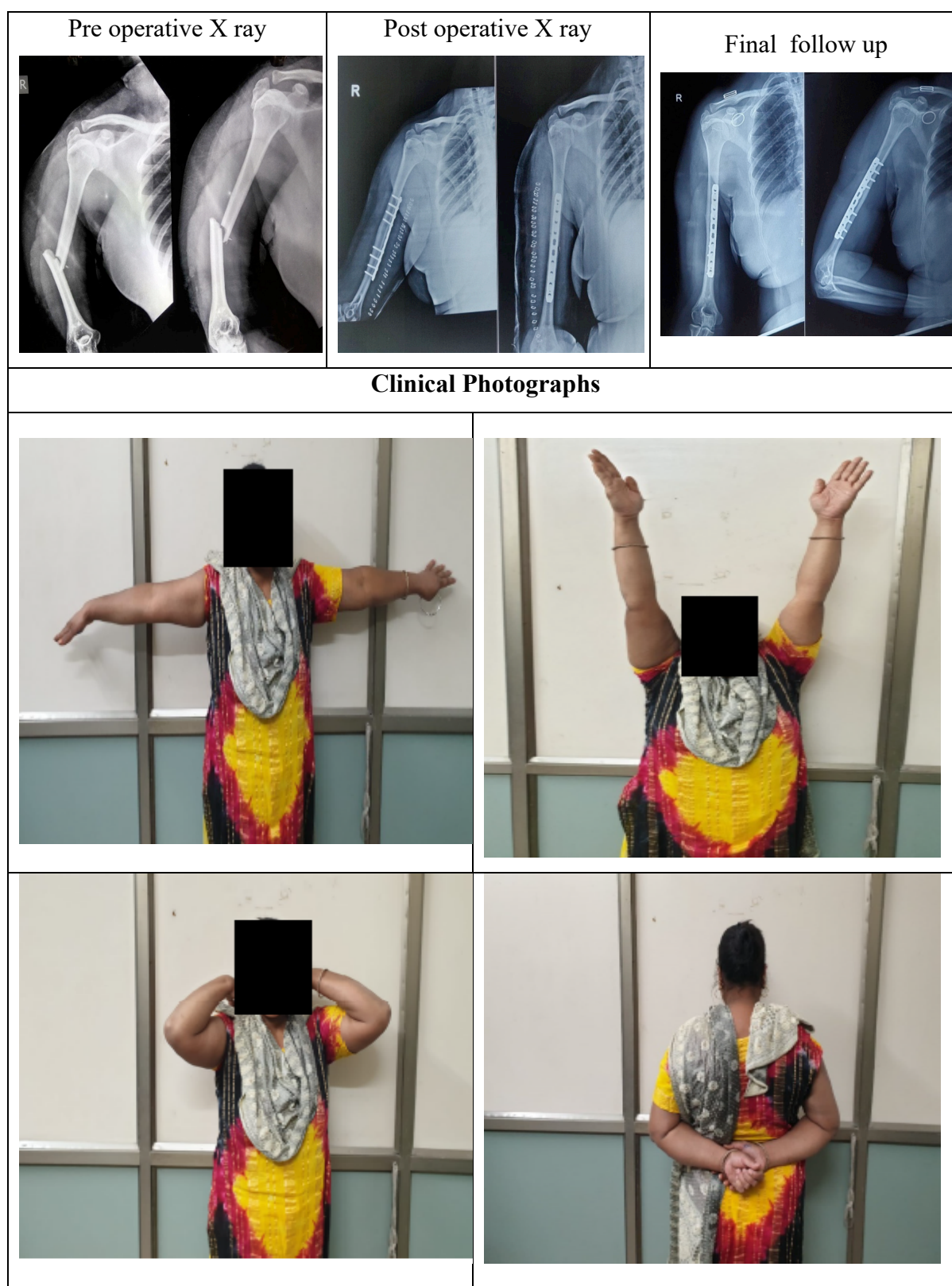


Figure 2: A 32 years old female with closed right side humerus shaft fracture, 12-A2 type, stabilized with extramedullary fixation with plate osteosynthesis

