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Functional outcome in patients treated with interlocking nailing and dynamic compression plating for fracture shaft of humerus in adults

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Abstract

Fractures of the humeral shaft accounts for 1 to 3% of all fractures and it is one of the common fractures. They are caused by high energy trauma and most commonly seen in Middle third of the shaft. Traditionally humeral shaft fractures have been treated non-operatively with hanging cast or brace. But the non-operative treatment has disadvantages of prolonged immobilization in cast or brace which sometimes may be required as long as 6 months resulting in huge morbidity. So various Surgical options were made available including Plate osteosynthesis, Intramedullary nailing and External fixation. In this study we are reporting functional outcome of various surgical fixation available for managing Fracture Shaft of Humerus.

Keywords: Humerus fracture, interlocking nail, plate Osteosynthesis, functional outcome

Introduction

Plate osteosynthesis is considered as gold standard of fixation of humeral shaft fractures comparing with other methods of fixation. But this requires extensive soft tissue dissection and complicated by the proximity of the radial nerve and the risk of mechanical failure in osteoporotic bones in old age.

Intramedullary interlocking nail is a better implant biomechanically. Nails are subjected to smaller bending loads and are less likely to fail due to fatigue. They act as load sharing and stress shielding devices. In cases of intramedullary nails, Cortical osteopenia that occurs right adjacent to the ends of plates is rarely seen. Thus chances of re-fracture after implant removal is less often seen. This does not require extensive soft tissue dissection with stable fixation and rotational control. It can be done by ante grade or retrograde manner.

External fixation is used only as a method of treatment in compound injuries and not used as a method of definitive fixation.

So, a study was undertaken to evaluate the end results of twenty-four cases to compare the functional outcomes of each method of fixation (dynamic compression plating and interlocking nailing) for the fracture shaft of Humerus and to analyse the difference in the results of these two methods.

Aim of the Study

The aim of this study is to compare the Functional outcome in patients with fracture shaft of the humerus treated with Dynamic Compression plating and those treated with Intramedullary Interlocking nailing.

Materials and Methods

This is a prospective comparative study of 24 patients with humeral shaft fractures treated with Intramedullary interlocking nailing and Plate osteosynthesis done in the Department of Orthopaedics, Government Stanley Medical College from June 2012 to September 2013.

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Inclusion Criteria

- Acute fractures of humeral shaft
- Patients aged above 18 years
- Fractures 2cm below surgical neck and 3 cm above olecranon fossa
- Multiple injuries
- Angulation more than 15 degrees

Exclusion Criteria

- Open physis
- Age less than 18 years
- Fractures involving Proximal 2cm and Distal 3cm of the humeral Diaphysis

Management

All cases are initially assessed for head injury and other associated injuries. Initial management was done with U – slab till the patient is fit for surgery.

Implant Used For Interlocking Nailing and Plating

The nail used in our study is Tetramed intra medullary humeral nail. They are available in diameters of 6.0mm which are non cannulated solid nails and the 7.0mm, 8. 0mm cannulated nails. They can be inserted over 2.4 mm thick guide wire. The nails are available in various lengths starting from 160 mm onwards at increments of 10 mm. The Proximal locking is provided from lateral to medial direction. The Proximal locking are 2 in number and both are static for the 6.0mm solid nails and the Proximal being dynamic and Distal static for the 7.0mm cannulated nails. The Distal locking are in the antero posterior direction.

The nail size is measured with the full length x-ray from tip of greater tuberosity to 3cms above the Proximal tip of olecranon fossa. Clinically it is measured by subtracting 5 cms from the tip of acromian to the lateral epicondyle of humerus. The best method is by a scanogram. It is a must to have all nail sizes and appropriate instrumentation. It is mandatory to have the C- arm image intensifier and a good technician.

The most commonly used plate for fixation of humeral shaft fractures is the broad, 4.5-mm dynamic compression plate, occasionally narrow, 4.5-mm, DCP is used for smaller bones. For spiral or oblique fractures, the ideal construct consists of a lag screw with a neutralization plate, whereas transverse fractures are ideally suited for a compression plating technique.

