

# Intramedullary Nailing Versus Plating for Treatment of Humeral Shaft Fractures in Adults

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## *Abstract*

*Background:* A fracture of the humerus shaft is commonly encountered by orthopedic surgeons and the successful treatment of a humeral shaft fracture demands a knowledge of anatomy, surgical indications, techniques and implants, patient functions and expectations. The aim of the current study was to compare the outcome of interlocking intramedullary nailing versus plating of diaphyseal humeral shaft fracture in adults

*Patients and Methods:* This prospective clinical trial was carried in Orthopedic Department, Zagazig University in Egypt Hospitals and Alwahda Hospital in Libya, on 36 cases with Humeral shaft fractures Group 1: included 18 patients managed by Intramedullary Nailing, Group 2: included 18 patients managed by plating during the period from March 2020 to December 2020. Patients were followed post operatively for union, and clinical assessment was done using The American Shoulder and Elbow Surgeons scale.

*Results:* Radial nerve injury was significantly higher in plate group and delayed union and nonunion was higher in nail with no significant. Excellent represent 72.2% in nail group and 66.7% in plate group, good represent 11.1% of both groups and fair founded 16.7% in plate group and 5.6% in nail group 2 cases were poor in Nail and 1 case was poor in plate Nail group was significantly associated with satisfaction.

*Conclusion:* The intramedullary nail fixation for humerus is treatment of choice in osteoporotic bone, less rate of infection less blood loss, however it associated with higher incidence of shoulder discomfort, and more malunion and non union rate

*Keywords:* Intramedullary Nailing; Intramedullary Platin; Humeral Shaft Fracture; The American Shoulder and Elbow Surgeons scale

## **Introduction:**

Humeral shaft fracture is one of the most common fractures in adults, accounting for approximately 3% of all fracture types. Whether or not surgical intervention is required for humeral shaft fractures remains controversial (1).

Operative treatment is indicated in patients in whom there is failure to maintain stable alignment and reduction at the fracture site, as well as those with severe open fractures, segmental fractures, or fractures associated with neurovascular injury, multiple injury, and floating shoulder or elbow. (2).

In the past few decades, development in internal fixation technique and implant design has occurred, widely expanding the indications for operation and generating new debate on procedure choice (3).

The commonly used fixation techniques include dynamic compression plating and intramedullary nailing. Plating with stable fixation, which is known to provide accurate anatomical reduction, can reduce the risk of malunion but requires wide intraoperative exposure associated with soft-tissue stripping. Furthermore, the over-stripping of soft tissue at the fracture site also lowers the blood supply, which might raise the risk of nonunion or infection (4).

Continuous innovation in the design of intramedullary nails has ensured the clinical application of intramedullary fixation in the treatment for humeral diaphyseal fractures (5).

The aim of the current study was to compare the outcome of interlocking intramedullary nailing versus plating of diaphyseal humeral shaft fracture in adults.

### **Patients and Methods:**

This prospective clinical trial was carried in Orthopedic Department, at Zagazig University hospitals and Alwahda Hospital in Libya, on 36 cases with Humeral shaft fractures. Patients were divided into two groups: Group 1: included 18 patients managed by Intramedullary Nailing, Group 2: included 18 patients managed by plating during the period from March 2020 to December 2020.

The work has been carried out in accordance World Medical Association (Declaration of Helsinki) for studies involving humans before prospective collection of patient's data and after informed consent was obtained from patients.

Inclusion criteria was patients above 18 years of both sexes with humeral shaft fractures. Exclusion criteria was patients with Fracture dislocation, associated neurovascular injuries, Neglected cases, Presence of infection, Pathological fractures or Open fracture Gustilo III.

The following radiographic views were obtained: Anteroposterior and Lateral views. X ray requested for any other suspected injuries including the skull, neck, chest, pelvis, spine and any other limb injuries.

After examination and resuscitation of patient in ER the patient received early primary management in ER as the fractured limb was splinted by U-shaped slab. Analgesic and anti-edematous measures were prescribed. Patients were kept under observation in the hospital till time of surgery with management of any associated injuries and other medical conditions.

### ***Surgical technique:***

#### ***1-Antegrade nailing group***

Simple decompression was performed through a 6-10 cm long curved incision, slightly going ventral to the medial epicondyle avoiding exposure and scar directly over the nerve at sulcus level, along the course of the ulnar nerve. The ligament of Osbourne and the superficial and

deep fascias of the flexor carpi ulnaris muscle were incised. The Struther's arcade or any aponeurosis were not released if the clinical findings did not indicate anything else. The ulnar nerve itself was then retained on its bed and not circumferentially dissected from the surrounding connective tissue.

