



A Clinical Study on Functional Outcome of Patients with Humerus Diaphyseal Fractures Treated by Mippo (Minimally Invasive Percutaneous Plate Osteosynthesis) Technique – Case Series

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ABSTRACT

BACKGROUND

The goal of the current study is to examine the clinical, functional, and radiological results of patients treated with minimally invasive plate osteosynthesis (MIPPO) and indirect reduction.

METHODS

It is a prospective study which was carried out from July 2022 to July 2023 in C.R.Gardi Hospital, Ujjain, Madhya Pradesh. In this study 15 cases of shaft of humerus fractures were managed by minimally invasive plate percutaneous osteosynthesis (MIPPO). The Mayo elbow performance scores and UCLA shoulder performance scores were used.

RESULTS

The patients with an average age of 35.31 years (18-50 years) were selected. The most frequent category of injuries in our study was road traffic accidents (RTAs; 80%). According to the UCLA score, shoulder function was fair in 2 cases (13.4%) and exceptional to good in 13 cases (86.6%).

CONCLUSION

For the treatment of humeral shaft fractures, the anterior bridge technique with a small incision produces good functional outcomes and need to be taken into consideration as a successful, cosmetically improved surgical alternative.

KEYWORDS: Diaphyseal humerus fracture, minimally invasive percutaneous plate osteosynthesis (MIPPO), Anterior Bridge plate.

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INTRODUCTION

Diaphyseal fractures of humerus are very common orthopaedics injuries. Fracture humerus commonly presents in polytrauma cases especially in road traffic accidents and accounts for approximately 3% of all orthopaedic injury.^[1,2,3,4]

The treatment for these fractures is still controversial, attributed to the multiplicity of treatment options. There are numerous ways to treat such fractures, both conservatively and surgically. Conventional Surgical methods include open reduction and internal fixation with plate or close reduction and internal fixation with nail.

Newer method of fixation include biological fixation and relative stability which has an advantage over absolute anatomical reduction as it does not compromise soft tissue and its vascularity.^[1]

The primary objective of any successful treatment outcome is an early and acceptable functional outcome for the limb.

Although they are still controversial, biological fracture fixations with soft tissue preservation and acceptable reduction are becoming increasingly common.

Therefore, concept of biological fixation was developed over a stable mechanical fixation. This is due to development and improvement in the techniques of biological fracture fixation and stabilization systems.⁵

The goal of the current study is to examine the clinical, functional, and radiological results of patients treated with anterior approach minimally invasive plate osteosynthesis (MIPPO) and indirect reduction.

MATERIAL AND METHODOLOGY

It is a prospective study which was carried out from July 2022 to July 2023 in C.R.Gardi Hospital, Ujjain, M.P. A sample size of 15 patients were selected according to the inclusion and exclusion criteria coming to the hospital with fracture of shaft of humerus.

The inclusion criteria included patients with shaft humerus fractures aged 18–50 years.

Exclusion criteria included patients with compound fractures, polytrauma patients with an injury severity score > 20, and patients with a history of chronic illnesses like malignancy, vascular insufficiency of the upper limb, and drug addicts.

A preoperative clinical examination of the affected arm was performed to look for abrasions, swelling, puckering, contusions, abrasions, and neurovascular impairment (especially radial nerve status). AP and lateral view radiographs were examined. These radiographs were also used to determine the proper length of the implant and to plan the procedure. **(Fig. 1 and 2)**



Fig. 1: Pre op Xray AP



Fig. 2: Pre op Xray Lateral

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Operative Technique

The patients were operated in supine position. (Fig. 3) Brachial block was administered to 11 patients, while general anaesthesia was administered to 4 individuals. The affected arm resting over arm board. Closed reduction was attempted under image intensifier guidance to check for the optimal reduction that could be achieved. A 3 cm (approx) proximal skin was made on the anterior aspect. After Superficial dissection and hemostasis control deep dissection was

made between the lateral border of proximal biceps and medial border of deltoid muscle. The dissection was continued until the humeral shaft was seen. A 3 cm (approx) skin incision was made around 5 cm proximal to elbow crease on the anterior aspect of arm along the lateral border of biceps. (Fig. 4) After Superficial dissection and hemostasis control deep dissection was made and biceps muscle was then retracted medially. This exposed the musculocutaneous nerve, which is located over the brachialis muscle.



Fig. 3: Arm position intraoperative



Fig. 4: Proximal and distal incision

The brachialis muscle was split longitudinally with medial half of the muscle along with the musculocutaneous nerve was retracted medially and the lateral half of the muscle was retracted as a protection for the radial nerve. A sub-brachialis extra periosteal tunnel was created using a long stripper such that the two incisions communicate with each other. Next, a 4.5-mm dynamic compression plate was pushed to the anterior surface from distal incision extending upto the proximal

incision(**Fig. 5**) Manual traction and indirect reduction techniques were used to restore the length, correct the varus and valgus angulation and rotation under image intensifier guidance. Post reduction, 2 distal and 2 proximal screws were inserted while maintaining the reduction. Incisions were then sutured in layers using interrupted sutures after saline wash. (**Fig. 6**) Radial nerve was not explored in any of the cases.



Fig. 5: Plate Sliding through incision



Fig. 6: Final closure of wound

The patients were advised to perform intermittent and active assisted range of motion exercises of the shoulder and the elbow from 1st post operative day. Immobilizer brace was removed completely after stitch removal on 14th post operative day. Most of the patients regained painfree full active range of movements of the shoulder at 4-6 weeks.

Patients were advised to come for follow-up post-operatively at,6 weeks, 3 months, 6 months for clinical and radiological assessments.

