

A Comparative Analysis of Locking Plate versus Intramedullary Nail for Humerus Shaft Fractures

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Abstract

Introduction: Humerus shaft fractures pose a significant challenge in Orthopaedic practice, with various treatment approaches available, including surgical methods like conservative management, Plating and Nailing. The choice between these methods remains debatable, necessitating further comparative studies.

Methods: This study compared Open Reduction Internal Fixation (ORIF) with Locking Compression Plates and Closed Reduction Internal Fixation (CRIF) with Intramedullary Interlocking nails for Humerus shaft fractures. Patients were categorized into two groups based on the intervention received. Perioperative parameters, radiological outcomes, and complications were assessed.

Results: Baseline demographics were comparable between the two groups. The Plating Group had longer surgery duration and higher blood loss compared to the Nailing Group. Both groups had similar rates of union and non-union, with no significant difference in shoulder function and pain outcomes at one year post-operation.

Discussion: Functional outcomes post-union remain acceptable despite notable deformities, suggesting the viability of conservative treatments. While ORIF with plating has been conventional, concerns over blood loss and nerve injury have led to exploration of CRIF with intramedullary nails. This study, consistent with previous findings, found no significant disparity in outcomes between the two methods, emphasizing the need for personalized treatment decisions. In conclusion, this study adds to the understanding of Humerus shaft fracture management, highlighting the need for individualized treatment decisions and further research in this field.

Keywords: Humerus Shaft Fractures, Open Reduction Internal Fixation (ORIF), Locking Compression Plates (LCP), Closed Reduction Internal Fixation (CRIF), Intramedullary Interlocking (IMIL) nails, Constant Murley Score (CMS)

Introduction

Humerus shaft fractures account for approximately 2-3% of all fractures, and treating these effectively is a common challenge in orthopaedic practice. [1] The treatment approach can vary from non-surgical methods, such as functional braces or hanging casts, to surgical interventions, such as Open Reduction Internal Fixation (ORIF) with locking plates and Closed Reduction Internal Fixation (CRIF) with interlocking intramedullary nails. [2]

While non-surgical methods can yield satisfactory results for non-displaced fractures, displaced fractures often necessitate surgical intervention. Over recent years, there has been an increasing trend towards internal fixation to avoid potential complications associated with conservative treatments, such as malunion, non-union, and shoulder stiffness.

Locking plates and interlocking intramedullary nails are two common techniques for the internal fixation of Humerus shaft fractures. Locking plates provide stable fixation and allow for direct visualization of the radial nerve, but require intensive soft tissue dissection and periosteal stripping, which can increase operative time. Intramedullary nailing, on the other hand, may lead to fewer disturbances to soft tissues and shorter operative time, but at the risk of shoulder-related complications, iatrogenic radial nerve injury, and incomplete fracture reduction.

Despite the widespread use of both techniques, there is on-going debate within the orthopaedic community about which method provides the best overall patient outcomes. Further comparative studies are needed to clarify this issue and guide treatment decisions. This study aims to contribute to this body of knowledge by comparing the functional results, radiological outcomes, and complications of ORIF with locking compression plates and CRIF with intramedullary nails in the treatment of Humerus shaft fractures.

Against this backdrop, this study seeks to compare the functional outcomes, radiographic findings, and associated complications between two methods for addressing Humerus shaft fractures: Open Reduction and Internal Fixation (ORIF) using locking compression plates and Closed Reduction and Internal Fixation (CRIF) utilizing intramedullary nails.

Method

Patients diagnosed with proximal Humerus fractures at Narayan Medical College & Hospital, Sasaram between May 2022 and January 2023 were included in the study. The inclusion criteria encompassed patients aged over 20 years with closed mid-shaft Humerus fractures of less than 3 weeks duration necessitating surgical intervention. Exclusions were applied to patients under 20 years of age, those with proximal or distal shaft Humerus fractures, Metaphyseal fractures, pathological fractures, neurovascular deficits, medical unsuitability for surgery, compound fractures, and polytrauma cases. Each participant underwent a thorough examination following a detailed history-taking process, and informed consent was obtained.

Participants were categorized into two groups based on the intervention received: the locking plate group and the interlocking intramedullary nail group. Twenty patients underwent Open Reduction and Internal Fixation (ORIF) using locking compression plates, while another twenty underwent Closed Reduction and Internal Fixation (CRIF) with Intramedullary Interlocking nails.

Patients in the plating group underwent surgery using the posterior approach. Following the posterior approach to the Humerus, fractures were stabilized using a Locking Compression Plate, ensuring engagement of a minimum of 6 cortices on either side of the fracture with 4.5 mm cortical screws or 4.5 mm locking cortical screws.

