

Original research article

A Comparative Study of MIPPO Versus ORIF with DCP in the Shaft of Humerus Fractures

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Abstract

Background: The optimal technique for the shaft of humerus fractures is a contentious issue. Several techniques from the conservative approach to nailing and MIPPO and ORIF have been in use with varying success. The current study tried to evaluate the MIPPO technique versus ORIF with DCP in mid-shaft humerus fractures based on the overall outcomes.

Methods: The fractures were classified based on the AO classification system into 3 types where type A was simple, spiral, transverse, and oblique fractures, type B included spiral, bending, and fragmented fractures while type C included complex fractures of the humeral shaft. All the operations were performed by the same surgeon. The fractures which extended to shoulder and elbow joints, preoperative radial nerve injuries, and pathological fractures were excluded. The patients were randomly allotted into two groups MIPPO or ORIF using computer-generated random numbers.

Results: Based on the AO classification of fractures Type A was commonly found fracture in n=20(50%) of all cases followed by type B and type C fractures were found in n=10(25%) cases each. DASH questionnaire at the end of 3 months follow-up the dash scores in MIPPO were 19.5 ± 10.2 versus ORIF 20.15 ± 11.4 . At the end of one year, the scores were 8.5 ± 4.2 and 8.33 ± 3.8 respectively. The study of complications shows in the MIPPO group n=2 cases were with complications which included infection in one case and non-union in one case.

Conclusion: minimal percutaneous plate osteosynthesis (MIPPO) technique is superior to ORIF because of the shorter union time, lower rates of complications, and good functional outcome which is similar to traditional ORIF. The quicker healing time makes patients go back to their routine activities early as compared to ORIF. Therefore, MIPPO must be preferably used in feasible cases of shaft of humerus fractures.

Keywords: Humeral mid Shaft fractures; Minimally Invasive Surgical Procedures, Internal Fracture Fixation, Distal compression plate

Introduction

Humeral shaft fractures occur commonly and account for 1- 3% of all the fractures. ^[1] Of these, about 10% are open fractures of which 20% of those are humeral shaft fractures. Incidence is 11.5 per 100,000 people annually or 0.011%. ^[2] The frequency is found peaks at different age groups, in adolescence due to activity/sports-related and in the third decade of life in men because of moderate to severe trauma and then occurs in 5th to 7th decade especially in females

due to simple falls. ^[1,3,4] Humeral shaft fractures are mostly due to fracturing of the diaphysis. The incidence of primary lesion of the radial nerve in association with humeral shaft fracture on average is stated to be around 11.8%.⁵ In more elderly people, humerus fracture occurs most commonly due to a simple fall which is generally proximal, sub-, or infra capital. In women, chances are more due to post-menopausal demineralization of the skeletal bones. ^[1] Isolated humeral shaft fractures are usually treated conservatively although this method can present unsatisfactory results. Recent concepts of internal fixation of long bones shaft fractures advocate relative stabilization technique with no harm to fracture zone. Operative treatment for humerus fractures has usually been reserved for the treatment of non-union, associated forearm fractures, polytrauma, and fractures with neurological complications. The advantages of operative management are early mobilization and patient comfort and compliance. Most of the researchers believe that open reduction and internal fixation with a dynamic compression plate (DCP) is a more reliable method. It has advantages such as anatomical reduction of fractures, lesser interference to elbow and shoulder functions. ^[5, 6] However, the disadvantage is extensive soft tissue stripping and disruption of periosteal blood supply, which increases the risk of non-union and iatrogenic radial nerve palsies. ^[7-9] More recently humeral shaft fractures have been successfully treated with minimally invasive percutaneous plating osteosynthesis (MIPPO). The advantages of MIPPO include lesser soft tissue dissections and avoiding the need to expose the radial nerve, therefore, lower risk of iatrogenic radial nerve palsies. ^[10] Although the advantages of MIPPO are clear there is no large-scale data available. With this background, we in the current study tried to evaluate the functional outcomes of MIPPO versus ORIF with DCP in the shaft of humerus fractures in cases presenting to our hospital.

