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To Evaluate the Efficacy of an Interlocking Nail Technique to that of a Well-Established Method of Plate Fixation in the Treatment of Acute Shaft Humerus Fractures: A Comparative Study

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ABSTRACT
The aim of the present study was to assess the management with interlocked nail in treatment of acute fracture shaft humerus and to compare its effectiveness with well-established method of plate fixation. The present study of management of acute humeral shaft fractures by antegrade interlocking nail fixation and dynamic compression plating was undertaken in the Department of Orthopedics for the period of 4 years. The average follow-up period was one year (range 10-24 months). 80 patients were included in the study. There were 60 men to 20 women, with the bulk in the 31-40 age bracket. Youngest patient was 22., oldest was 69 in male. Average age was 37.53. Road traffic accidents (80%), falls from height (15%) and assault (4%) dominated our research. Middle third shaft fractures were most prevalent, then lower and higher. The most fractures were transverse, then oblique. There were 60 (75%) close and 20 (25%) open fractures. There were 30 preoperative radial nerve palsies. In 28 of 30 instances, recovery was complete. No iatrogenic nerve palsy was seen in our investigation. Nerves were intact in 18 of 20 instances and contused in 2. Most radial nerve palsy instances included middle third shaft humerus fracture. Most shaft humerus fractures were caused by head injury, followed by lower extremities and ipsilateral forearm fractures. Dynamic compression plating and interlock nailing stabilise and repair humeral shaft fractures in surgical patients. Plating takes greater dissection, blood loss and operation time than nailing. Proper antegrade interlock nailing is safe, fast and effective.

INTRODUCTION

Time is relentless and so the traffic flows, contributing to the daily increase in trauma cases. Fractures occurring in the shaft of the humerus demonstrate a proportional rise, with a higher incidence seen in young adult men. The active participation of the productive people in a country result in a significant economic decline for the nation. The majority of fractures in the diaphysis of the humerus may be successfully treated with proper care. However, a small but constant percentage of these fractures may need surgery in order to get the best possible result. This is often the case with solitary fractures[1]. The first therapy procedures mostly emphasised patient comfort and movement. An uncomplicated technique included securing the limb to the patient's body using a Sling and Swathe device. While this did provide solace and encourage unity, the management of alignment was inadequately regulated. The subsequent introduction of the hanging arm cast resulted in improved alignment. This technique depended not only on the direct immobilising action of plaster, but also on the force of gravity to counteract the deforming forces. The use of a hard plastic orthosis with adjustable straps, which was popularised as functional cast bracing by Sarmiento, has resulted in outstanding clinical and radiological results in cases of humerus fractures[2-4].

While problems are rare, opting for nonoperative therapy necessitates a lengthy period of immobilisation, which increases the chances of persistent shoulder stiffness and may be bothersome for the patient[5,6]. Moreover, nonunion after conservative treatment of these fractures may occur in up-10% of patients and managing this condition can be quite challenging[7-9]. Orthopaedic surgeons often come with fractures of the humeral shaft, which make up for 3% of all fractures. There is a consensus that the majority of fractures in the humeral shaft are most effectively treated without surgery. However, there are certain circumstances when surgical intervention may be necessary as a main or secondary treatment option[10,11]. The treatment approaches for these injuries are constantly improving as advancements are made in both non-surgical and surgical therapy[12]. Plate fixation yields a high percentage of bone union, but necessitates a comprehensive open surgical procedure including the removal of soft tissues from the bone. Additionally, it offers a less stable method of fixation, particularly in cases with osteoporotic bone and when crutch walking is necessary[13,14]. Nevertheless, several research advocate for intramedullary nailing (IMN) as a conventional surgical technique, either by antegrade or retrograde approaches. Conversely, other studies indicate that IMN might potentially result in shoulder joint injury and a low incidence of successful bone union[15]. Thus, the effectiveness of plate fixation and intramedullary nailing (IMN) is a topic of ongoing discussion. Open reduction and internal fixation (ORIF) with plates and screws remains the preferred surgical approach because to its superior outcomes, including a reduced risk of complications and a faster healing period compared to intramedullary nailing[16].

The objective of this research was to evaluate the use of interlocked nail in treating acute fractures of the humerus shaft and to compare its efficiency with the traditional technique of plate fixation.

MATERIALS AND METHODS

The present study of management of acute humeral shaft fractures by antegrade interlocking nail fixation and dynamic compression plating was undertaken in the Department of Orthopedics for the period of 4 years. The average follow-up period was one year (range 10-24 months). 80 patients were included in the study.

Forty-five patients with closed acute humeral shaft fracture requiring operative intervention were treated with either interlocking nailing or plating procedures. A randomization attempt was made by allocating each patient to either of the groups depending on the criteria of odd or even hospital number.

The Inclusion Criteria were:

- Humeral shaft fractures which required operative intervention and were treated with interlocking or plating procedures.
- Patients of age of 18 years or more.

The Exclusion Criteria were:

- The patient was aged <18 years.
- Pathological fractures.
- Segmental fractures.
- Fractures within 4cm of proximal and distal end of humerus.
- Patients who were lost to follow-up or at early stages of follow-up at the time of completion of the study (minimum follow up of six months required).

