

## A PROSPECTIVE COMPARATIVE STUDY OF FUNCTIONAL OUTCOME IN PATIENTS TREATED WITH INTERLOCKING NAILING AND DYNAMIC COMPRESSION PLATING FOR FRACTURE SHAFT OF HUMERUS IN ADULTS

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### ABSTRACT

**Objective:** The purpose of this study is to compare the functional outcome between patients who underwent intramedullary interlocking nailing treatment and those who had Dynamic Compression plating applied to the fractured shaft of the humerus.

**Methods:** A prospective comparative study involving 30 people who had humeral shaft fractures was carried out. Fractures treated at the Department of Orthopaedics, Pacific Medical College and Hospital, Udaipur, between December 2020 and November 2022 using intramedullary interlocking nailing and Dynamic Compression plating.

**Results:** According to our analysis, there is no appreciable difference in the fracture union times between the two techniques. The incidence of infection was greater in the plating group than in the patients who received closure reduction and an interlocking nail procedure.

**Conclusion:** The interlocking nail group in our study reported higher complications. The majority of them involved excruciatingly poor shoulder function. However, both treatment techniques' secondary complications a group of interlocking nails were more common than they should have been. I, therefore, come to the conclusion that patients can be treated with dynamic compression plating and interlocking nailing for a fractured humerus shaft. Intramedullary interlocking nailing is a safe and effective alternative therapy of diaphyseal fractures in the humerus. It can be used by those who have osteoporosis segmentation-and polytrauma-affected fractures.

**Keywords:** Interlocking, Nailing, Dynamic compression plate, Fracture, Shaft of humerus.

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### INTRODUCTION

1%–3% of all fractures are humeral shaft fractures. In addition, this fracture is one of the most frequently occurring fractures. These fractures occur due to vigorous trauma. Mainly, the middle-third part of the shaft of humerus exhibits trauma. Historically, nonoperative care has been used to treat humeral shaft fractures with a brace or hanging cast. Sarmento *et al.*, noted the utilization of the early introduction of functional activity in a plastic sleeve. However, the non-operative disadvantage of treatment includes long-term cast immobilization or a brace, which occasionally may be needed for up to 6 months and results in massive morbidity. Furthermore, not all fractures of the shaft of the humerus may be treated a conservatively. Wide range of conservative management is available. These are: (1) A splint for coaptation this method is recommended when fractures have little shortening. Even for transverse or oblique fracture that appears brief. The drawbacks are Patients' axilla can get irritated, and splints can slip. (2) Velpeau bandage It is recommended for fractures that are not displaced or only minimally displaced. Do not need reduction (3). Hanging arm cast is indicated for shortening and displacement of the midshaft of the humerus, especially oblique or spiral fracture patterns. The patient must stay standing erect, or always maintain a semi-upright position. To be effective, the cast must be in a dependent position. (4). Effective bracing to create and sustain this, hydrostatic soft tissue compression is used while permitting motion in nearby joints. fracture alignment Typically, it is administered for 1 or 2 weeks following the use of a hanging arm cast to treat the fracture or splint for coaptation. The surgical options that are accessible are first, plate osteosynthesis second, intramedullary nailing third, external fixation the gold standard for fixing fractures is plate osteosynthesis. Humeral shaft fractures in comparison to other fixation techniques. Yet this significant soft-tissue dissection, made

more challenging with the nearer radial nerve and risk of osteoporotic bones breakage in later life. Biomechanically, an excellent implant is an intramedullary interlocking nail. These Nails seem less likely of failure since they are subjected to smaller bending loads fatigue. They serve as stress-shielding and load-sharing mechanisms. When there is cortical osteopenia that is immediately close to intramedullary nails, rarely do plates have ends. The likelihood of refracture upon implant Removal occurs less frequently. It does not call for a lot of soft-tissue dissection, but it is fixed securely and rotational control. You can accomplish it by A retrograde or antegrade approach Indications for closed intramedullary nailing include fractures of the humeral shaft has several fractures and overlying burns individuals who have pathological fractures, osteoporotic bone. The interlocking nail system's advancement has significantly increased indication's scope. Currently, the humeral shaft has a communication fracture. Interlocking nails that can be used to treat bone loss rotational alignment and control length. Only in compound fractures external fixation is being used as a form of treatment. However not used as a definitive fixing technique. To compare the functional outcomes of each repair approach, a study was done to evaluate the outcomes of thirty instances. To treat the fracture in the humeral shaft, two different procedures were used (dynamic compression plating and interlocking nailing).