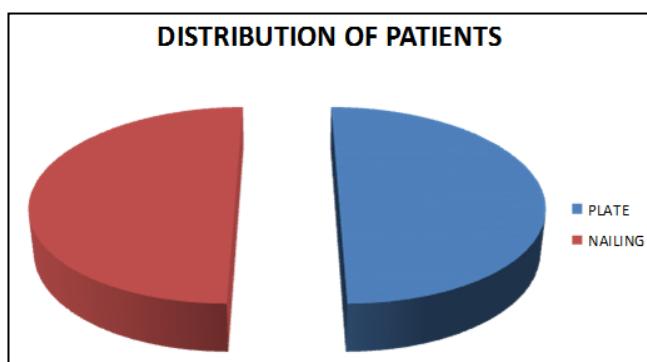
**Observation and Results****Table 1:** Distribution of Patients

Plate Osteosynthesis	Interlocking Nailing	Total
12(50%)	12(50%)	24(100%)

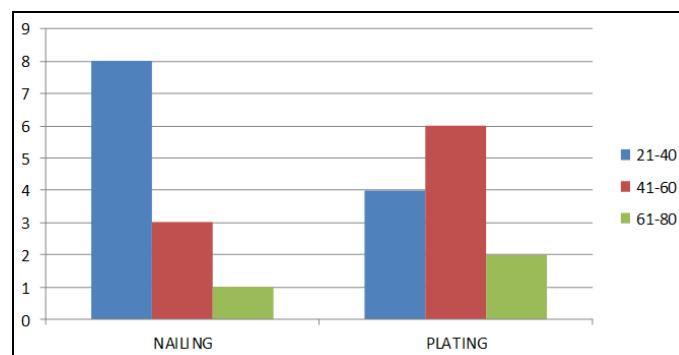
There were 24 patients who were randomly allotted to interlocking nailing group and to plate osteosynthesis group.

Table 2: Sex of the Patients

	Interlocking Nailing	Plate Osteosynthesis	Total
Female	4	2	6
Male	8	10	18
Total	12	12	24

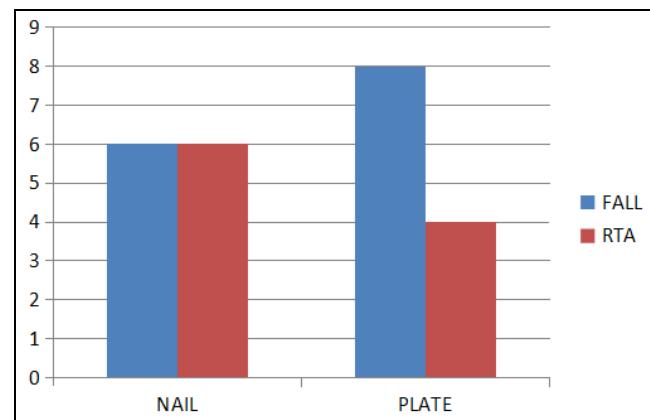
Sex Distribution of Patients**Table 3:** Age of the Patients

Age	Interlocking Nailing	Plate Osteosynthesis
21-40	8	4
41-60	3	6
61-80	1	2

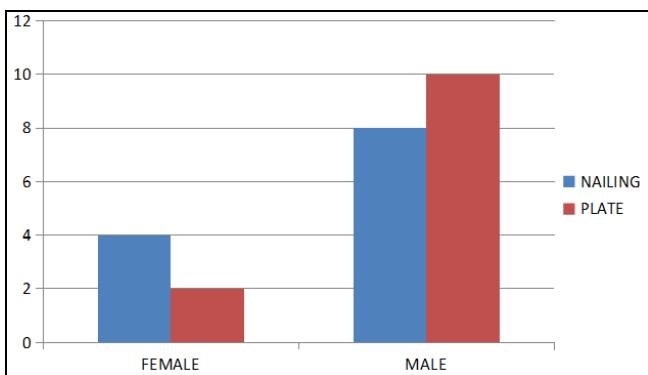
**Table 4:** Mode of Injury

	Interlocking Nailing	Plate Osteosynthesis	Total
Accidental Fall	6	8	14
Rta	6	4	10
Total	12	12	24

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

**Table 5:** Side of Injury

Side of Injury	Nail	Dcp	Total
Right	9(75%)	8(66.6%)	17(70.8%)
Left	3(25%)	4(33.3%)	7(29.1%)
Total	12(100%)	12(100%)	24(100%)



Right side was found to be involved in majority of cases 70% and left side involvement was found in only 29% of cases.