The point of entry was just medial to the greater tuberosity. The point of an awl was placed over this point then checked with the image to confirm its alignment with the medullary canal, then opening of the medulla was done with medullary finder instrument or by a straight hand reamer. Then a 2.0 mm guide rod was inserted.

The reduction of fracture was usually achieved by adducting the arm with gentle traction. The guide rod was inserted until its bent tip was seen at the fracture site by the image intensifier. The guide rod was then rotated until the tip engaged the medullary canal of the distal fragment. The guide rod was then advanced until its tip rested at end of medullary canal above the olecranon fossa.

We measured the guide rod length prior to insertion then measured the outside part after its insertion and subtracted this part from the whole length of the guide to know the nail length. This was confirmed by measuring the length of the guide wire in the bone using image intensifier.

Sharp end-cutting reamers were used to ream the humerus by screwing them manually without drilling over the 2.0mm guide rod. Reaming was done starting with 6mm reamer and increased by 0.5 mm. Reaming was stopped once the reamer passed into the distal fragment to allow rigid purchase of the distal serrated end of the nail into the distal end of the humerus.

The selected nail was attached to the T handle of the target device, and then the nail was driven gently over the guide rod by screwing and not by hammering. When the nail reached the fracture site, reduction was maintained manually and the nail was advanced by gentle screwing, the guide rod was removed after the nail had entered the distal fragment, the nail was advanced until its tip reached the distal end of the canal or at least 1 cm proximal to the olecranon fossa. The proximal end of the nail should lie 2 mm subchondrally to avoid impingement. **(fig. 1)**

Proximal locking screw and Distal interlocking screw was typically performed. Therefore, the arm has to be placed in a stable position for distal locking under image intensification. It is crucial for a proper free hand interlocking to define the correct position of the arm/C-arm



**Figure (1):** Nail insertion

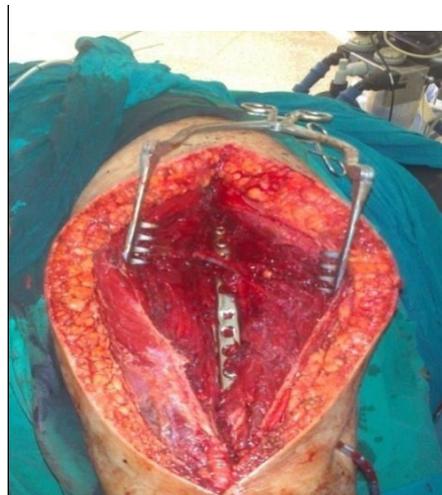
**2-Plate group:**

There are two approaches for plating anterolateral approach for proximal and mid-third shaft fractures while posterior approach for distal one third(6).

**Posterior approach (7)**

Deep fascia of the arm was incised in line with the skin incision. The gap between the lateral and long heads of triceps was identified by fingertip then spitted gently and bluntly. Lateral head was retracted laterally and long head retracted medially.

The medial head of the triceps muscle was exposed deep to the other two heads. The radial nerve was identified just running proximal to medial head and was reflected out of the field, then incision of the medial head in the midline, continuing the dissection down to the periosteum. The posterior aspect of the humerus was exposed. Fracture was manipulated in a trial reduction of the fracture. Application of at least 6 holes DCP and insertion of at least 3 cortical screws distal and another 3 proximal to the fracture site to achieve rigid fixation was done. inter fragmentary screws used if needed.



**Figure (2):** Radial nerve identification and fracture fixation in Posterior approach

**Anterolateral approach: (7)**

The fascia overlying these muscles Incised. The radial nerve lies between the brachialis and brachioradialis muscles. The brachialis and biceps were retracted medially and the brachioradialis laterally. Sub periosteal elevation of the brachialis revealed the humeral shaft underneath. DCP plate applied with 4 screw proximal to fractures and 3 screws below.



**Figure (3):** Antrolateral incision with radial nerve identification

The functional outcome was assessed by clinical examination and scoring systems using following scores:

- 1- The American Shoulder and Elbow Surgeons (ASES) score (8).
- 2- Pain Intensity assessed by Visual Analogue Scale (VAS) in which: 0 implies no pain and 10 implies the worst possible pain. (9)

### Statistical analysis

The data was analyzed by using Statistical Package for Social Sciences (SPSS) software program. The values were noted as mean and standard deviation. In all tests, P value below 0.05 was considered statistically significant.