### METHODS

The Department of Orthopedics at Pacific Medical College and Hospital, Udaipur, treated 30 patients with shaft of humerus fractures using Intramedullary interlocking nailing and Dynamic Compression plating between December 2020 and November 2022. Study Center-Pacific Medical College and Hospital, Udaipur, Rajasthan, with a diagnostic standards at least two of the following

are present (1) Severe pain and discomfort in the abdomen that could be pancreatitis. (2) Three times the typical levels of serum lipase/ amylase. (3) USG and/or CT imaging results that are indicative of acute pancreatitis.

#### Inclusion criteria

(1) A patient who is at least 18-years-old. (2) All patients who have been treated with interlocking nails as well as dynamic compression plate (DCP) for shaft of humerus fractures (3) Humeral shaft fractures that are recent (4) Patients over the age of 18 (5) Fractures 3 cm above the olecranon fossa and 2 cm below the surgical neck (6) Numerous wounds (7) An angle  $>15^\circ$ .

#### Exclusion criteria

(1) Patients are handled gently. (2) Humerus intra-articular fracture (3) Patients under the age of 16. (4) Open body (5) Humeral Diaphysis fractures affecting the Proximal 2 cm and Distal 3 cm

#### Methodology

(1) The Ethics Committee's blessing was obtained (2) Patients who met the inclusion criteria gave their informed consent. (3) In accordance with the case record pro forma, this study was carried out by taking a thorough history, a clinical examination, etc.

#### Study procedure

Management of every case is first examined for head injuries and other related injuries. U-slab was used for initial management up until the patient was surgically fit.

#### Implants that we used for nailing

Intra medullary humeral nail employed in our investigation is a tetramer product. They come in diameters of 6 mm for solid, non-cannulated nails and 7 mm and 8 mm for cannulated nails. These can be inserted over a guide wire that is 2.4 mm thick. Nails are available in a range of lengths from 160 mm and going up in 10 mm increments. From the lateral to medial direction, proximal locking is offered. For 6.0 mm solid nails, there are two proximal locking points, both of which are static. For 7 mm cannulated nails, proximal locking points are dynamic and the distal locking points are static. Anterior to posterior is the orientation of the distal locking. From the larger tuberosity's tip to three centimeters above the proximal end of the olecranon fossa, a full-length X-ray is used to estimate the nail size. Clinically, it is calculated by subtracting 5 cm from the distance between the lateral epicondyle of the humerus and the acromion. The scanogram is the most effective way. All nail sizes must be available, as must the necessary equipment. C-arm as well as a skilled technician are essential.

#### Antegrade humerus nailing by closed method patient's position

A sandbag is placed under the patient's shoulder while they are lying supine on a fracture table, and then the entire upper limb is prepared as well as draped.

#### Anesthesia

Using regional blocks or general anesthesia.

#### Approach

Using the image intensifier and the lateral deltoid splitting approach the entry point is situated at the junction of the head's articular surface and larger tuberosity, just medial to the latter. A Rotator cuff is then being exposed as well as separated at the level of supraspinatus muscle after deltoid is split. Just medial to the larger tuberosity, the humeral head is entered using an entry point reamer enlarged. Through the entrance location, a 45 cm guide wire is inserted and advanced into the distal fragment. Closed reduction was carried out with C-arm image intensifier's supervision. The required

nail size was gradually increased by up to 1 mm above the guide wire. Inserting nails on the zag, the proper nail is attached before being threaded through the guidewire. It is important to choose the nail size carefully because a larger nail can be splintered into distal piece. The nail has been pulled back until it no longer protrudes through the Proximal humerus' articular surface. Proximal locking the sizes of the nails are non-cannulated 6 mm, cannulated 7 mm, and cannulated 8 mm. With 3.00 mm drill bits, 4.5 mm self-tapping locking screws served as distal locking. Antero-posterior locking is used in distal locking. The Brachialis muscle and biceps muscle are separated to reveal the bone's surface with the stab incision on the anterior portion of forearm under the directions of an image. The distal screws are inserted using the proper drill bit under the direction of an image. Nearby Locking A proximal jig, which is mounted using a nail, is used for this. The axillary nerve must be avoided at all costs. The mediolateral plane contains the proximal locking. After-operational protocol an arm sling is used to support the limb just after surgery. On the second post-op day, wound inspection was performed. Suture removal on day 12 following surgery. On the 3<sup>rd</sup> day, active shoulder as well as elbow exercises were begun with physiotherapist's guidance.