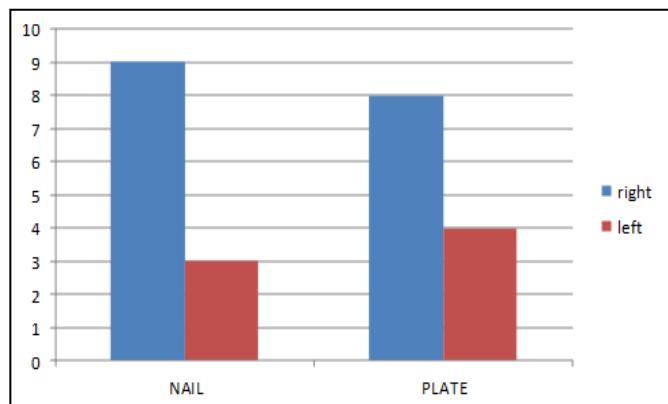
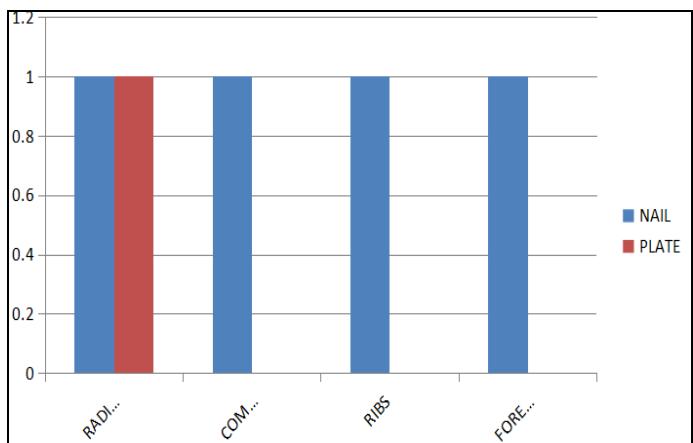


Table 6: Associated Injury

Associated Injury	Interlocking nailing	Plate osteosynthesis	Total
Radial Nerve Palsy	1(recovering)	1	2
Forearm Fracture	1	0	1
Clavicle Fracture	0	0	0
Rib Fractures	1	0	1
Compound Injury	1(GRADE I)	0	1
Total	4	1	5

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

Table 7

SI NO	Surgical Procedure	Time Taken For Union		Average
		Minimum	Maximum	
1	Interlocking Nailing	16 Weeks	28 Weeks	22 Weeks
2	Plate Osteosynthesis	16 Weeks	24 Weeks	20 Weeks

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

Functional Outcome

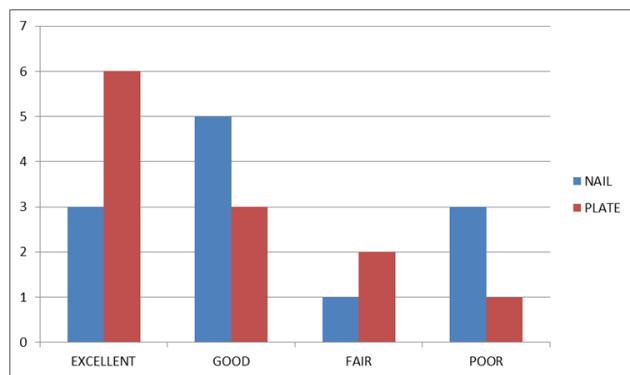
Rodriguez Merchan Criteria

Table 8

Rating	Elbow Rom	Shoulder Rom	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% To 30% Loss	With Activity	Moderate
Poor	Extension 40 Flexion 90	>30% Loss	Variable	Severe

