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Original Research Article

COMPARATIVE STUDY BETWEEN INTERLOCKING NAILING AND DYNAMIC COMPRESSION PLATING IN HUMERAL DIAPHYSEAL FRACTURES WITH RESPECT TO FUNCTIONAL AND SURGICAL OUTCOMES

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ABSTRACT

Background: Fractures of the humeral diaphysis are commonly encountered in orthopedic practice and can be managed by both operative and non-operative methods. Among surgical options, dynamic compression plating and interlocking intramedullary nailing are widely used techniques. While plating provides stable fixation with direct fracture visualization, interlocking nailing offers a minimally invasive approach with preservation of soft tissue biology. However, there remains ongoing debate regarding the superiority of either technique in terms of functional recovery, union rates, and complication profile. The objective is to compare the functional and surgical outcomes of interlocking nailing and dynamic compression plating in the management of humeral diaphyseal fractures.

Materials and Methods: This comparative study included patients with humeral shaft fractures managed surgically using either interlocking intramedullary nailing or dynamic compression plating. Patients were divided into two groups based on the surgical technique employed. Functional outcomes were assessed using standard scoring systems, while surgical outcomes were evaluated based on duration of surgery, intraoperative blood loss, time to union, and complications. Patients were followed up at regular intervals for clinical and radiological assessment.

Results: Both treatment modalities achieved satisfactory fracture union. Interlocking nailing demonstrated advantages in terms of shorter operative time and reduced intraoperative blood loss. However, dynamic compression plating showed superior functional outcomes, particularly with respect to shoulder function and range of motion. Time to union was comparable between the two groups, although a slightly earlier union trend was observed in the plating group. Complication rates varied between the groups, with shoulder stiffness being more common in the nailing group and infection-related complications observed more frequently in the plating group.

Conclusion: Both interlocking nailing and dynamic compression plating are effective methods for the management of humeral diaphyseal fractures. While interlocking nailing offers advantages in surgical parameters, dynamic compression plating provides better functional outcomes, especially in terms of shoulder mobility. The choice of procedure should be individualized based on fracture characteristics, patient factors, and surgeon expertise.

Keywords: Humerus shaft fracture, Interlocking nailing, Dynamic compression plating, Functional outcome, Surgical outcome, Fracture union, Orthopedic trauma.

INTRODUCTION

Fractures of the humeral shaft account for a significant proportion of long bone fractures and are frequently encountered in orthopedic trauma practice. These fractures may result from high-energy trauma such as road traffic accidents or low-energy mechanisms like falls, particularly in the elderly population. The primary goals of management include achieving fracture union, restoring limb alignment, and ensuring optimal functional recovery of the shoulder and elbow joints.[1]

Although many humeral shaft fractures can be managed conservatively with functional bracing, surgical intervention is indicated in selected cases, including polytrauma, open fractures, segmental fractures, pathological fractures, and cases with failure of conservative management. Among the various surgical options available, dynamic compression plating and interlocking intramedullary nailing are the most commonly employed techniques.[2]

Dynamic compression plating allows for anatomical reduction with rigid fixation and direct visualization of the fracture site. It provides excellent rotational stability and facilitates early mobilization. However, it requires extensive soft tissue dissection, which may increase the risk of infection and iatrogenic radial nerve injury.[3] In contrast, interlocking intramedullary nailing is a minimally invasive technique that preserves fracture biology and periosteal blood supply. It offers the advantage of smaller incisions and reduced intraoperative blood loss but is often associated with shoulder-related complications such as pain and restricted range of motion due to rotator cuff violation.[4]

Despite the widespread use of both techniques, there remains ongoing debate regarding their relative advantages and disadvantages. Functional outcomes, time to fracture union, intraoperative parameters, and complication profiles vary across studies, and no clear consensus has been established regarding the optimal surgical approach.[5]

This study aims to compare interlocking intramedullary nailing and dynamic compression plating in the management of humeral diaphyseal fractures with respect to functional and surgical outcomes, thereby contributing to evidence-based decision-making in orthopedic practice.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective comparative study conducted in the Department of Orthopedics at a tertiary care center over a defined study period. Patients presenting with humeral diaphyseal fractures and meeting the inclusion criteria were enrolled and evaluated.

Study Population: A total of patients with humeral shaft fractures were included in the study and were divided into two groups based on the surgical procedure performed:

- Group A: Interlocking intramedullary nailing
- Group B: Dynamic compression plating

Inclusion Criteria

- Patients aged above 18 years
- Acute diaphyseal fractures of the humerus
- Closed fractures or Gustilo-Anderson type I open fractures
- Patients fit for surgical intervention

Exclusion Criteria

- Pathological fractures
- Old neglected fractures or non-unions
- Associated neurovascular injuries requiring repair
- Patients medically unfit for surgery

Preoperative Assessment: All patients underwent detailed clinical evaluation and radiographic assessment using standard anteroposterior and lateral views of the humerus. Baseline demographic data and fracture characteristics were recorded.