Surgical techniques of plating. Wide, 4.5 mm DCP is the plate that is most frequently used to fix humeral shaft fractures. On rare occasions, a 4.5 mm DCP is used for small bone which is the optimal treatment for oblique/spiral fracture. Transverse fractures are best treated with a compression plating technique, whereas the construction including lag screw and a neutralization plate. Procedure: Anesthesia: General/ Regional Block.

#### The patient's position

The patient is put on a lateral position in which forearm is dangling by the side and elbow is flexed. Approach POST r arrangement an incision was created in the midline, running from the olecranon's tip to the humeral head. The triceps fascia is dissected all the way down, and it is then cut. To enable mobilization, the radial nerve is recognized and both proximally as well as distally released. The fracture site is made visible once triceps is excised from the periosteum after that fragments of fracture are reduced as well as secured with bone clamps/lag screws after the fracture ends have been freshened. A 4.5 mm narrow/broad DCP is then used to fix it in neutralization or compression mode. The 2<sup>nd</sup> post-operative day saw a wound examination according to post-operative protocol. Suture removal was completed on the 12<sup>th</sup> day, and the patient was able to tolerate activity in the shoulder and elbow from the third to the 4<sup>th</sup> day after the discomfort subsided.

#### RESULTS

There were 30 patients who were randomly nailing group and to plate osteosynthesis group.

The majority of the cases in both groups were found to due to accidental fall (58%) and due to road traffic accidents (42%).

Right side was found to be involved in majority of cases 70% and left side involvement was found in only 30% of cases.

The following factors were compared between plate osteosynthesis and interlocking nailing

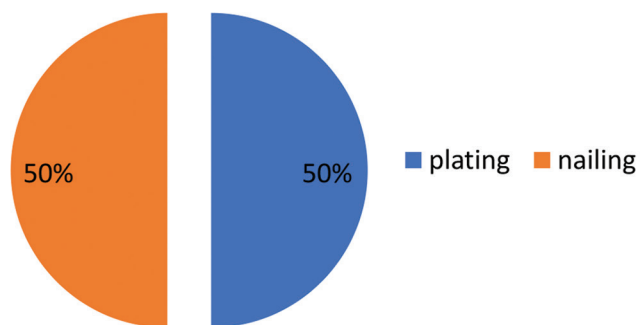
1. Time taken for fracture Union
2. Functional outcome
3. Complications

#### Time taken for fracture union

The interlocking nailing group was found to have a minimum time for union of 16 weeks with a maximum of 28 weeks with an average time for union was at 22 weeks and for plate osteosynthesis group it

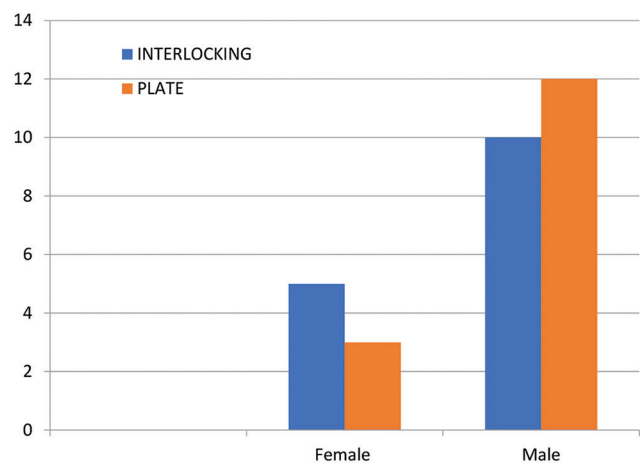
**Table 1: Distribution of patients**

Plate osteosynthesis, n (%)	Interlocking nailing, n (%)	Total, n (%)
15 (50)	15 (50)	30 (100)