Table 9: Comparision of Rodriguez Merchan Score

Results	Nailing	Dip	Total
Excellent	3	6	9
Good	5	3	8
Fair	1	2	3
Poor	3	1	4
Total	12	12	24



Rating	Percentage
Excellent	58.33%(7)
Good	25%(3)
Fair	16.67%(2)
Poor	-

Interlocking Nailing Group

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

Table 11: Elbow Rom

Rating	Percentage
Excellent	91.6% (11)
Good	8.3% (1)
Fair	-
Poor	-

The elbow function was found to be excellent in 91% of cases and good recovery was found in 8.3% of cases.

Interlocking Nailing Group Shoulder Rom

SHOULDER ROM

- EXCELLENT
- GOOD
- FAIR
- POOR

Elbow Rom

ELBOW ROM

- EXCELLENT
- GOOD
- FAIR
- POOR

Plate Osteosynthesis Group

Table 12: Shoulder Rom

RATING	PERCENTAGE
EXCELLENT	75%(9)
GOOD	25%(3)
FAIR	-
POOR	-

It was found that range of movement of shoulder joint was excellent and good in 75% of cases and it was found to be good in only 25% of cases

Table 13: Elbow Rom

Rating	Percentage
Excellent	75% (9)
Good	25% (3)
Fair	-
Poor	-

The elbow function was found to be excellent in 75% of cases and good recovery was found in 25% of cases.

Plate Osteosynthesis Group Shoulder Rom

SHOULDER ROM

- EXCELLENT
- GOOD
- FAIR
- POOR

Elbow Rom

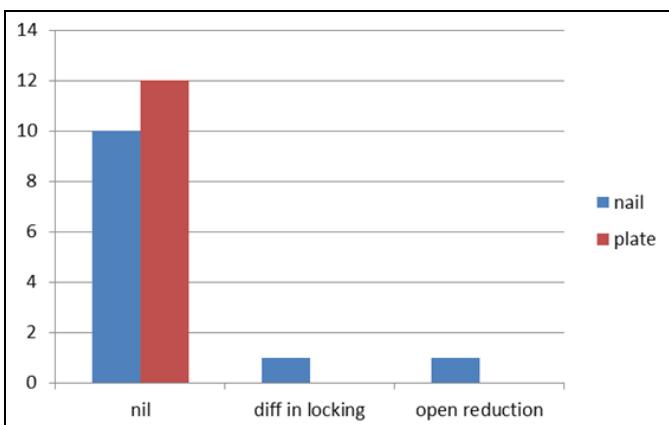
ELBOW ROM

- EXCELLENT
- GOOD
- FAIR
- POOR

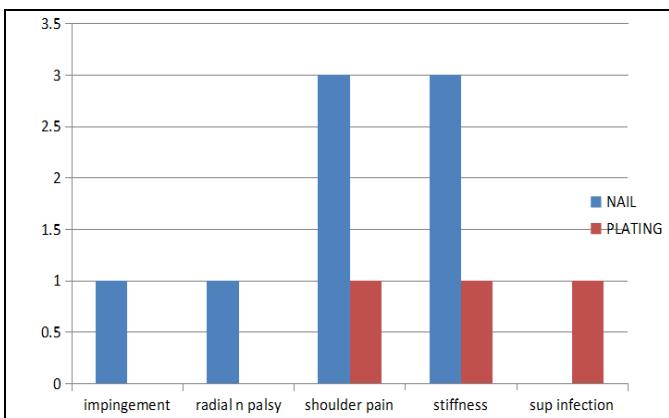
Complications

Table 14: Intra-operative complications

Intraoperative complications	Nail	DCP
#greater tuberosity	0	0
Communition at fracture site	0	-
Open reduction	1	-
Radial nerve palsy	1	0
Problem in locking	1	-
Nil	9	12

**Table 15:** Postop Complication

Post Op Complication	Nail	Dcp
Impingement	1	-
Non-union	0	0
Post op Radial nerve palsy	1	0
Shoulder pain	3	1
Shoulder stiffness	3	1
Superficial infection	1	1



Discussion

Intramedullary nailing is considered as gold standard in treatment in fracture of femoral and tibial shaft fractures. But there is no agreement about the ideal treatment for fractures of humeral shaft. This study is to compare the union rate of the fractures and functional outcome between the patients treated with Plate Osteosynthesis and those treated with Interlocking Nailing for fracture shaft of humerus.