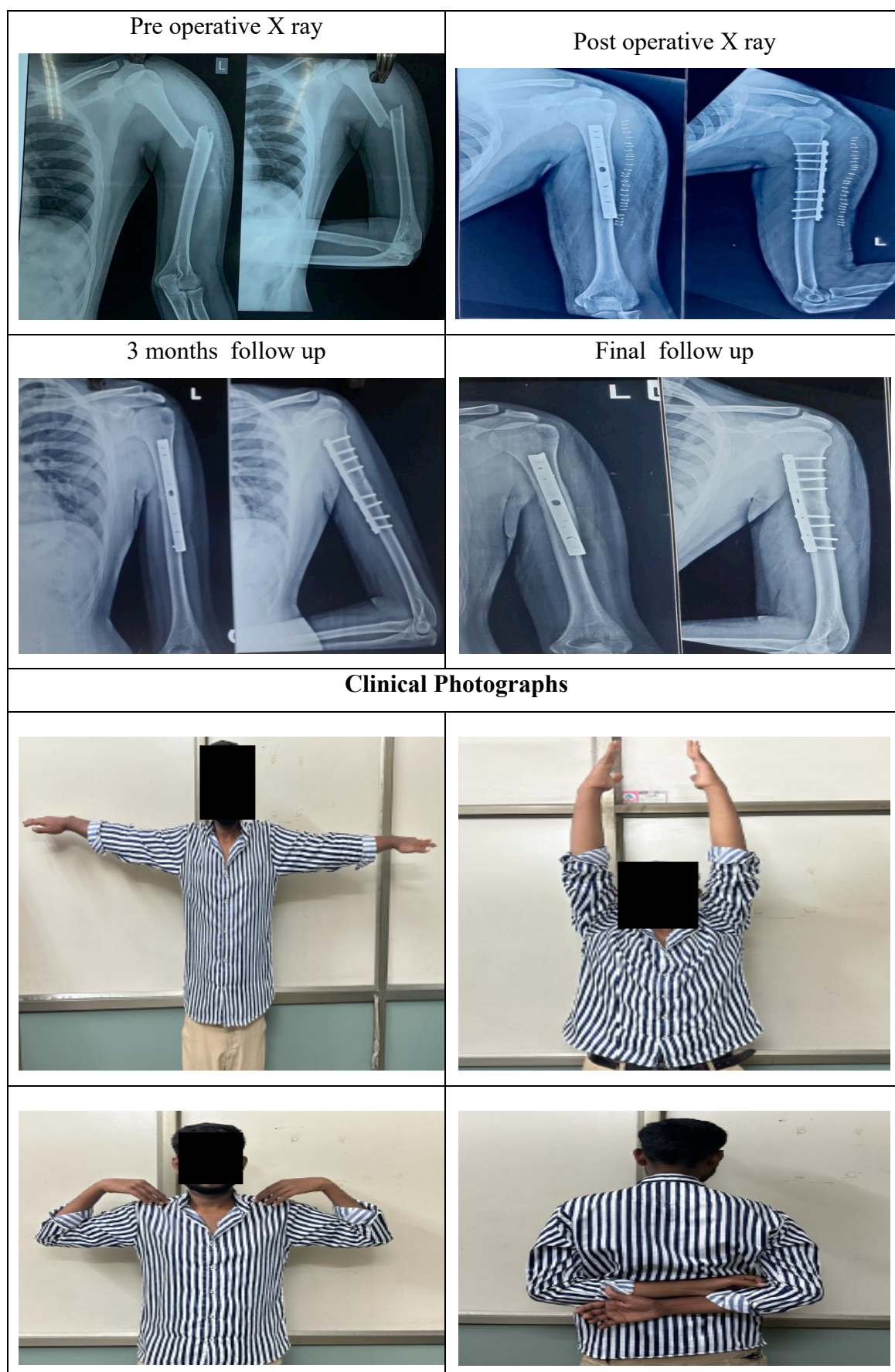


Figure 3: A 20 years old male with closed left side humerus shaft fracture, 12-B1 type, stabilized with extramedullary fixation with plate osteosynthesis