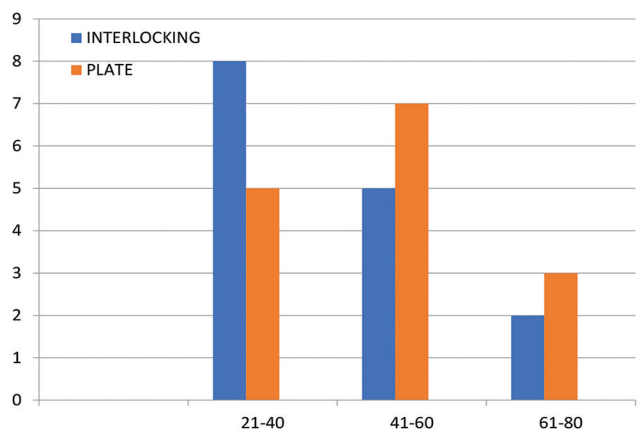
**Table 2: Sex of the patients**

Patients	Interlocking nailing	Plate osteosynthesis	Total
Female	5	3	8
Male	10	12	22
total	15	15	30



**Table 3: Distribution of patients**

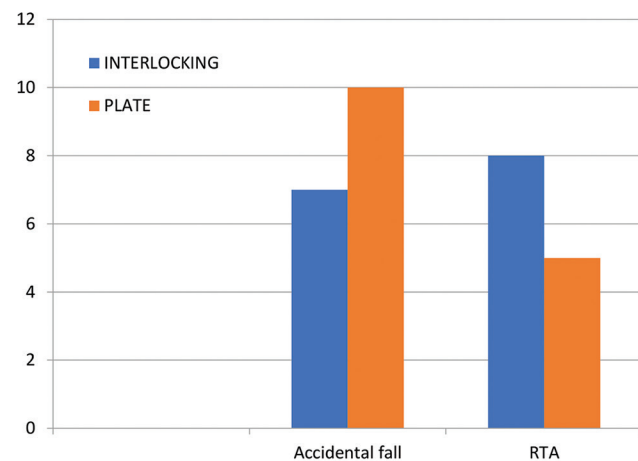
Age	Interlocking nailing	Plate osteosynthesis
21-40	8	5
41-60	5	7
61-80	2	3



**Table 4: Mode of injury**

Patients	Interlocking nailing	Plate osteosynthesis	Total
Accidental fall	7	10	17
RTA	8	5	13
total	15	15	30

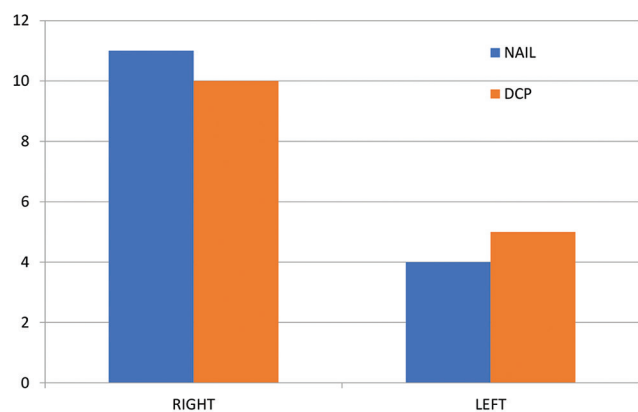
RTA: Road traffic accident



**Table 5: Side of injury**

Side of injury	Nail (%)	DCP (%)	Total (%)
Right	11 (73.33)	10 (66.6)	21 (70)
Left	4 (26.67)	5 (33.3)	9 (30)
Total	15 (100)	15 (100)	30 (100)

DCP: Dynamic compression plate



was 16 weeks minimum and 24 weeks maximum with an average of 20 weeks.