In this study, the age group of the patients in both the groups ranges from 20 to 70 years with a mean age of 45 years. Majority of the patients sustained this fracture are males and the most common mode of injury is due to Road Traffic Accident (around 70%) in both groups.

In incidence of non-union after plating has ranged from 2% to 4% [5, 19, 48]. In our study in DCP group the incidence of non-union is 0%. The incidence of nonunion in interlocking nail was found to be 0 to 8% [19, 28, 51]. In our study the incidence was found to be of 0%.

This study shows no significant difference between the time of union with an average of 22 weeks in the Interlocking Nailing group and an average of 20 weeks in the Plating group. This is comparable with Ragavendra S *et al* in their study found no significant difference in bony union between plating group and nailing group in a series of 31 cases.

The incidence of radial nerve palsy in humeral shaft fractures was found to be 6 to 15%. In our series the incidence was found to be 12.5% (3cases). All of the 3 cases recovered

which was similar to seddonss and pollocks series of 70% and 68%.In the plating group the incidence of post-operative radial nerve palsy was found to be 2 to 5%, there was no such cases of radial nerve palsy postoperatively.

The incidence of postoperative radial nerve palsy was found to be 2.6% to 14.3% in the interlocking group in various studies. In our series there was one case postoperative radial nerve palsy in nailing group which recovered completely.

There was no problem with infection in our study but one case had superficial infection which subsided with antibiotics. The rate of intraoperative communiton during interlocking nail insertion was found to 7.7% to 10%. In our study there was no intraoperative communiton noticed in our study.

In this study shoulder pain occurred in 3 out of 12 patients due to impingement of nail (25%). This is comparable to the study by James P. Stannard *et al* [47] where they showed an occurrence of mild to moderate shoulder pain in about 20% of the patients and also in a study made by Chapman *et al* [37] there is significant reduction in shoulder movement in the Nailing group. Impairment of shoulder function could due to impingement at the acromian and consequent impairment of abduction. Ante grade nailing is found to violate the rotator cuff. A medial starting point is a avascular area of rotator cuff and it gives entry point for access to medullary canal without compromising the healing of rotator cuff.

Conclusion

In our study, there is no significant difference in the period of union of fractures after both the methods.

The chance of infection is more in the Plating group than in patients treated with closed reduction and Interlocking Nailing patients.

The Restriction of shoulder movements are seen in patients in the Nailing group possible due to Prominent nail tip at the entry site and also due to violation of the Rotator Cuff.

The Advantages of Interlocking Nailing are

1. No need for open reduction of fractures as it is done under C-arm Image Intensifier.
2. Minimal soft tissue dissection.

The Disadvantages are

1. Inadequate compression at the fracture site.
2. Distraction at the fracture site due to improper nail length
3. Impingement due to protrusion of nail at the site of entry.
4. Exposure to Radiation

The Advantages found in the Plating are

1. Adequate compression at the fracture site.
2. No need for secondary procedure.
3. Less incidence of Non-union.

The Disadvantages are

1. Needs more soft tissue Dissection.
2. Careful isolation of Radial nerve has to be done.
3. Chances of infection is more.

The complications were more in our study in the interlocking nail group with most of them pertaining to poor shoulder function with pain. Though both modalities of treatment provide comparable union rates, secondary complications were more in interlocking nailing group. So I conclude that patients can be treated with dynamic compression plating and interlocking nailing for fracture of shaft of humerus. Intramedullary interlocking nailing is an effective and safe

alternative for treatment of diaphyseal fractures of humerus. It is suitable for patients with osteoporosis, polytrauma and in segmental fractures.

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