### Results:

Age was distributed as  $35.5 \pm 9.53$  and  $38.22 \pm 9.24$  respectively between nail and plate groups ranged from 21 year to 54 year for both group. Nail group 11 female (62%) with 7 male (38%) and in plating group 6 female (34%) and 12 male (66%). Heavy workers were 9 (50%) cases in nail group while in plate group were 8 (44%) cases.

Fractures shaft humerus on left side in the nail group were 14 patients while in the plate group were 12, on right side were 4 patients in plate group and 6 in nail group

Ten cases fractures result of road traffic injury in nail group, 6 in plate group while 8 cases in nail group result from RTA and 12 cases in plate group

Type A 9 cases in nail group while plate group 8 cases, 8 cases type B in nail group while 6 in plate group, 4 cases type C fracture in plate group and one case in nail group according to AO classification

Operation time was distributed as  $134.44 \pm 23.52$  and  $155.54 \pm 22.85$  respectively between nail and plate groups and nail group was significantly shorter. Blood loss (cc) during operation was as  $232.78 \pm 77$  with range from 150 to 400 cc in plate groups. While Mean  $\pm$ SD  $87.78 \pm 15.17$  with range from 50 to 110 cc in nail and plate groups and nail group. Blood loss was significantly more for plate group compared to nail group  $p < 0.05$ .

Mean follow up time in plate group was  $5.11 \pm 1.23$  with range from 4 to 8 months. Mean  $\pm$ SD follow up time in nail group was  $5.16 \pm 1.76$  with range from 3 to 10 months, the difference statistically insignificantly  $p > 0.05$ .

Union occurred in all cases fixed by plate undergone the study (100%) while Union occurred in 17 cases undergone the study (94.7%) with one case developed nonunion weeks (5.6%). Union time was shorter in plate group but not significantly as it was distributed as  $14.64 \pm 3.99$  and  $13.26 \pm 3.97$  respect, nonunion and mail union was higher in nail group compared to plate group with no significant difference  $P > 0.05$ . (Table 1)

**Table (1):** Union time (weeks) distribution between studied groups related problems

			Nail Group (N=18)	Plate Group (N=18)	t	p
<b>Time union</b>			14.64 $\pm$ 3.99	13.26 $\pm$ 3.97	1.527	0.098
<b>Delay union</b>	<b>No</b>	<b>N</b>	15	17	1.12	0.281
		<b>%</b>	83.3%	94.4%		

	Yes	N	3	1		
		%	16.7%	5.6%		
Non union	No	N	17	18	0.18	0.54
		%	94.7%	100%		
	Yes	N	1	0		
		%	5.6%	0.0%		
Mal union	No	N	15	18	f	0.229
		%	83.3%	100%		
	Yes	N	3	0		
		%	16.7%	0.0%		

Shoulder movement were significantly better in Plate groups with no other significant difference. (Table 2) Infection was higher in rate in plate group with no significance but radial nerve injury was significantly higher in plate group and delay and nonunion was higher in nail with no significant (Table 3).

**Table (2):** Assessment of clinical outcome distribution between studied groups

		Nail Group (N=18)	Plate Group (N=18)	Mann Whitney/ X2	P	
Pain		0.5±1.04 (0-3)	1 (0-4)	0.64	0.630	
Shoulder movement	Fair	N	5	1		
		%	27.8%	5.6%		
	Good	N	8	5	6.21	0.046*
		%	44.4%	27.8%		
	Full	N	5	12		
		%	27.8%	66.7%		
Elbow movement	Fair	N	2	1		
		%	11.1%	5.6%		
	Good	N	2	5	1.77	0.412
		%	11.1%	27.8%		
	Full	N	14	12		
		%	77.8%	66.7%		

**Table (3):** Complications distribution between studied groups

		Management		X2	P	
		Nail	Plate			
Infection	No	N	16	14	0.80	0.37
		%	88.9%	77.8%		
	Yes	N	2	4		

		%	11.1%	22.2%		
<b>Radial nerve palsy</b>	<b>No</b>	<b>N</b>	18	14	4.52	0.035*
		<b>%</b>	100.0%	77.8%		
	<b>Yes</b>	<b>N</b>	0	4		
		<b>%</b>	0.0%	22.2%		
<b>Delay union</b>	<b>No</b>	<b>N</b>	15	17	1.12	0.281
		<b>%</b>	83.3%	94.4%		
	<b>Yes</b>	<b>N</b>	3	1		
		<b>%</b>	16.7%	5.6%		
<b>Non union</b>	<b>No</b>	<b>N</b>	17	18	0.18	0.54
		<b>%</b>	94.7%	100%		
	<b>Yes</b>	<b>N</b>	1	0		
		<b>%</b>	5.6%	0.0%		