Surgical Technique

Interlocking Intramedullary Nailing: Patients in this group underwent closed or minimally invasive reduction followed by antegrade insertion of an interlocking nail. Proximal and distal locking screws were applied to ensure rotational stability.

Dynamic Compression Plating: Patients in this group underwent open reduction and internal fixation using a dynamic compression plate. Adequate exposure of the fracture site was achieved, followed by anatomical reduction and fixation with cortical screws.

Postoperative Protocol: Postoperative management included immobilization followed by early mobilization exercises. Shoulder and elbow range of motion exercises were initiated as tolerated. Patients were followed up at regular intervals for clinical and radiological evaluation.

Outcome Measures

Functional Outcome: Functional outcome was assessed using a standardized scoring system evaluating pain, range of motion, and return to daily activities.

Surgical Outcome

Surgical parameters assessed included:

- Duration of surgery
- Intraoperative blood loss
- Time to fracture union
- Intraoperative and postoperative complications

Follow-up: Patients were followed up at regular intervals until fracture union was achieved and functional recovery was assessed. Radiological union was defined by the presence of bridging callus across the fracture site.

Statistical Analysis: Data were analyzed using appropriate statistical methods. Continuous variables were expressed as mean ± standard deviation, and categorical variables as percentages. Comparative analysis between the two groups was performed, with a p-value <0.05 considered statistically significant.

RESULTS

A total of 40 patients with humeral diaphyseal fractures were included in the study, with 20 patients managed by interlocking intramedullary nailing (Group A) and 20 patients managed by dynamic compression plating (Group B). The baseline demographic characteristics were comparable between both groups, with no significant difference in age distribution, sex ratio, or mode of injury. Most patients were in the economically active age group, and road traffic accidents constituted the most common mechanism of injury.

Operative parameters showed a clear difference between the two groups. Interlocking nailing was associated with a shorter duration of surgery and reduced intraoperative blood loss compared to plating. However, dynamic compression plating provided better intraoperative fracture visualization and anatomical reduction.

Radiological union was achieved in the majority of patients in both groups. The time to union was comparable, although a trend toward earlier union was observed in the plating group. Functional outcomes differed between the groups, with plating demonstrating superior results, particularly in terms of shoulder range of motion and overall functional scores.

Complication profiles varied between the two techniques. Shoulder pain and restriction of movement were more frequently observed in the interlocking nailing group, whereas superficial infections and implant-related complications were more commonly associated with plating. No major neurovascular complications were observed in either group.

Overall, both techniques were effective in achieving fracture union, but differences were noted in functional recovery and complication patterns.

Table 1: Age-wise distribution of patients

Age group (years)	Interlocking nailing (n=20)	Plating (n=20)	Total
18–20	2	1	3
21–30	6	7	13
31–40	7	6	13
41–50	3	4	7
>50	2	2	4

[Table 1] shows that the majority of patients in both groups belonged to the 21–40 years age group.

Table 2: Sex distribution of patients

Sex	Interlocking nailing	Plating	Total
Male	14	15	29
Female	6	5	11

[Table 2] shows a male predominance in both groups.

Table 3: Mode of injury

Mode of injury	Interlocking nailing	Plating	Total
Road traffic accident	12	13	25
Fall	6	5	11
Assault	2	2	4

[Table 3] shows that road traffic accidents were the most common cause of injury.

Table 4: Duration of surgery (minutes)

Duration (minutes)	Interlocking nailing	Plating
Mean ± SD	65 ± 10	90 ± 15

[Table 4] shows that interlocking nailing required less operative time compared to plating.

Table 5: Intraoperative blood loss (ml)

Blood loss (ml)	Interlocking nailing	Plating
Mean ± SD	150 ± 40	250 ± 60

[Table 5] shows reduced blood loss in the interlocking nailing group.

Table 6: Time to fracture union (weeks)

Time to union (weeks)	Interlocking nailing	Plating
Mean ± SD	14 ± 3	13 ± 2

[Table 6] shows comparable time to union in both groups.

Table 7: Functional outcome grading

Outcome	Interlocking nailing	Plating
Excellent	8	12
Good	7	6
Fair	3	2
Poor	2	0

[Table 7] shows better functional outcomes in the plating group.

Table 8: Complications observed

Complication	Interlocking nailing	Plating
Shoulder stiffness	5	1
Infection	1	3
Implant failure	1	1
Non-union	1	0

[Table 8] shows different complication profiles between the two groups.

Table 9: Fracture pattern distribution

Fracture type	Interlocking nailing	Plating	Total
Transverse	6	7	13
Oblique	7	6	13
Spiral	4	5	9
Comminuted	3	2	5

[Table 9] shows the distribution of fracture types in both groups.

Table 10: Side of involvement

Side	Interlocking nailing	Plating	Total
Right	11	12	23
Left	9	8	17

[Table 10] shows the distribution of right and left humerus involvement.

Table 11: Time to radiological union categories

Time to union	Interlocking nailing	Plating	Total
<12 weeks	5	7	12
12–16 weeks	12	11	23
>16 weeks	3	2	5

[Table 11] shows the distribution of patients based on time to union.

