Section: Orthopaedics

Original Research Article

# TO EVALUATE THE COMPLICATIONS OF AN OPERATIVE TECHNIQUE OF MINIMAL INVASIVE PLATE OSTEOSYNTHESIS (MIPO) FOR HUMERAL SHAFT FRACTURES

**Siddhant R. Shah[1], Ripple J. Shah[2], Miteshkumar J. Patel[3], Dhrumil S. Dave[4]**

[1,4]Assistant Professor, Department of Orthopaedics, Smt. NHL Municipal Medical College, Ahmedabad, Gujarat, India.
[2]Associate Professor, Department of Orthopaedics, GCS Medical College, Ahmedabad, Gujarat, India.
[3]Fellow, Hip & Pelvi-Acetabular Reconstruction Surgery & Arthroplasty, Max Super Specialty Hospital, Mohali, Punjab, India.

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Corresponding Author:
**Dr. Dhrumil S. Dave,**
Email: dhrumil1990@gmail.com.

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## Abstract

**Background:** Humeral shaft fracture is one of the common injuries encountered in orthopedic surgery accounting for 1% - 5% of all fractures. The present study was conducted to evaluate the complications of an operative technique of minimal invasive plate osteosynthesis (MIPO) for humeral shaft fractures. **Materials and Methods:** The present prospective study was conducted among patients attending Department of Orthopaedics in GCS Medical College, Hospital & Research Centre from July 2020 to January 2021 who was diagnosed with shaft of humerus fracture and willing for surgery. Complications of an operative technique of minimal invasive plate osteosynthesis (MIPO) for humeral shaft fractures were assessed. **Results:** Among the 20 patients studied, highest number of patients was seen in 20-40 years (45%) age group. The average was 42.5 years. Among the 20 cases there were 10 Male and 10 Female patients with equal male and female distribution. Most of the patients had affected left side compared with right. 55% patients had RTA and 45% patients had accidental fall. Maximum patients belong to A2 and least belongs to A1 category. Maximum patients had no complications (95%). Radial nerve palsy occurs in 5% patients. **Conclusion:** The study concluded that the chance of infection is negligible due to decreased surgical exposure. Risk of radial nerve palsy is there to start with, but with experience can be neglected.

## INTRODUCTION

Humeral shaft fractures account for 2–4% of all fractures,[1] yet at present, there is no clear gold standard for the treatment of humeral shaft fracture.[2,3] Although most humeral shaft fractures can be treated nonoperatively, surgical treatment leads to better fracture reduction and early functional exercise.[4] Minimally invasive plate osteosynthesis, is a technique based on relative stability, where the plate is inserted through a percutaneous approach, by two separate incisions, offering the advantages of less soft tissue disruption and blood loss, also while preserving the fracture haematoma and blood supply to the bony fragments.[5] MIPO can be done by both lateral and anterior approaches to the surface of the humerus, however, anterior approach is recommended as it carries the least risk of injury to the nearby neurovascular structures.[6] Minimally invasive treatment modalities with low morbidity, rapid patient recovery and earlier return to work and activities of daily living are favored to other modalities.[7] This method requires less soft tissue disruption and preserves the fracture hematoma and blood supply to the bone fragments.[8,9] The present study was conducted to evaluate the complications of an operative technique of minimal invasive plate osteosynthesis (MIPO) for humeral shaft fractures.

## MATERIALS AND METHODS

The present prospective study was conducted among patients attending Department of Orthopaedics in GCS Medical College, Hospital & Research Centre from July 2020 to January 2021 who was diagnosed with shaft of humerus fracture and willing for surgery. Patients who fail to maintain adequate close reduction and intolerance to cast, close fractures, open grade 1 & 2 fractures, segmental or comminuted fractures, with or without radial nerve palsy were included in the study. Patients who had Juxta/Intra articular fracture of humerus, open grade 3, vascular


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injury, pathological fracture were excluded from the study. Timing of Surgery was 1 to 5 days from the time of injury.

**Pre-Operative Assessment**

1. X-ray of the affected arm including one joint above and one joint below; including the ipsilateral shoulder and elbow joints
2. Minimum two views are necessary: Antero-posterior and Lateral Views.
3. Anteroposterior and lateral radiographs were used to template the exact length of implant
4. The Fracture pattern was classified according to Orthopaedic Trauma Association classification

**Procedure**

Surgical approach[10]

With the arm and forearm fully supinated and supported on a surgical table, two small windows must be made on the anterior surface of the arm. The most proximal window is made between the pectoralis major and the medial border of the deltoid.