Discussion

Although ORIF with extramedullary plate osteosynthesis provides absolute stability & allows mobilization, it is having disadvantages like wide exposure, high chances of infection, technically more demanding, intra operative blood loss, high chances of radial nerve palsy, big surgical scar & more operative time as compared to intramedullary fixation. [4] Intramedullary fixation with modified ender technique has all advantages. It is very less invasive, no blood loss, technically easier, less chances of infection, very tiny scar, negligible chances of radial nerve injury, no soft tissue invasion & immediate mobilization without brace. This technique preserves biology & provides micromotion. Theoretically stress risers can arise in extramedullary fixation at end points of implant. But in modified ender nailing these points don't exist as they span throughout the length of bone. In implant removal also ender nails are easier to remove as compared to plates. Wrong screw placement, improper reduction with gap in fracture line, improper plate placement & higher cost of implant are some drawbacks in extramedullary plate osteosynthesis. While in modified ender nails wrong entry, improper curves can lead to difficulties in reduction, backing out of nails & nail impingement. Failure occurs only in mal reduction, distraction & loss of reduction in postoperative period. We have studied patients from 18 to 78 years with mean age of 35.40 in intramedullary group & 40.8 in extramedullary group. Majority patients were male with most common mode of injury of fall. Our study shows time of union with an average 12.25 weeks in intramedullary fixation with modified ender nailing & 13.20 weeks in extramedullary fixation with plate osteosynthesis. There is no statistical difference. This is comparable to Kant KS et al.⁵ in their study of ender nail fixation of humerus diaphyseal fractures with mean fracture union time of 12.8 weeks. [5] In Pansey NK et al. [6] study of comparison

between intramedullary nailing versus open plating in humerus diaphyseal fractures, they also found mean union time of 13 weeks in intramedullary implants & 15 weeks in extra medullary implants without any statistical difference amongst 43 cases. In this study, there is no statistical difference in RUHM score between both study groups at 3 & 6 month interval. Apart from this in view of Rodriguez & Merchan criteria also there is no statistically different functional outcome at 6 months. In this study, we have given modification in ender nails in regard to precise entry point, 'S' & 'C' bends. 'S' contour of nail helps in indirect reduction & when the nail enters through pre drilled bone from lateral condylar ridge region it gives exceptionally strong hold. 'C' contour helps in press fit fixation of fracture by elastic recoil & its bent tip enhances the hold in distal fracture fragment which prevents distraction at fracture site. Due to these modifications, we could minimize complications of nail impingement, nail backout, loss of reduction & shoulder stiffness; while these complications are frequent in conventional ender nailing. [5] There was an incidence of iatrogenic radial nerve palsy in 1 patient of extramedullary fixation in our study amounting to 5% of total from extramedullary plate fixation group. There was no such incident in fractures fixed with modified ender nails. It is comparable to other international studies on locked intramedullary nails which shows a rate of iatrogenic injury between 0-4%. [7] In our study, union rate was 100% in both type of fixation. There was a case of delayed union in each group which ultimately united without any second intervention. This is again comparable to other international studies of intramedullary fixation of humerus diaphyseal fractures which shows union rates of 90-100%. [7,8] and of extramedullary fixation with plate osteosynthesis which shows fracture union rates of 93-100%. [9,10]

Conclusion

From our study, it is concluded that the effectiveness of intramedullary fixation with modified Enders nailing and extramedullary fixation with plate osteosynthesis is comparable in viewpoints of radiological and functional outcomes with no significant differences. Modified contouring of Ender nails ('S' shape and 'C' shape), and precise entry points, help to achieve an indirect & good reduction with better rotationally stable fixation. These modifications induce the desired micromotion by press-fit elastic fixation. They also prevent the migration of nails which was the limitation of the old conventional method. The intramedullary fixation with modified ender nailing is a better choice than extramedullary fixation with plate osteosynthesis in view of less soft tissue damage, less soft tissue irritation, and fewer chances of iatrogenic radial nerve palsy.

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