Material and methods

This cross-sectional study was performed in the Department of Orthopedics, Government Medical College and Hospital, Mahaboobnagar, Telangana State. Institutional Ethical committee permission was obtained for the study. Written consent was obtained from all the participants of the study after explaining the nature of the study in the local language. The fractures were classified based on the AO classification system into 3 types where type A was simple, spiral, transverse, and oblique fractures, type B included spiral, bending, and fragmented fractures while type C included complex fractures of the humeral shaft. All the operations were performed by the same surgeon. The fractures which extended to shoulder and elbow joints, preoperative radial nerve injuries, and pathological fractures were excluded. The patients were randomly allotted into two groups MIPPO or ORIF using computer-generated random numbers. All the routine blood investigations were done, and the fitness of patients was evaluated before surgery. Any associated comorbid conditions were noted. The Surgery was performed under general anesthesia or interscalene block under I.V antibiotic cover of cefazolin 1 gm was given intravenously at the time of induction of anesthesia and was continued for a minimum of 3 days in the postoperative period.

For MIPO operation the patient was in supine or breech position a pad was placed beneath the scapula to elevate the limb, and the arm was draped free to facilitate access to the shoulder and elbow. With the forearm positioned in supination and the elbow flexed 70°, a 3 – 4 cm incision was made 5 cm distal to the acromion along the anterior border of the deltoid muscle and palpable lateral border of the biceps brachii. On the Distal aspect a 3 – 4 cms incision was made on the anterior surface of the arm along the lateral border of the biceps muscle it extended within 5 cms proximal to flexion crease. The biceps muscle was retracted medially to expose the musculocutaneous nerve care was taken to avoid injury to the nerve. In the depth of incision, the brachialis was exposed and split longitudinally to the bone and the medial half was retracted medially with the musculocutaneous nerve and the lateral half retracted laterally to protect the

radial nerve. The sub-brachialis tunnel was prepared over the periosteum deep to the brachialis muscle. To reduce the risk of radial nerve injury care was taken to pass the periosteal elevator anteriorly or anteromedially to avoid using lever retractors and use gentle traction and manipulation for reduction. A dynamic compression plate 4.5 mm with 9 – 14 holes depending on the length of fracture was inserted through the submuscular tunnel from proximal or distal incision based on the location of the fracture and after reducing the fracture by gentle traction abduction a screw was inserted in the distal fragment and quality of reduction was evaluated using an image intensifier. If the reduction was acceptable a second screw was inserted in the proximal fragment followed by one or two screws on each side to secure the fixation.

For patients with ORIF with DCP, a standard anterior approach was used. The patients were in a supine position with the arm abducted on a broad arm board. A midline longitudinal incision of 15-20 cms was made and skin and subcutaneous tissues were incised in the line of incision. The biceps muscle was retracted medially along with the musculocutaneous nerve. Then a plane was developed between the medial and lateral halves of the brachialis muscle and the fracture site was exposed. The fracture site was cleared of the soft tissue and the fracture was reduced and fixed with 8 holed broad nonlocking dynamic compression plate. If the bone was found to be osteoporotic, a locking plate was used to get a better purchase for the screws. In cases of fractures with communication, lag screws were used appropriately after taking care of hemostasis a drain was placed insitu and the wound was closed in layers and a sterile dressing was applied. The drain removal was done on the third postoperative day. The wound was inspected on the third and fifth postoperative days and the sutures were removed on the 12th day. Postoperative radiographs were taken to evaluate the quality of reduction and fixation. At the time of discharge, the patients were advised to continue active mobilization of the shoulder and elbow. The following were one on 1, 3 and 6 months and one year. At the time of follow-up, the evaluation was done radiologically to assess the status of fracture union, and functional assessment was done by using DASH Scores. All the available data was uploaded on an MS Excel spreadsheet and analyzed by SPSS version 19 for descriptive and inferential statistics.