Patients in the nailing group underwent anterograde nailing with a Humerus Intramedullary nail. After appropriate incision and bone entry with an awl, serial medullary reaming was performed, and the nail with the largest possible diameter was inserted over a guide wire. Prior to inserting the proximal locking bolts, meticulous soft tissue dissection was performed, and any overlying neurovascular bundles were

carefully retracted. Proximal and distal locking of the nail was then conducted under fluoroscopic guidance with cortical bolts.

Postoperative radiographs were taken to confirm satisfactory reduction. Patients received injectable antibiotics and analgesics for two days post-surgery, followed by oral medication. They were immobilized in an arm sling postoperatively and encouraged to begin pendulum exercises and passive followed by active range of motion exercises of the elbow from the first postoperative day. Patients were discharged on the sixth postoperative day once they were pain-free and adequately mobile.

Follow-up appointments were scheduled at regular intervals in the outpatient department: 1 month, 3 months, 6 months, and 1 year postoperatively. Clinical examinations were performed at each visit to assess surgical wound status, range of motion at the elbow and shoulder, and any other potential complications. Plain radiographs were taken at each visit to evaluate hardware integrity, screw loosening, and signs of fracture union, defined as visible bridging callus on at least two orthogonal view radiographs. Functional status at one year was assessed using the Constant Murley Score's criteria.

Perioperative parameters data (surgery duration, blood loss) were collected for both groups. Variables such as Constant-Murley scores for shoulder activity, and postoperative complications were documented, and a comparative analysis of perioperative data between the two groups was conducted.

Result

In the plating group, there were an equal number of males and females (10 each), while in the nailing group, there were slightly more males than females (12 males and 8 females). The mean ages of patients in the plating and nailing groups were 49.9 years and 50.85 years, respectively. The standard deviations were 10.88 years and 13.84 years for the plating and nailing groups, respectively. A statistical test yielded a p-value of 0.79, indicating that the difference in mean age between the two groups was not statistically significant. Road Traffic Accidents (RTA) were the most common cause of shaft Humerus fractures in both the plating and nailing groups, followed by falls from height and other causes. The distribution of modes of injury was similar between the two groups. In both the plating and nailing groups, the majority of fractures occurred on the right side.

Table 1: Baseline Demographics

Characterstics		Plating Group	Nailing Group
Sex	Male	10	12
	Female	10	8
Age (pValue 0.79)		49.9 ± 10.88	50.85 ± 13.84
Mode of Injury	RTA	11	10
	Fall from height	4	5
	Others	5	5
Side	Right	13	12
	Left	7	8

There was no statistically significant distinction observed in the baseline demographics between the two groups, rendering them comparable. The perioperative parameters were compared, and the findings were tabulated.

Table 2 presents a comparison of various characteristics between the Plating Group and the Nailing Group, along with the associated p-values, which indicate the statistical significance of the observed differences. The average duration of surgery was significantly longer in the Plating Group (84.95 minutes) compared to the Nailing Group (69.25 minutes), with a p-value of 0.027. This suggests that surgeries in the Plating Group took more time on average compared to those in the Nailing Group. The average amount of blood loss during surgery was substantially higher in the Plating Group (346.65 ml) compared to the Nailing Group (121.2 ml), with an extremely low p-value of 9.8×10^{-13} . This indicates a highly significant difference in blood loss between the two groups, with much lower blood loss observed in the Nailing Group. The table also lists several types of post-operative complications observed in each group. In the Plating Group, there were 2 cases of Superficial Infection, 1 case of Radial Nerve Palsy, 2 cases of Delayed Union, and no cases of Implant Failure. In contrast, the Nailing Group had 1 case of Superficial Infection, 2 cases of Radial Nerve Palsy, 2 cases of Delayed Union, and 1 case of Implant Failure.

In the nailing group, two instances of non-union and one instance of implant failure were managed by removing the nail and performing internal fixation using compression plates along with autologous bone grafting. Similarly, the two cases of non-union in the plating group were addressed through autologous bone grafting. In all these instances, successful fracture union was achieved.