**Functional outcome**

Interlocking nailing group

**Shoulder ROM**

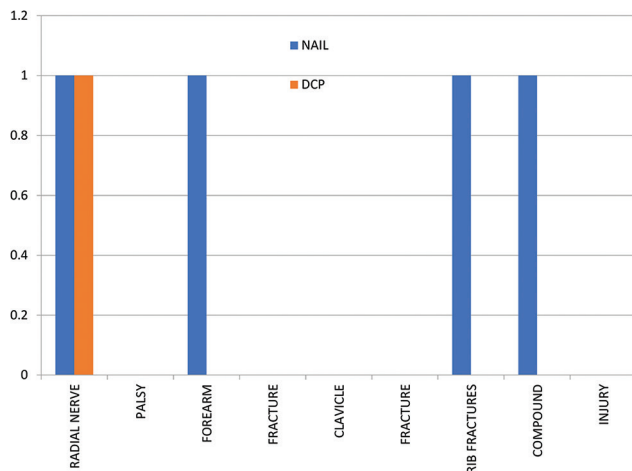
It was found that range of movement of shoulder joint was excellent and good in 83% of cases and it was found to be fair in only 16% of cases.

**Elbow rom**

The elbow function was found to be excellent in 86.6% of cases and good recovery was found in 13.3% of cases.

**Table 6: Associated injury**

Associated injury	Interlocking nailing	Plate osteosynthesis	Total
Radial nerve palsy	1	1	1
Forearm fracture	1	0	1
Clavicle fracture	0	0	0
Rib fractures	1	0	1
Compound injury	1	0	1
Total	4	1	5



**Table 7:**

Surgical procedure	Time taken for union (weeks)		Average (weeks)
	Minimum	Maximum	
Interlocking nailing	16	28	22
Plate osteosynthesis	16	24	20

**Table 8: Rodriguez merchan criteria**

Rating	Elbowrom	Shoulderrom	Pain	Disability
Excellent	Extension 5 Flexion 130	Full rom	None	None
Good	Extension 15 Flexion 120	<10% loss of total rom	Occasional	Mild
Fair	Extension 30 Flexion 110	10-30% loss	With activity	Moderate
Poor	Extension 40 Flexion 90	>30% loss	Variable	Severe

Plate osteosynthesis group

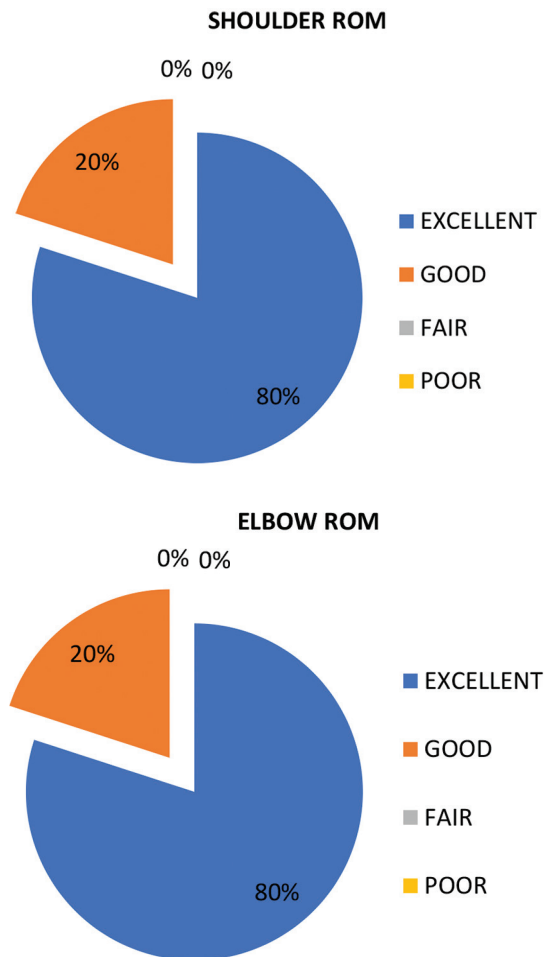
Shoulder ROM

It was found that range of movement of shoulder joint was excellent and good in 80% of cases and it was found to be good in only 20% of cases.

Elbow ROM

The elbow function was found to be excellent in 80% of cases and good recovery was found in 20% of cases.

Plate osteosynthesis group



**Complications**

Postop complication.

**DISCUSSION**

The gold standard of care for treating femoral and tibial shaft fractures is intramedullary nailing. However, there is disagreement over the best course of action for humeral shaft fractures this research's goal. In the case of humerus fractures, contrast the functional results and fracture union rates between patients who underwent plate osteo-synthesis and patients who underwent nailing. The patients in these studies range in age between 20 and 70 years old, in which mean age is 45 years. The major portion of patients with fracture of humerus seems to be men, and injuries to both groups are typically caused by auto accidents in roughly 70% of cases. Non-union rates following plating have ranged in between 2% and 4%.