**Incision**

Proximal: A 3 cm longitudinal incision is made proximally starting approximately 6 cm distal to the anterior part of the acromion process. The dissection is carried down to the humerus using the intermuscular interval described above.

**Distal:** A 3 cm longitudinal incision is made on the anterior aspect of the arm in the midline 3 cm proximal to the flexion crease of the elbow.

**Exposure:** The interval between the biceps brachii and the brachialis is identified. The biceps is retracted medially with the lateral cutaneous branch of musculocutaneous nerve which lies on the anterior surface of the brachialis. The brachialis is then split longitudinally along its midline to reach the periosteum of the anterior cortex of the distal humerus. The lateral cutaneous branch of the musculocutaneous nerve is retracted together with the medial half of the split brachialis muscle using Army Navy retractors. The lateral half of the brachialis muscle serves as a cushion to protect the radial nerve, which, at this point, has pierced the lateral intermuscular septum and is lying between the brachioradialis and brachialis muscles.

**Preparation and Introduction of the Plate:** The critical steps to take before introducing the plate are to prepare adequate space for the tunnel through the tight musculotendinous section between the brachialis and the deltoid muscles, and ensure that the tunnel is in the correct plane and direction. Before insertion of the plate the fracture must be initially reduced to achieve correct alignment and rotation. Once the plate is placed in the tight tunnel and a screw is inserted in one fragment, rotation cannot be altered. The plate can be introduced directly from the proximal window to the distal window manually, keeping the elbow at 90° with the forearm supinated to protect the radial nerve. Some difficulty may be encountered during passage of the plate under the brachialis in the middle portion of the arm. It is important to slide in the plate with contact on the bone until it reaches the distal window. During this procedure the elbow must be kept in traction and aligned by an assistant. The LCP can be introduced using two drill sleeves attached to one end to act like a handle. Another technique to introduce the plate uses a tunneling instrument introduced deep to the brachialis from the distal to the proximal incision. Some difficulty may be encountered at the proximal part of the tunnel during passage of the tunneling instrument due to the intricate blending of the fibers of the brachialis and deltoid muscles along the lateral aspect of the tunnel at this point. To avoid injury to the radial nerve at the lateral aspect of the distal humerus, the tunneling instrument should be passed along the anterior, or slightly anteromedial aspect of the humerus. The selected narrow LCP is then tied with a suture to a hole at the tip of the tunneling instrument and pulled back with it along the track that was created.

**Reduction and Fixation[10]:** When using the LCP, an LCP drill sleeve attached to each end of the plate is helpful to manipulate the plate into the correct position. These drill sleeves are used as a guide for correctly placing the plate on the anterior surface of the humerus by putting the sleeve perpendicular to the bicondylar plane of the elbow. After positioning the plate over the center of the anterior surface of the distal humerus, it is fixed with one cortex screw distally which is not completely tightened. Reduction of the fracture is usually achieved by traction to restore length, abduction, and correct varus. The intercondylar axis is kept perpendicular to the long head of the biceps to correct rotational deformities. The assistant maintains this position and alignment is checked with image intensification. In the proximal window the plate is maintained in place using the drill guide and the drill hole is made. The screw is inserted proximally and both screws are tightened. The alignment is verified with image intensification. If it is correct one or two more screws are inserted into each fragment. It is preferable to fix the screws in a divergent direction to catch more of the cortex. The divergent screw direction also requires smaller incisions. When using an LCP, it is advisable to first put one conventional unicortical screw in each fragment to reduce the fracture in the sagittal plane before fixing it with two more locking screws.

**Post-Operative Protocol**

All patients are immobilized with arm sling

At the end of 48 hrs – pendular exercise and elbow ROM started.

When Pain reduces – Active assisted Shoulder & elbow ROM exercises were started.

Wound inspection was done on 3rd, 6th & 9th POD

Suture removal was done on 11thPost operative day.

Patients were followed up Clinically and Radiologically at 6wks, 3 months, and 6 months & yearly intervals until the fracture heal completely. Complications of an operative technique of minimal invasive plate osteosynthesis (MIPO) for humeral shaft fractures were assessed.