Excellent represent 72.2% in nail group and 66.7% in plate group, good represent 11.1% of both groups and fair founded 16.7% in plate group and 5.6% in nail group 2 cases were poor in Nail and 1 case was poor in plate. Nail group was significantly associated with satisfaction. (Table 4)

**Table (4):** Overall outcome and satisfaction distribution between studied groups

			Management		X <sup>2</sup>	P
			Nail	Plate		
<b>Outcome</b>	<b>Poor</b>	<b>N</b>	2	1	4.18	0.211
		<b>%</b>	11.1%	5.6%		
	<b>Fair</b>	<b>N</b>	1	3		
		<b>%</b>	5.6%	16.7%		
	<b>Good</b>	<b>N</b>	2	2		
		<b>%</b>	11.1%	11.1%		
	<b>Excellent</b>	<b>N</b>	13	12		
		<b>%</b>	72.2%	66.7%		
<b>Satisfaction</b>	<b>Not</b>	<b>N</b>	0	4	4.50	0.034*
		<b>%</b>	0.0%	22.2%		
	<b>Satisfied</b>	<b>N</b>	18	14		
		<b>%</b>	100.0%	77.8%		

## Discussion

The current study aimed to compare the outcome of mid shaft humerus fracture fixation by intramedullary nailing with that of plating to achieve which better for fixation.

The current study was done on 36 patients with diaphyseal fractures of humerus, Among the 18 patients in the plating group the age varied from 21 to 53 years (average being 35years). Posterior approach was used in 8 patients and an anterolateral approach was used for 9patients and anterior approach was used for 1patients (MIPO). Among the 18 patients in

the interlocking nail group, the age varied from 21 years to 51 years (average being 38.05 years). A 7 mm nail was used in 14 patients, whereas 6mm nail was used for 4 patients. Only antegrade nailing was done in nailing group.

**Intraoperative results** of the current study showed that the Operation time was distributed as  $134.44 \pm 23.52$  minutes and  $155.54 \pm 22.85$  minutes respectively between nail and plate groups and nail group was significantly shorter while blood loss in plate group was  $232.78 \pm 77$  milliliter and in intramedullary nail blood loss  **$87.78 \pm 15.17$**  blood loss was significantly more for plate group compared to nail  $p < 0.05$ . Which in agreement with the study of **Saroj et al. 2020(10)**, who reported that average time taken for surgery was 70 minutes interlocking nailing group and 82 minutes for plating with a significant difference between both groups. In contrary **Sena et al., 2019(11)** reported that the mean Operative time was  $2.53 \pm 0.52$  hours in nailing group and  $2.47 \pm 0.52$  hours in plating group with no significant difference between studied groups ( $P = 0.634$ ).

Regarding the **clinical results** which assessed in the current study by **ASES** score and **VAS** score for pain showed that Shoulder movement was full in 5 patients (27.8%), good in 8 (44.4%) and fair in 5 patients (27.8%) in Nail Group, while in plate group, 12 patients (66.7%) were full, 5 patients (27.8%) were good and one patient (5.6%) was fair with a significant difference between studied groups ( $p = 0.046$ ). while in the elbow movement there were 14 patients (77.8%) were excellent, good in 2 (11.1%) and fair in 2 (11.1%) in Nail Group while in plate group there were 12 patients (66.7%) excellent, 5 patients (27.8%) were good and one patients (5.6%) was fair with no significant difference between studied groups ( $P=0.412$ ). regarding the pain score the rang was in nail group.

Which in agreement with the study of **Kelany et al., 2020(12)** reported that regarding Elbow movement, 9 patients (100%) were full in Nail Group while in plate group 6 patients (66.7%) were full, 2 patients (22.2%) were good and one patients (11.1%) was fair with no significant difference founded between studied groups ( $P=0.16$ ) regarding Shoulder and elbow movements. Also, **Pansey et al., 2017(13)** concluded that the range of movements of elbow was not statistically significant ( $P > 0.05$ ).