The techniques for fixing the humerus's immobilization are unchanged throughout a number of years. Egypt is seen in the Edwin Smith Papyrus from about 1600 BC. Originally described using splints made of to treat three humeral shaft fractures. Alum, honey, and cloth Greeks wrote about that 1300 years later in De Fracturis (400 BC), outlined weighted traction for closed reduction and talked about splinting techniques using bandages soaked in an ointment called cerate consisting of reduced lard combined with wax. There are several splinting techniques that have gained popularity, including Modified Velpeau dressings, Thomas arm splints, a hanging-arm cast Coaptation splints, shoulder spica casts, and splints that resemble an abduction. Despite the many ways stated, stabilization's fundamental idea never changes unchanged. Functional bracing was first described by Sarmiento et al., significant progress was

Table 9: Comparison of rodriguez merchan score

Results	Nailing	DCP	Total
Excellent	4	6	10
Good	5	4	9
Fair	2	3	5
Poor	4	2	6
Total	15	15	30

DCP: Dynamic compression plate

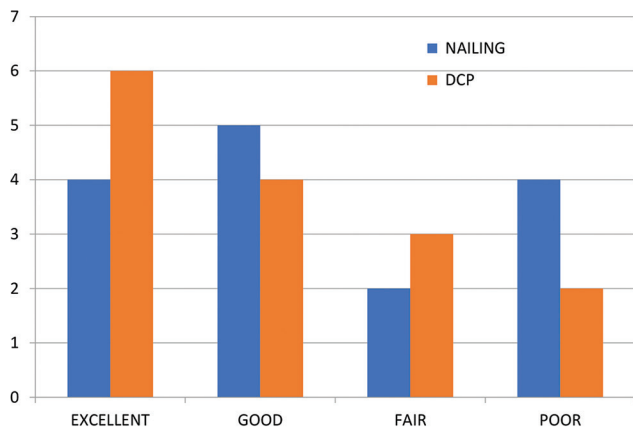
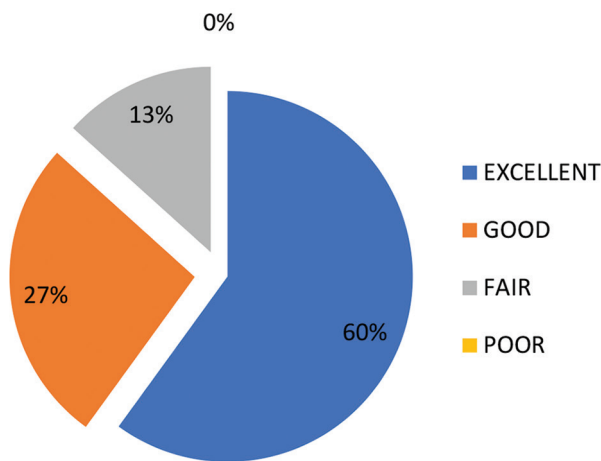


Table 10:

Rating	Percentage
Excellent	9 (60)
Good	4 (26.67)
Fair	2 (13.33)
Poor	-



made, ushering in the contemporary era of splinting. Functional bracing has become the gold standard for definitive care of the majority of midshaft humeral fractures since it was first established. Dr. J.A. Caldwell first provided a description of the hanging cast in 1933. Fracture in the humerus [1,2]. The plaster circle used in the hanging cast is circular. Bandage covering the upper extremity's top third to the elbow It holds the elbow at 90° of flexion and is supported from its neck by a wrist sling. 1982 saw George [3]. According to Balfour et al., diaphyseal fractures of A ready-made fracture brace can treat humerus effectively [4]. Co-optation splints were applied to stabilize the humerus fracture. and it was dependent method-based. The functional brace management system created in 1977 by Sarmiento et al. It was reported that humeral shaft fractures had a high rate of union and excellent healing. Functional outcomes for a fractured humerus, surgical intervention was

Table 11:

Rating	Percentage
Excellent	13 (86.6)
Good	2 (13.3)
Fair	-
Poor	-

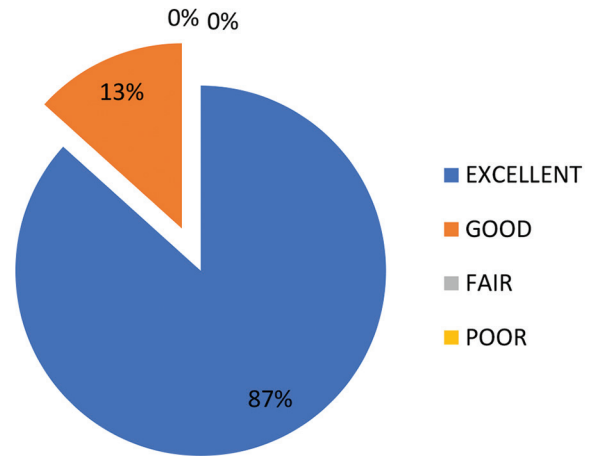


Table 12:

Rating	Percentage
Excellent	12 (80)
Good	3 (20)
Fair	-
Poor	-

Table 13:

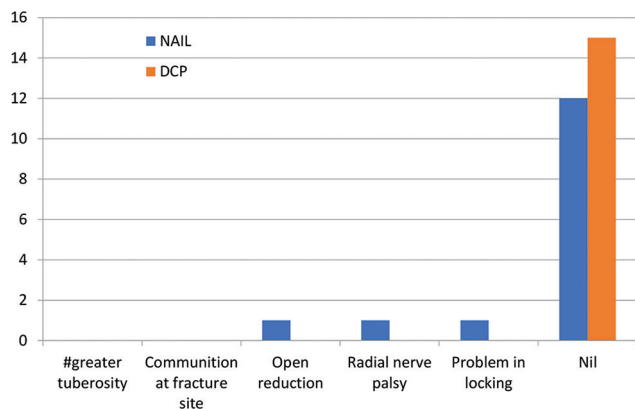
Rating	Percentage
Excellent	12 (80)
Good	3 (20)
Fair	-
Poor	-

recommended by Balfour et al., and Klernerman et al., [4] discovered that the value alignment of despite not being detected, >150 was unsatisfactory in terms of appearance to be functionally impaired in any way. Bell et al., found that plating humeral shaft fractures in patients with numerous wounds can produce excellent results [5]. In a retrospective analysis of 237 cases, Bleeker et al., discovered that the occurrence after surgical stabilization, the incidence of delayed union was low [6]. The unreamed humeral nail was discovered to be superior by Blum et al., Implant for these fractures and discovered that plating was preferable. Nil is a biological sort of stabilization with little osteo-synthesis in that way. Invasion of soft tissues with little endosteal and periosteal damage blood supply damage [7]. In 1961, Muller created a plate that could be compressed using a plate using an external compression tool. Using a self-compressing plate, oval-holed semi tubular plate [8,9]. DCP research was reported for By Allgower and Davos, rigid internal fixation was achieved [10,11]. It was created with screw holes at the edge of the plate hole to boost its strength compression. The screw hole could be angled in order to produce screwed through the plate inter-fragmentarily. Foster et al. from did a multicentric investigation that looked at in 96 patients who received AO plating treatment between 1976 and 1983, they discovered and in 27 cases, there was a 100% union with an excellent functional outcome [12]. Rush brothers recommended nailing the humerus intra-medullary; In cases of proximal diaphyseal fractures, elastic nails were employed [13]. Its foundation was it is based on the three-point fixation

**Table 14: Intra-operative complications**

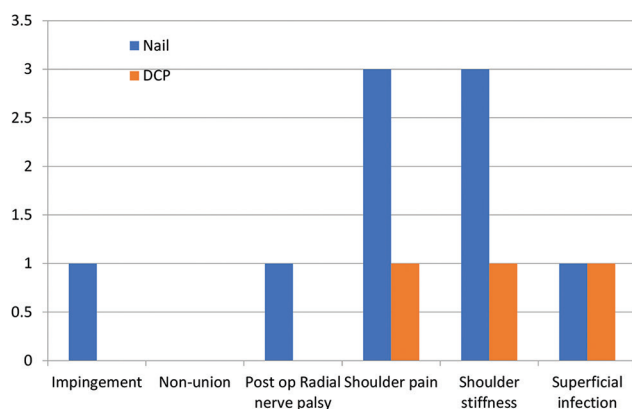
Intraoperative complications	Nail	DCP
Greater tuberosity <sup>#</sup>	0	0
Communion at fracture site	0	-
Open reduction	1	-
Radial nerve palsy	1	0
Problem in locking	1	-
Nil	12	15