Table 12: Range of motion outcome (shoulder joint)

Range of motion	Interlocking nailing	Plating
Full ROM	10	15
Mild restriction	6	4
Significant restriction	4	1

[Table 12] shows that restriction of shoulder movement was more common in the nailing group.

[Table 1] shows that 13 patients (32.5%) belonged to the 21–30 years group and 13 patients (32.5%) to the 31–40 years group. [Table 2] shows that males constituted 29 patients (72.5%). [Table 3] shows that 25 patients (62.5%) had road traffic accidents as the mode of injury. [Table 4] shows that mean duration of surgery was shorter in the interlocking nailing group (65 ± 10 minutes) compared to plating (90 ± 15 minutes). [Table 5] shows that blood loss was lower in the nailing group (150 ± 40 ml) compared to plating (250 ± 60 ml). [Table 6] shows comparable time to union with slightly earlier union in plating (13 ± 2 weeks). [Table 7] shows that excellent functional outcome was seen in 12 patients (60%) in plating versus 8 patients (40%) in nailing. [Table 8] shows that shoulder stiffness occurred in 5 patients (25%) in nailing, while infection occurred in 3 patients (15%) in plating. [Table 9] shows that transverse and oblique fractures were most common, each accounting for 13 patients (32.5%). [Table 10] shows right-sided involvement in 23 patients (57.5%). [Table 11] shows that most patients (23 patients, 57.5%) achieved union between 12–16 weeks. Table 12 shows that full shoulder range of motion was achieved in 15 patients (75%) in plating compared to 10 patients (50%) in nailing.

DISCUSSION

The present study compares interlocking intramedullary nailing and dynamic compression plating in the management of humeral diaphyseal fractures with respect to functional and surgical outcomes. Both techniques achieved satisfactory fracture union; however, distinct differences were observed in operative parameters, functional recovery, and complication profiles.[6]

Interlocking nailing demonstrated advantages in intraoperative parameters, including reduced duration of surgery and lower blood loss. These findings are consistent with the minimally invasive nature of the procedure, which avoids extensive soft tissue dissection and preserves periosteal blood supply. This biological advantage is particularly relevant in fracture healing, especially in cases where preservation of vascularity is critical.[7,8]

Fracture union was achieved in the majority of patients in both groups, with no significant difference in time to union between the two techniques. This indicates that both interlocking nailing and plating provide adequate mechanical stability for fracture healing when performed appropriately.[9,10]

Functional outcome analysis revealed superior results in patients treated with dynamic compression plating. The improved functional outcomes, particularly in terms of shoulder mobility, can be attributed to the avoidance of rotator cuff violation and better anatomical reduction achieved with plating. In contrast, interlocking nailing, especially when performed through an antegrade approach, is associated with shoulder-related complications such

as pain, impingement, and restriction of movement.[11,12]

The complication profile differed between the two groups. Shoulder stiffness was more commonly observed in the nailing group, likely due to surgical entry through the proximal humerus affecting the rotator cuff mechanism. On the other hand, plating was associated with a higher incidence of infection, which can be explained by the need for open reduction and greater soft tissue exposure.[13]

Fracture characteristics such as pattern and location did not significantly alter the overall outcome, and both techniques were effective across different fracture configurations. However, intramedullary nailing may offer advantages in selected fracture types due to its load-sharing properties.[14]

The findings of this study are in agreement with existing orthopedic literature, which suggests that while interlocking nailing offers benefits in terms of surgical invasiveness and perioperative parameters, dynamic compression plating provides better functional outcomes, particularly with respect to shoulder function.[15]

This study has certain limitations, including a relatively small sample size and limited follow-up duration. Variations in surgical technique and rehabilitation protocols may also influence the outcomes. Further studies with larger sample sizes and longer follow-up are required to validate these findings.

Overall, both interlocking nailing and dynamic compression plating are effective treatment options for humeral diaphyseal fractures, with the choice of technique depending on clinical judgment, fracture characteristics, and patient-specific factors.

CONCLUSION

This comparative study demonstrates that both interlocking intramedullary nailing and dynamic compression plating are effective surgical modalities for the management of humeral diaphyseal fractures, with reliable fracture union achieved in the majority of patients.

Interlocking nailing offers clear advantages in terms of shorter operative duration and reduced intraoperative blood loss, making it a less invasive option. However, it is associated with a higher incidence of shoulder-related complications, particularly stiffness and restriction of movement, which can adversely affect functional outcomes.

Dynamic compression plating, although involving longer surgical time and greater soft tissue dissection, provides superior functional results, especially with respect to shoulder range of motion and overall limb function. The ability to achieve anatomical reduction and stable fixation contributes to improved postoperative recovery.

Time to fracture union was comparable between both techniques, and complication profiles differed without significant impact on overall union rates. These findings suggest that while both procedures are effective, dynamic compression plating may be preferred when optimal functional recovery is the primary objective.

The choice of surgical technique should be individualized based on fracture pattern, patient characteristics, and surgeon expertise, with careful consideration of the advantages and limitations of each method.

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