Table 2: Perioperative parameters

Characteristics		Plating Group	Nailing Group	pValue
Average Intraoperative time (in minutes)		84.95 ± 13.86	69.25 ± 24.24	0.027
Average Blood Loss (in ml)		346.65 ± 63.81	121.2 ± 19.93	9.8×10^{-13}
Post-Operative complications	Superficial Infection	2	1	
	Radial Nerve Palsy	1	2	
	Delayed Union	2	2	
	Implant Failure	0	1	

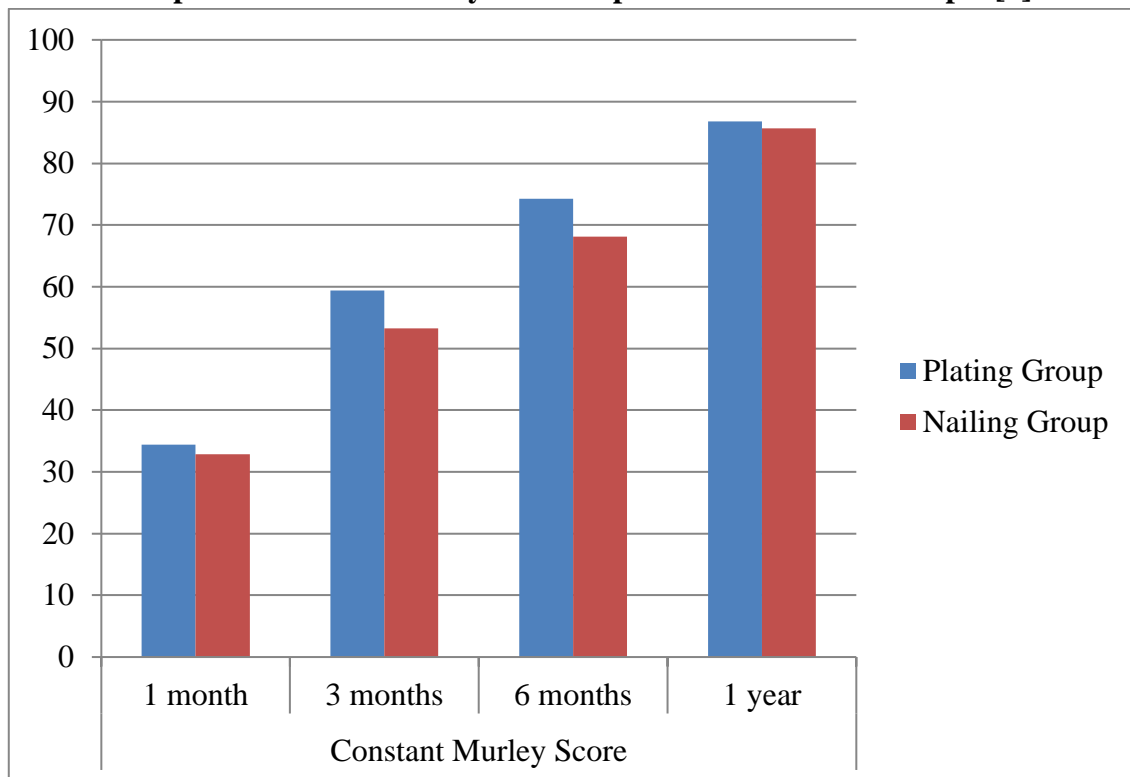
In the plating group, 18 patients achieved union, while 2 experienced non-union. In the nailing group, 17 patients achieved union, while 3 experienced non-union at radiographic findings after 1 year. This table also compares the Constant Murley Score, a measure of shoulder function and pain, between the two groups at different time points: 1 month, 3 months, 6 months, and 1 year post-operation. At 1 month post-operation, the mean Constant Murley Score was 34.45 in the plating group and 32.85 in the nailing group, with a p-value of 0.63673, suggesting no statistically significant difference in scores between the two groups at this time point. At 3 months post-operation, the mean Constant Murley Score was 59.35 in the plating group and 53.5 in the nailing group, with a p-value of 0.09346, indicating a trend towards significance but not reaching it. At 6 months post-operation, the mean Constant Murley Score was 74.25 in the plating group and 68.1 in the nailing group, with a p-value of 0.07904, again showing a trend towards significance. At 1 year post-operation, the mean Constant Murley Score was 86.75 in the plating group and 85.7 in the nailing group, with a p-value of 0.741821, indicating no statistically significant difference in scores between the two groups at this time point.

Overall, while there were numerical differences in the mean Constant Murley Scores between the plating and nailing groups at certain time points, these differences did not reach statistical significance except for a trend towards significance at 3 and 6 months post-operation. Therefore, both plating and nailing techniques appear to result in similar shoulder function and pain outcomes in the long term.