Before surgery, all patients were evaluated clinically and radiographically. AO classification was used for all fractures. Antegrade interlocking was employed with a Russell-Taylor intramedullary nail to minimize rotator cuff injury. Based on bone width and AO principles, the plating group employed a 3.5-mm or 4.5-mm dynamic compression plate. Antero-lateral or posterior plating surgery was up to the surgeon. Radiographs were obtained regularly and all patients were recommended to do shoulder and elbow exercises immediately after surgery. The postoperative effects of interlocking nailing and plating were compared using Rodriguez-Merchan criteria (1995). The intended

purpose was to compare compression plating with Hackethal nailing in closed humeral shaft fractures[17]. Following the surgery, shoulder and elbow motions, discomfort and impairment were scored to determine outstanding, good, fair and bad results. The lower category was used to identify outcomes when two criteria fell into distinct categories.

RESULTS AND DISCUSSIONS

Table 1: Age wise and Gender wise Distribution of Patients

Age in years	Gender		
	Male	Female	Total
<30	15	5	20
31-40	30	10	40
41-50	10	4	14
51-60	1	1	2
>60	4	0	4
Total	60	20	80

There were 60 men to 20 women, with the bulk in the 31-40 age bracket. Youngest patient was 22., oldest was 69 in male. Average age was 37.53.

Table 2: Distribution according to characteristics of fracture

Mechanism of injury	N	%
Road Traffic Accident	64	80
Fall From Height	12	15
Assault	4	5
Anatomical Level of Fracture Shaft		
Upper third	18	22.5
Middle third	42	52.5
Lower third	20	25
Type of Fracture		
Transverse	36	45
Oblique	24	30
Spiral	12	15
Comminuted	8	10
Type of fracture		
Open	20	25
Close	60	75
Associated Injuries		
Head Injury	16	20
Fracture forearm bone same	12	15
Lower Extremity Fracture	12	15
Chest Injury	8	10
Blunt Abdomen	8	10
Other Associated Injury	8	10
No Associated Injury	16	20

Road traffic accidents (80%), falls from height (15%), and assault (4%) dominated our research. Middle third shaft fractures were most prevalent, then lower and higher. The most fractures were transverse, then oblique. There were 60 (75%) close and 20 (25%) open fractures.

Table 3: Distribution According to Radial Nerve Injury and Intervention

Radial nerve palsy and recovery (N=30)	N	%
Pre-operative	30	100
Post-operative	0	0
Radial Nerve Palsy Recovery		
Recovered	28	93.34
Not recovered	2	6.66
Condition of Radial Nerve on Exploration N=20		
Intact	18	90
Contused	2	10
Lacerated	0	0
Site of Fracture Shaft Presented with Radial Nerve Palsy		
Upper third	0	0
Middle third	18	60
Lower third	12	40

There were 30 preoperative radial nerve palsies. In 28 of 30 instances, recovery was complete. No iatrogenic nerve palsy was seen in our investigation. Nerves were intact in 18 of 20 instances and contused in 2. Most radial nerve palsy instances included middle third shaft humerus fracture. Most shaft humerus fractures were caused by head injury, followed by lower extremities and ipsilateral forearm fractures.

Table 4: Distribution According to Approach for Surgery of fracture

Operative Procedure	Fracture	Anterior Approach	Posterior Approach	Total
Dynamic Compression Platting		28	12	40
Interlock Nailing	Close	32	0	40
	Open	8	0	

Anterolateral approach was used in 28 patients with dynamic compression plating. Posterior approach was used in 12 cases of lower third shaft fracture. Close interlock nailing was performed in 32 patients and open nailing by anterior approach in 8 patients.

Table 5: Distribution According to Radiological Union Time of Fracture

Period	Interlock Nail		Dynamic Compression Plate	
	N	%	N	%
<17 weeks	28	70	24	60
<26 weeks	8	20	11	27.5
<30 weeks	0	0	3	7.5
No union	4	10	2	5
Total	40	100	40	100

Majority of fractures in nailing and plating group were united within 17 week respectively. There was 3 non-union in plating as compared to one in nailing group. There was highly significant difference between mean values of duration of surgery in nailing and plating group ($p<0.01$).

Table 6: Distribution According to Intra operative and Post-Operative Characteristics of Fracture

Variable	Interlock Nail		Dynamic Compression Plate
	Open	Close	
Blood Loss (ml)	30.2	70.00	107.2
Duration of Surgery (min)	58.4	55.00	123.8
Radiological Union (weeks)	14.3	-------	16.2
Radial Nerve Recovery (weeks)	9,9	-------	9.9
ASES Score	51.5	-------	51.2

The average blood loss in plating was 107.2 ml, statistically significant as compared to nailing group (31.5 ml in close and 70 ml in open nailing) ($p<0.01$). Union rate and time to union were not significantly different in nailing and plating group (14.3 V/s 16.2) ($p>0.05$). Average radial nerve recovery period was not statistically significant between both groups (9.9 week in nailing and 9.8. week in plating) ($p>0.05$). At minimum of 8 month follow-up there was no significant difference in functional outcome as per American Shoulder and Elbow Surgeons Score (ASES), strength, range of movement or return to activity in both groups ($p>0.05$).