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## RESULTS

Among the 20 patients studied, the highest number of patients were seen in 20-40 years (45%) age group. The average was 42.5 years. Among the 20 cases there were 10 Male and 10 Female patients with equal male and female distribution. Among the patients studied most of the patients had affected left side compared with right. 55% patients had RTA and 45% patients had accidental fall. Maximum patients belong to A2 and least belongs to A1 category. 1 out of 20 had Radial nerve palsy post operatively. Postoperatively, these cases are given with cockup splints, preferably dynamic cockup splits. Nerve conduction study was done in this case by 6 weeks. Recovery was assessed at every followup by sensory and motor examination. Had full recovery by the end of 6 months.

**Table 1: Age Distribution**

| Age | Frequency | Percentage(%) |
|---|---|---|
| <20 | 0 | 0 |
| 20-40 | 9 | 45 |
| 41-60 | 8 | 40 |
| >60 | 3 | 15 |
| Total | 20 | 100 |

**Table 2: Gender Distribution**

| Gender | Frequency | Percentage(%) |
|---|---|---|
| Male | 10 | 50 |
| Female | 10 | 50 |
| Total | 20 | 100 |

**Table 3: Side Distribution**

| Side | Frequency | Percentage(%) |
|---|---|---|
| Right | 5 | 25 |
| Left | 15 | 75 |
| Total | 20 | 100 |

**Table 4: Mode of Injury**

| Mode | Frequency | Percentage(%) |
|---|---|---|
| RTA | 11 | 55 |
| Accidental Fall | 9 | 45 |
| Total | 20 | 100 |

**Table 5: Classification (Ota Classification)**

| Classification | Frequency | Percentage(%) |
|---|---|---|
| A1 | 1 | 5 |
| A2 | 7 | 35 |
| A3 | 4 | 20 |
| B1 | 4 | 20 |
| B2 | 4 | 20 |
| B3 | 0 | 0 |
| Total | 20 | 100 |

**Table 6: Complications**

| Complications | Frequency | Percentage(%) |
|---|---|---|
| Radial Nerve Palsy | 1 | 5 |
| Infection | 0 | 0 |
| Delayed Union | 0 | 0 |
| Nonunion | 0 | 0 |
| None | 19 | 95 |
| Total | 20 | 100 |

## DISCUSSION

MIPO scores over open reduction and plate fixation of humerus fractures by decreasing the surgical trauma to the soft tissue and maintaining the periosteal circulation. Application of the plate on the bone by an open technique interferes with the local vascularization, leading to osteonecrosis beneath the implant, which can cause delayed healing or nonhealing (the reported rate of nonunion being 5.8%). The primary bone healing without callus formation is not very strong and there exists a real risk for refracture after removal of the implant in the open technique.[11]

Among the 20 patients studied, highest number of patients was seen in 20-40 years (45%) age group. The average was 42.5 years. Among the 20 cases


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there were 10 Male and 10 Female patients with equal male and female distribution. Most of the patients had affected left side compared with right. 55% patients had RTA and 45% patients had accidental fall. Maximum patients belong to A2 and least belongs to A1 category. Maximum patients had no complications (95%). Radial nerve palsy occurs in 5% patients.

No cases reported infection postoperatively which was better compared to Concha et al study which reported 2 cases of infection.[12]

Postoperative iatrogenic radial nerve palsy was reported in 1 case which was higher compared to Deepak S et al,[13] study and Hadhoud MM. et al,[14] one case recovered by 6 months followup & one case did not show recovery at 1 year for which tendon transfer to be planned subsequently. These nerve injuries occurred earlier in the study probably due to plate off set and unicortical drilling with chance of drill bit slippage into the neural structures posteriorly. Hence plate position should be visualized digitally and radiologically before drilling. Take care to be in the proper intermuscular plain and the plate advanced gently in close contact to bone over the anterior surface in a proximal to distal direction to protect deltoid insertion. The forearm must be positioned in supination; Pronation brings the radial nerve closer to plate according to Apivatthakakul et al study. Taking in mind the danger zone for musculocutaneous and radial nerves.[15,16]

The scar was cosmetically acceptable when compared to ORIF. The average blood loss was less compared to ORIF and all the patients showed early return of activities due to decreased postoperative morbidity.

## CONCLUSION

The study concluded that the chance of infection is negligible due to decreased surgical exposure. Risk of radial nerve palsy is there to start with, but with experience can be neglected.

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