Table 3: Outcome Parameters

Parameters		Plating Group	Nailing Group	pValue
Radiological Outcome	Union	18	17	
	Non Union	2	3	
Constant Murley Score	1 month	34.45 ± 11.23	32.85 ± 9.38	0.63673
	3 months	59.35 ± 10.90	53.5 ± 8.91	0.09346
	6 months	74.25 ± 11.12	68.1 ± 8.41	0.07904
	1 year	86.75 ± 10.81	85.7 ± 8.34	0.741821

Graph 1: Constant Murley Score improvement over follow ups: [3]



Discussion

The analysis underscores that despite shaft Humerus fractures resulting in notable deformities such as up to 3cm of shortening, 30 degrees of rotation, and 20 degrees of angulation post-union, functional outcomes remain acceptable. This aspect underscores the potential viability of conservative treatment strategies for many such fractures. [5]

However, there's a noticeable inclination towards operative management, primarily driven by the desire to expedite patients' return to daily activities and work commitments. While open reduction with plating

has conventionally been the preferred operative approach, concerns regarding blood loss and radial nerve injury during surgery have prompted exploration of alternative methods.

Closed Reduction and Internal Fixation (CRIF) utilizing intramedullary nails have emerged as a less invasive option, with a reduced risk of intraoperative radial nerve injury, making it a promising alternative for managing Humerus shaft fractures.

The article references an extensive meta-analysis by Ouyang, which compared outcomes of intramedullary nailing and plating techniques for these fractures. [6] The study concluded no significant differences between the two methods, except for an increased incidence of shoulder-related complications in the nailing group.

Consistent with these findings, this study also found no significant disparity in radiological outcomes and time to union between the two groups. These findings underscore the necessity for meticulous consideration when selecting the optimal treatment approach for Humerus shaft fractures. Each method presents its own advantages and potential drawbacks, necessitating a personalized decision based on individual patient characteristics and fracture particulars.

Conclusion

This comparative study aimed to shed light on the surgical effectiveness of locking plates versus interlocking intramedullary nails in managing shaft Humerus fractures. Our findings reveal several important insights into the treatment landscape for this common orthopedic challenge.

Firstly, both techniques demonstrated satisfactory functional outcomes and radiographic union rates, indicating their efficacy in promoting fracture healing and restoring shoulder function. Despite numerical differences in certain outcome measures, particularly in the mid-term follow-ups, these variances did not reach statistical significance, suggesting comparable long-term outcomes between the two groups.

Secondly, while locking plates and intramedullary nails each have their unique advantages and potential complications, our study did not identify a clear superiority of one technique over the other in terms of overall patient outcomes. The choice between plating and nailing should thus be guided by individual patient characteristics, fracture complexity, and surgeon preference.

Thirdly, our findings underscore the importance of considering factors such as surgical duration, blood loss, and postoperative complications when selecting the optimal treatment approach. While plating procedures were associated with longer operative times and higher blood loss, intramedullary nailing offered advantages in terms of reduced surgical duration and blood loss, albeit with a slightly higher incidence of certain complications.

In light of these findings, orthopedic surgeons should approach the management of shaft Humerus fractures with a nuanced understanding of the benefits and limitations of each surgical technique. Further research, including prospective studies with larger sample sizes and longer follow-up periods, is warranted to validate these findings and inform evidence-based treatment guidelines.

Ultimately, our study contributes to the ongoing discourse surrounding the optimal management of shaft Humerus fractures, providing valuable insights that can guide clinical decision-making and improve patient outcomes in this challenging orthopedic scenario.

Conflict of Interest

The authors declare no conflicts of interest related to the design, execution, or reporting of this study on

the comparative effectiveness of locking plates and interlocking intramedullary nails in treating proximal Humerus fractures. The study was conducted with the sole objective of contributing to clinical knowledge and providing guidance in the management of these fractures. The authors have no financial or personal relationships that could potentially bias the interpretation of results or influence the presentation of findings.

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References

1. Brinker MR, O'Connor DP. The incidence of fractures and dislocations referred for orthopaedic services in a capitated population. *J Bone Joint Surg Am.* 2004;86:290–297.
2. Sarmiento A, Kinman PB, Galvin EG, Schmitt RH, Phillips JG (1977) Functional bracing of fractures of the shaft of the Humerus. *J Bone Joint Surg Am* 59:596–601.
3. Constant, C. R., & Murley, A. H. (1987). A clinical method of functional assessment of the shoulder. *Clinical Orthopaedics & Related Research*, 214, 160–164.
4. Chapman JR, Henley MB, Agel J, Benca PT. Randomised prospective study of humeral shaft fractures fixation; intramedullary nails versus plates. *J Orthop Trauma* 2000;149[3]:162-166.
5. Papasoulis E, Drosos GI, Ververidis AN, et al. Functional bracing of humeral shaft fractures. A review of clinical studies. *Injury.* 2010;41:e21–e27
6. Ouyang H, Xiong J, Xiang P, Cui Z, Chen L, Yu B. Plate versus intramedullary nail fixation in the treatment of humeral shaft fractures: an updated meta-analysis. *J Shoulder Elbow Surg.* 2013;22:387–395.