Results

A total of n=40 cases of fractures of humeral shaft presented to our hospital were managed by surgical means and followed up to 2 years post-surgery. The n=40 cases were equally divided into two groups MIPPO group and the ORIF group of n=20 each. In the MIPPO group there were 80% males and 20% females the mean age was 39.5 years depicted in table 1. Based on the laterality of involvement in this group n=13(65%), were involving the right side and n=7(35%), were involving the left side. In the ORIF group out of n=20 cases, 70% were males and 30% were females. The mean age in this group was 40.1 years. The right hand was involved in n=12(60%) cases and the left hand was involved in n=8(40%) cases given in table 1.

Table 1: Demographic profile of the cases included in the study

Parameters	Groups		P-value
	MIPPO	ORIF	
Gender			
Male	16(80%)	14(70%)	0.365
Female	04(20%)	06(30%)	
Age in Years			
Mean ± SD	39.5	40.1	0.217
Range	17 – 54	19 - 58	

Based on the AO classification of fractures Type A was commonly found a fracture in n=20(50%) of all cases followed by type B and type C fractures were found in n=10(25%) cases each depicted in table 2. The commonest cause of the fractures was Road Traffic Accidents (RTA). The average time from fracture to surgery was 3.5 days in MIPPO and 4.0 days for ORIF

Table 2: Classification of fractures and mode of fractures

	Groups		P-value
	MIPPO	ORIF	
AO Classification of Fractures			
A	09 (45%)	11 (55%)	0.157
B	05 (25%)	05 (25%)	
C	06 (30%)	04 (20%)	
Mode of Injury			
RTA	12 (60%)	15 (75%)	0.331
Falling down	06 (30%)	04 (20%)	
Sports injury	02 (10%)	01 (5%)	

The mean duration of surgery was lesser in the MIPPO group as compared to the ORIF group although, the p-values were not found to be significant. The mean intraoperative duration of radiation exposure was 75 seconds to 90 seconds in the MIPPO Group. Similarly, the mean duration of hospital stay was 6.5 days in the MIPPO group. In the ORIF group, the mean duration of surgery was 116.5 ± 10.5 minutes (Table 3). There was no radiation exposure in ORIF since Fluoroscopy was not used. The mean duration of hospital stay was 7.0 days

Table 3: Surgical profile of the cases included in the study

	Groups		P-value
	MIPPO	ORIF	
Duration of Surgery in minutes			
Mean \pm SD	85.5 ± 9.5	116.5 ± 10.5	0.114
Range	68 – 170	75 - 150	
Blood loss in ml			
Mean \pm SD	90.5 ± 15.5	245.5 ± 20.5	0.227
Range	110 - 125	210.5 – 265.0	
Time to fracture Union			
Mean \pm SD	14.5 ± 1.5	16.5 ± 2.0	0.021*
Range	13.5 – 17.0	15.0 -18.0	

* Significant

The functional outcomes were measured by the Quick-DASH questionnaire. [11] At the end of 3 months follow-up, the dash scores in MIPPO were 19.5 ± 10.2 versus ORIF 20.15 ± 11.4 . At the end of one year, the scores were 8.5 ± 4.2 and 8.33 ± 3.8 respectively. The study of complications shows in the MIPPO group n=2 cases were with complication which included infection in one case and non-union in one case (Table 4). In the ORIF group total of n=4(20%) showed complications in which superficial skin infections were seen in n=2 cases and it was settled down well with antibiotics and n=1 patient had neuropraxia of the radial nerve due to excessive retraction. A dynamic cock-up splint was given to the patient and he recovered completely by the end of two months. There were no complications of implant failure encountered in this study.