The majority of fractures in the shaft of the humerus may be successfully treated with proper care.

However, a small but constant percentage of these fractures may need surgery in order to get the best possible result. This is often the case with solitary fractures[18]. The first therapy procedures mostly emphasised patient comfort and movement. A straightforward technique included securing the limb to the patient's torso using a Sling and Swathe device. While this did provide solace and encourage unity, the management of alignment was inadequately regulated. The subsequent introduction of the hanging arm cast resulted in improved alignment. This technique depended not only on the direct immobilising action of plaster, but also on the force of gravity to counteract the deforming forces. The use of a stiff plastic orthosis with adjustable straps, which was made popular as functional cast bracing by Sarmiento, has resulted in outstanding clinical and radiological results in cases of humerus fractures[19-21]. While problems are rare, opting for nonoperative therapy necessitates an extended period of immobilisation, which increases the likelihood of chronic shoulder stiffness and may cause inconvenience to the patient[22,23].

The male population significantly outnumbered the female population, with 60 males compared to 20 females. The bulk of the population fell into the 31-40 years age bracket. The youngest patient was 22 years old and the oldest was a 69-year-old guy. The average age was 37.53 years. These results were consistent with earlier investigations[24,25]. The predominant instances in our analysis were road traffic accidents, accounting for 80% of the total. This was followed by incidents involving falls from height, which constituted 15% of the cases. Only 4 cases were attributed to assault. Fractures in the middle third of the shaft were more prevalent, followed by fractures in the lower and higher thirds, respectively. The number of transverse fractures was the highest, followed by oblique fractures. There were 60 fractures classified as close fractures, accounting for 75% of the total and fractures classified as open fractures, accounting for 25% of the total. Our results are consistent with earlier investigations[23,26].

Open reduction and internal fixation of acute fractures of the humeral shaft are indicated in cases of open fractures, fractures accompanied by vascular or neural injuries, or fractures associated with shoulder, elbow, or forearm lesions in the same limb. This procedure is also recommended for bilateral upper extremity injuries, fractures that have not responded to closed treatment methods, pathological fractures and fractures in patients with multiple injuries[27-30]. Multiple injuries were often seen in various published series, making it the primary reason for performing internal fixation of the humeral shaft[27,29,30]. Habernek and Orthner[31] initially reported positive outcomes with Seidel's interlocking nail in 1991. However, they later retracted their support in 1998 due to their failure to properly assess the shoulder functions of their patients. This failure was attributed to the disruption of the rotator cuff in its avascular zone, specifically at its insertion to the greater tuberosity. This disruption can result in poor healing[32]. There were a total of 30 instances of radial nerve palsy occurring before surgery. Among the total of 30 instances, 28 individuals had achieved full recovery. No cases of iatrogenic nerve palsy were seen in our investigation. Among the 20 cases examined, the nerve was found to be undamaged in 18 cases and bruised in 2 cases. The majority of instances of radial nerve palsy were linked to fractures of the humerus shaft's middle third. The majority of instances involving a fracture in the shaft of the humerus were found to be connected with a head injury, followed by fractures in the lower extremities and fractures in the forearm bone on the same side. A total of 28 patients underwent dynamic compression plating using the anterolateral technique. The posterior technique was used in 12 instances of fractures located in the lower part of the shaft. Close interlock nailing was used in 32 cases, whereas open nailing via the anterior route was used in 8 patients. The majority of fractures in the nailing and plating group were successfully healed after a period of 17 weeks. There were three non-union cases in the plating group, compared to one in the nailing group. There was a statistically significant difference in the average length of operation between the nailing and plating groups ($p<0.01$). The mean blood loss during plating was 107.2 ml, which was statistically significant when compared to the nailing group (31.5 ml in closed nailing and 70 ml in open nailing) ($p<0.01$). The union rate and time to union did not show a significant difference between the nailing and plating groups (14.3 vs 16.2) ($p>0.05$). The average duration of radial nerve healing did not show a statistically significant difference between the two groups (9.9 weeks in the nailing group and 9.8 weeks in the plating group) ($p>0.05$). After a minimum follow-up period of 8 months, there was no notable disparity in functional result, as measured by the American Shoulder and Elbow Surgeons Score (ASES), strength, range of movement, or return to activity between the two groups ($p>0.05$).

CONCLUSION

Both dynamic compression plating and interlock nailing are reliable techniques for stabilising and promoting healing in patients with humeral shaft fractures who need surgical treatment. Plating necessitates thorough dissection, resulting in more blood loss and a longer surgical procedure time as compared to nailing. When

executed correctly, antegrade interlock nailing is a safe, effective and efficient procedure. Interlock nailing is a more appropriate method for treating osteoporotic fractures and comminuted fractures when plating is not the preferred option. If it is not feasible to achieve anatomical alignment in instances of humeral shaft fracture accompanied with radial nerve paralysis, it is necessary to surgically explore the nerve and perform fixation.

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