Regarding **complications**, the current study showed that in nail group there was infection in 2 patients (11.1%), while in plate group there was infection in 4 patients (22.2%) with no significance between studied group ( $P = 0.37$ ) Regarding Radial nerve palsy, the current study showed that there was no incidence of post-operative radial nerve palsy in nail group while in plate group, there were 4 patients (22.2%) with incidence of post-operative radial nerve palsy with a significant difference between studied groups ( $P=0.035$ ). with one case reported with nonunion in nail group (5.6%) and no cases reported in plate group with no significance between studied group ( $P = 0.5$ ).

Which in agreement with the study of **Sena et al., 2019(11)** who reported that in nail group there was no infection, while in plate group there was 2 patients (10%) with infection with no significance between studied group ( $P = 0.146$ ). **Akahn et al., 2020(14)** concluded that two patients in group plate with superficial infections were treated with antibiotics and recovered, no infection was detected in nail group with no significance between studied group ( $p = 0.493$ ).

In contrast to our study, **Kurup et al., 2011(15)** found that there was no difference in incidence of post-operative radial nerve palsy identified in their patients ( $P > 0.05$ ), although their study underpowered to detect differences in this complication rate and others.

Regarding **overall outcome**, the current results showed that excellent results were represented in 13 patients (72.2%) in nail group and in 12 patients (66.7%) in plate group, good represented in 2 patients (11.1%) of both groups and fair founded in 3 patients (6.7%) in plate group and one patient (5.6%) in nail group, while 2 cases (11.1%) were poor in Nail group and 1 case (5.6%) was poor in plate group with no significant difference between studied groups ( $P = 0.211$ ). Which in agreement with the study of **Chandan et al., 2020(16)** who reported that 3 patient (15%) were excellent, 10 patients (50%) were good, 3 patients (15%) were fair and 2 patients (10%) were poor in nail group, while in plate group 3 patients (15%) were excellent, 12 patients (60%) were good and 2 patients (10%) was fair and no poor cases with no significant difference between studied groups ( $P > 0.5$ ). Also, **Sena et al., 2019(11)** where they found 13 patient (65%) were excellent, 4 patients (20%) were good and 3 patients (15%) were poor in nail group, while in plate group 16 patients (80%) were excellent, 3 patients (15%) were good and one patients (5%) was poor with no significant difference between studied groups ( $P = 0.821$ ).

In contrast to our study **Naveen and Chaitanya 2013(17)** reported that among the 11 patients with excellent results, 6 patients were treated by plating and 5 were treated by interlocking nailing. among the 9 patients with good results, 5 patients were treated by plating and 4 were treated by interlocking nailing. among the 8 patients with fair results, 5 were treated by plating and 3 were treated by interlocking nailing and lastly the 6 patients with poor results, 2 belong to the plating group, 4 patients belong to interlocking nailing group with a significant difference between studied groups ( $P = 0.010$ ), where the plating group showed better results than the interlocking nailing group.

Also, contrary to our results **Saroj et al., 2020(10)** found in nail group ( $n = 20$ ) 2 (10%) were excellent, 6 patients (30%) were good, 8 patients (40%) were fair and 4 patients (20%) were poor, while in plate group ( $n = 18$ ) 8 (44.5 %) were excellent, 6 patients (33.3%) were good, 2 patients (11.1%) were fair and 2 patients (11.1%) were poor, with a significant difference between studied groups ( $P = 0.024$ ).

the current study showed that **satisfaction** was reported in 18 patients (100%) in Nail group, while in plate group satisfaction was reported in 14 patients (77.8%) and 4 patients (22.2%) were unsatisfied and Nail group was significantly associated with satisfaction ( $P = 0.034$ ). In agreement with our results, the study of **Sahni et al., 2015(18)** who found that 25 patients (96%) in Nail group were satisfied while in plate group 27 patients (93.3 %) were satisfied with no significant difference between both groups.

In contrary to our results the study of **Kelany et al., 2020(12)** who reported that satisfaction was reported in 9 patients (100%) in Nail group, while in plate group satisfaction was reported in 7 patients (77.8%) and 2 patients (22.2%) were unsatisfied with no significant difference between both groups.

We can summarize that midshaft fractures humerus in adults could be fixed by either intramedullary nailing or plating. Selection of treatment for these fractures should be based on patient factors (e.g., age, sex and occupation), fracture morphology, location, soft tissue

injury, and surgeon preference. Either method, properly selected and performed, could lead to successful results in a large majority of patients

### Conclusion:

The plate fixation allows for anatomical reduction, high union rate but it associated with more blood loss and higher infection rate and so, the intramedullary nail fixation for humerus is treatment of choice in osteoporotic bone, less rate of infection less blood loss, however it associated with higher incidence of shoulder discomfort, and more malunion and nonunion rate.

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