DCP: Dynamic compression plate

**Table 15:**

Postoperative complication	Nail	DCP
Impingement	1	-
Nonunion	0	0
Postoperative radial nerve palsy	1	0
Shoulder pain	3	1
Shoulder stiffness	3	1
Superficial infection	1	1

DCP: Dynamic compression plate



technique in the intramedullary canal. In 1978, Ender developed flexible intramedullary nailing for long bones fractures. 18 humeral fracture patients were operated on by Leutenegger *et al.* [14,15]. shaft fractures treated with open reduction and AO plating for internal fixing method. These fractures were fixed using broad DCP. They discovered 17 patients had successful bone repair with satisfactory functional results. Brumback *et al.*, [8] discovered in 1986 that intramedullary nailing of It was discovered that the humeral shaft provided great outcomes with little loss of providing stability for blood and neurovascular systems while mobilization.

In this study, incidence of non-union came 0% in the DCP group. Non-union was reported to occur in interlocking nails in a range of 0-8%.

The incidence was found to be zero in our investigation. According to our study, there doesn't seem any discernible difference between the average period of union 22 weeks for the nailing group as well as 20 weeks for the compression plating group between two groups. Comparable studies by Ragavendra *et al.*, investigated 31 patients in total and found no discernible difference between the bony union of the plating group and the nailing group. It was shown that 6-15% of humeral shaft fractures were associated with radial nerve palsy and incidence was determined to be 12.5% in our study. All cases were successfully resolved, which is comparable to Seddon and Pollock's series of 70% and 68%. There were no occurrences of postoperative radial nerve palsy in the plating group, while the incidence of the condition ranged from 2% to 5%. The incidence of postoperative radial nerve palsy in the interlocking group ranged from 2.6% to 14.3%, according to numerous investigations. In our study, there seemed just 1 instance of post operative radial nerve palsy in the interlocking nailing group, and that patient fully recovered. In our study, there was no issue with infection, however one person had a superficial infection that went away with medicines. 7.7-10% of interlocking nails were inserted with intraoperative communion. No intraoperative communication was observed during our trial. In this study, 3 out of 12 patients (or 25%) experienced shoulder pain as a result of nail impingement.

### CONCLUSION

According to our analysis, there is no appreciable difference in the fracture union times between the two techniques. The incidence of infection was greater in the plating group than in the patients who received closure reduction and an interlocking nail procedure. Restricted shoulder motion is a common complaint among patients in the nail group, which can be brought on by both a torn rotator cuff and an obvious nail tip at the entry site.

1. Since interlocking nails are placed beneath a C-arm image intensifier, open fracture reduction is not required
2. Little to no cutting of fragile tissues.

The fracture site doesn't receive enough compression, which is one of the drawbacks.

1. Distraction at the fracture site due to an improper nail length
2. Impingement brought on by a nail that protrudes from the piercing point
3. Radioactive pollution.

The fact that plating adequately compresses the fracture site is one of its advantages.

1. No additional procedure is necessary
2. Less non-union action is occurring.

The drawback is that more soft tissue dissection is needed.

1. Carefully separate the radial nerve
2. The danger of infection is increased.

The interlocking nail group in our study had more issues overall, the bulk of which were caused by uncomfortable, diminished shoulder function. Even though both treatment methods had identical union rates, the interlocking nailing group had more secondary issues. I therefore come to the conclusion that dynamic compression plating and interlocking nailing can be used to treat patients with humerus shaft fractures. Intramedullary interlocking nailing is a reliable and effective method of treating humeral diaphyseal fractures. It can be used by those who have osteoporosis, polytrauma, or segmental fractures.

### AUTHORS CONTRIBUTION

HL, AS, BR: Conceived and designed the study, conducted trial, provided research material, and collected organized data and provided manuscript. PS: Wrote initial and final draft. Both authors have critically reviewed and approved the final draft and are responsible for the content and similarity of index of manuscript.

**CONFLICTS OF INTEREST**

There were no conflicts of interests between authors.

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