Table 4: Functional outcome and complications in the study

	Groups		P-value
	MIPPO	ORIF	
DASH Score (mean) ^[11]			
At 3 months	19.5 ± 10.2	20.15 ± 11.4	0.173
At 1 year	8.5 ± 4.2	8.33 ± 3.8	
Complications			
Infection	1(5%)	2(10%)	0.041*
Nonunion	1(5%)	1(5%)	
Nerve injury	0(0%)	1(5%)	

* Significant

Discussion

The management of fractures of the shaft of the humerus is an arduous task due to its involvement with multiple injuries leading to frequent complications. There is no standard approach universally agreed for the treatment. The main aim of treatment is to achieve anatomical alignment and maintain the limb length and preserve the hematoma as well as soft tissue and obtain the best possible functional outcome. S Bhat N et al., ^[12] in a similar study found the mean age 41.1 years. R Kumar et al., ^[13] in their study n=30 cases found the mean age of 45.33 years, and LL Kumar et al., ^[14] in their study in South India found the mean age of 41.4 years for humerus shaft fractures in agreement with the observations of the current study. In the current study, we found out of n=40 cases of shaft of humerus fractures n=30(75%) were males and n=10(25%) were females. The male to female ratio was 3:1. Gongol T et al., ^[15] in their study found 76% were males with the shaft of humerus fractures similarly, A Kasturi et al., ^[16] found 77% of humerus shaft fractures occurred in males in agreement with results of the current study. In this study laterality of involvement showed right humerus was involved in n=25(65%) of all the cases and the left side in n=15(35%) of a total number of cases in the study. S Bhat N et al., ^[12] in their study found out of n=41 cases 64.8% were involving the right shaft of humerus fractures. In the study, the most common cause of humerus fracture was Road traffic accidents 12 cases (40%), the 2nd most common cause was fall from height 9 cases (30%) and the least common cause was domestic violence 3 cases (10%). This helps with the force and type of fracture. The common cause of shaft humerus fractures in this study was Road Traffic Accidents (RTA) 67.5% followed by falls from height in 25% of cases and sports-related injuries in 7.5% (table 2). The other important finding of the current study was the union time was shorter in the MIPPO technique as compared to ORIF significantly and the patients were able to return to routine activities more quickly. An et al., ^[17] studying the results of treatment of mid-distal humeral shaft fractures with ORIF and MIPO in n=33 cases found iatrogenic radial nerve injury occurred in 31.3% cases of patients with ORIF and none in the MIPO group. Their mean union time was 15.29 weeks in the MIPO group and 21.25 in the ORIF group. However, the functional outcomes were similar in both groups. In this study, we found the DASH scores were similar in both the groups at the end of 3 months and 1 year and the p-values were not significant. The humeral shaft fractures in many cases heal effectively with conservative management ^[5, 18] in some cases surgical treatment may be unavoidable. ^[19] Sarmiento et al., ^[8] found that using functional bracing for treating closed fractures of the humeral diaphysis resulted in a high rate of union due to the hydraulic impacts of the soft tissues. But limitations in shoulder and elbow mobility and angular deformities have been seen in functional bracing. ^[5, 8, 19] Intramedullary nailing has shown good results according to some studies. ^[20, 21] but the problems in the insertion of the nail from the humeral head or olecranon fossa can produce shoulder impingement or elbow fracture. ^[22, 23] Therefore, humeral plating is now the commonly used method of treatment of humerus

fractures. [25] MIPPO is increasingly favored by surgeons because of the minimal incision least likely to damage the radial nerve and preservation of fracture site hematoma. The current study has found that the mean union time for the MIPPO group was earlier than the ORIF with a lower incidence of complications. Malhan et al. [26] in a prospective study investigated the outcomes of MIPO using a locking compression plate (LCP) in 42 patients and found that disabilities of arm, shoulder & hand score (DASH score) improved significantly after 1 year.

Conclusion

Within the limitations of the present study, we conclude that the minimal invasive percutaneous plate osteosynthesis (MIPPO) technique is superior to ORIF because of the shorter union time, lower rates of complications, and good functional outcome which is similar to traditional ORIF. The quicker healing time makes patients go back to their routine activities early as compared to ORIF. Therefore, MIPPO must be preferably used in feasible cases of shaft of humerus fractures.

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