At 12-monthly post-operative follow up, the patients' shoulder and elbow joint

function were assessed using the UCLA score^[6] and the Mayo's Elbow Performance Score (MEPS).^[7] The UCLA shoulder score was assigned four grades: excellent (34–35 points), good (29–33 points), fair (21–28 points), poor (0–20 points). MEPS was divided into excellent (≥ 90 points), good (75–89 points), fair (60–74 points), or poor (<60 points).

Anteroposterior and lateral radiographs were evaluated radiologically for proof of union. The definition of union is absence of any complication and appearance of bridging callus. (**Fig. 7 & 8**)



Fig. 7: Post Op Xray AP



Fig. 7: Post Op Xray Lateral

RESULTS

The patients in the study with an average age of 35.31 year (18 to 50 years). In our study, we discovered that males account for 9 (60 %) of the incidence, while females account for 6 (40 %) with male to female ratio being 1.5:1. Dominant site involvement was seen in nine patients (60%). The most frequent category of injuries in our study was road traffic accidents (RTAs; 80%) followed by fall (15%) and assault by blunt weapon (5 %). Mean surgical time in minutes was 77.5 (60–120 minutes) and mean

radiation exposure was 98.6 seconds (60–168 seconds). The mean union (radiological) time was 13.2 (10–18 weeks). According to the UCLA score, shoulder function was fair in 2 cases (13.4%) and excellent to good in 13 cases (86.6%). At the one-year post-operative follow-up, 14 patients (93.3%) had an excellent outcome, 1 patient (6.7%) had a good result, and none had a fair or bad result, according to the Mayo Elbow Performance Scoring system. (Fig. 9 & 10).



Fig. 9 and 10: Follow up patient at 1 year

In one case, 3 degree of varus, angulation at the end of 6 months; which did not affect his functional outcome and one has 6degrees of varus with fair functional outcome.

Out of 15 patients, one patient had developed shoulder joint and elbow joint stiffness at 9 months but patient can do his daily routine work without any difficulty.

DISCUSSION

Tscherne and Krettek first reported minimal invasive osteosynthesis for supracondylar femoral fractures in 1996.^[8] Since then Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) is used for treatment of many fractures in human body. As described by Sarmiento et al. the humerus bone has a wide range of acceptability criteria in its reduction and is highly amenable to conservative management or closed reduction as done in our study by MIPPO technique.^[9]

Though there are many ways of treating a patient with shaft humerus fracture, all have some advantages and disadvantages with them. The conservative method preserves the natural vascularity of the bone and surrounding soft tissue around the fractures but this method of treatment has been marred by inadequate fracture reduction and loss of fracture reduction during the course of treatment. This not only leads to difficulties for the patients but lengthens the overall treatment period and also hampers the optimal functional outcome as desired by the patient.

Open reduction and plate fixation has been a widely accepted and popular method of treatment of the fracture shaft of the humerus. This method though popular has its own fallacies like stripping of the already compromised blood supply of the bone and surrounding soft tissue around the fracture. Long incisions are needed for fixation and hence there is increased blood loss during the surgery and also the surgical scar is big. Overall there are increased chances of Non union, infection and iatrogenic nerve injury with this modality of treatment.

Closed reduction and interlocking nailing has also been a popular method of

treatment of the fracture of the shaft of humerus. This modality of treatment does not jeopardize the periosteal blood supply of the fracture ends and is associated with less chances of infection as compared to open reduction and plating treatment. The main problem associated with modality of treatment is that the entry of the nail is made through the rotator cuff. This leads to the damaging of the rotator cuff and leads to shoulder pain and functional disabilities.

Close reduction and flexible nailing has also been a treatment modality for the fracture of the shaft of humerus. Though initially this method was described and performed for paediatric patients, now a days many surgeons are performing this surgery to protect both the fracture end vascularity and avoid damage to the rotator cuff. But the main drawback with this modality of treatment has been lack of rotational control of the fracture fragments leading to unacceptable loss of reduction and increased incidences of malunion. This in turn calls for prolonged immobilization to prevent malreduction leading to more chances of shoulder and elbow stiffness thereby decreasing the overall functional outcome for the patient.

The MIPPO approach offers the best of all the above modalities that is preserving the blood supply of the fracture ends and surrounding soft tissues without damaging the rotator cuff and shoulder function along with stable fixation. This technique uses the plate as an extramedullary splint, fixing the two main fragments while the intermediate zone is left untouched.

The MIPPO approach appears to be repeatable and useful in practically all forms of shaft humeral fractures, despite the need for high surgical competence and the length of time required for learning. Minimal soft tissue dissection, little disruption of bone vascularity, and lower risks of iatrogenic nerve damage are all advantages over traditional plate method. Even though the reduction and plating processes were initially challenging, the surgical expertise improved with time.

One thing was clear from our study: anterior bridge plating of mid-shaft and lower

1/3rd humerus fractures with minimum invasion is a very effective approach to treat such fractures to date. This is due to the great radiological union and the good functional scores in UCLA and MEPS. ABP's primary benefit is that it provides stable fixation without interfering with periosteal supply or soft tissue, hence increasing the predictability of healing and union. Along with producing outstanding radiological and functional results, this approach also prevents the danger of non-union (as in cases of rigid posterior plating) and impingement (as in cases of intramedullary humerus nailing) and damages to the rotator cuff.

CONCLUSION

The present study found a high overall rate of union as well as excellent functional outcomes for the patients with fracture of the shaft of humerus. The minimal incision anterior bridge approach plating for humeral shaft fractures yields good functional results and should be considered as cosmetically enhanced, safe and less time-consuming surgical method in the treatment of shaft humerus fractures.

Limitation of the Study

Small sample size is a limitation of the study. Further larger multicentric studies are required to verify the findings.

On behalf of all authors, the corresponding author states that there is no conflict of interest and patient consent is taken properly.

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Prior consent from patients for this study has been taken.

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