



Comparative Analysis of Functional Outcomes in Midshaft Humerus Fractures: Anterior Bridge Plating versus Intramedullary Interlocking Nailing

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ABSTRACT

Surgical therapy of midshaft humerus fractures presents difficulties; typically used methods include anterior bridge plating and intramedullary interlocking nailing. The purpose of this research is to compare the effectiveness and functional results of these approaches. Forty individuals with midshaft humerus fractures participated in a prospective comparative research. Patients were divided into two groups: Group B received intramedullary interlocking nailing, and Group A received anterior bridge plating. Evaluations included fracture union, neighbouring joint range of motion, the Disabilities of the Arm, Shoulder, and Hand (DASH) score, and patient satisfaction. Both groups showed comparable rates of fracture union, with most showing signs of union after six weeks and full union after three months. While both groups' elbow range of motion was comparable, Group B's shoulder range of motion was somewhat greater than Group A's. Following surgery, there was a significant improvement in both groups' functional outcomes as measured by the DASH score. In midshaft humerus fractures, anterior bridge plating and intramedullary interlocking nailing both show promise in promoting fracture union and improving functional results. Even though similar overall efficacy was seen, small variations in patient satisfaction and joint mobility should be taken into account when choosing a course of treatment.

Key words: midshaft humerus fractures, anterior bridge plating, intramedullary interlocking nailing, DASH score, Treatment efficacy

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INTRODUCTION

A significant percentage of upper extremity injuries are midshaft humerus fractures, which pose difficult care and rehabilitation problems. These fractures, which happen in the space between the proximal and distal humeral segments, are frequently brought on by direct hits, falls, or high-energy trauma. Because these fractures affect upper limb functionality, joint mobility, and the general quality of life for those who are affected, their management is essential [1-5].

In the past, open reduction and internal fixation (ORIF) with anterior bridge plating or intramedullary interlocking nailing were used as surgical interventions for midshaft humerus fractures. In order to promote the best possible functional recovery, surgical therapy aims to achieve anatomical reduction, restore biomechanical stability, and permit early mobilisation. Still, debates rage about whether these methods are better at producing desirable functional results [1-5].

Through a direct anterior approach to the humeral shaft, anterior bridge plating enables plate fixation using screws positioned along the shaft. This method allows for direct sight of the fracture site, which facilitates precise reduction, and offers superior biomechanical stability. However, a less invasive method is possible with intramedullary interlocking nailing, which entails inserting a nail into the medullary canal. It protects the blood flow to the periosteum and has demonstrated encouraging outcomes in specific fracture forms.

The results of studies evaluating each of these treatment techniques separately have been inconsistent, which has caused disagreement about the best course of action for midshaft humerus fractures. Certain studies support anterior bridge plating, highlighting its adaptability and stability in treating different types of fractures. Some favour intramedullary interlocking nailing because of its less invasiveness and ability to maintain the periosteal blood flow, which could hasten recovery [4-8].

Fracture union rates are only one aspect of the discussion around these methods; other factors include postoperative functional recovery, comorbidities, and patient satisfaction. Although the goals of both approaches are fracture union and functional rehabilitation, there is still debate over how these procedures would affect the motion of other joints, especially the elbow and shoulder. Research has shown that various procedures differ in their postoperative range of motion, which can be attributed to different surgical approaches and biomechanical factors [4-9].

In addition, functional outcomes following treatment have been measured using the “Disabilities of the Arm, Shoulder, and Hand (DASH)” score, a validated method for evaluating upper extremity function. The relative effectiveness of these techniques in raising DASH scores and promoting a more functional recovery, however, is still up for debate.

In addition to clinical results, postoperative satisfaction and treatment choices are significantly influenced by patient demographics and work demands. For example, labourers and farmers may have different needs when it comes to upper limb function, which could affect how well they feel about their therapy [9-13].

A thorough comparison between intramedullary interlocking nailing and anterior bridge plating is necessary to resolve these disputes and offer clarity in treatment decision-making. Clinical practise based on evidence will be greatly aided in the management of midshaft humerus fractures by taking into account the subtle variations in outcomes and taking into account different components of functional recovery, joint mobility, and patient satisfaction.

MATERIAL AND METHODS

Research Design

In patients with midshaft humerus fractures, a prospective comparative research was carried out to evaluate and compare the functional outcomes of two treatment modalities: intramedullary interlocking nailing and anterior bridge plating. The research was carried out in accordance with the Declaration of Helsinki's tenets at the tertiary care center with approval from the institutional ethics committee.

Choice of Patient

After giving their informed agreement, a total of 40 patients who presented with midshaft humerus fractures between 2021-2022 for a period of 18 months were included in the research. Patients who met the inclusion criteria were those who were skeletally mature and qualified for surgery due to closed midshaft humerus fractures. Open fractures, pathological fractures, concurrent injuries impairing upper limb function, and patients reluctant to follow up or participate were among the exclusion criteria.

Group Allocation

Based on the chosen treatment method, patients were split into two groups: Group A was assigned to anterior bridge plating, and Group B was assigned to intramedullary interlocking nailing. To reduce bias, computer-generated randomization was used to assign groups.

Surgical Procedure

Depending on their allocated treatment group, patients either had regional or general anaesthesia for their surgery. Upper limb trauma specialists with years of experience performed the surgical procedures. Group B underwent intramedullary interlocking nailing, whilst Group A underwent anterior bridge plating. In order to guarantee accurate implant placement and fracture reduction, intraoperative fluoroscopy was used.

Multiple outcome measures were utilised in order to evaluate and contrast the functional outcomes. These measurements include:

1. **Fracture Union:** Based on callus formation and the lack of fracture lines, radiographic evaluation was performed at regular intervals (six weeks and monthly for six months) to estimate the time to fracture union.
2. **Range of Motion (ROM):** Standardised goniometry was used both preoperatively and at follow-up visits to assess the ROM of neighbouring joints, such as the elbow and shoulder.
3. **DASH Score:** To assess functional results, the preoperative and follow-up visits involved the administration of the DASH questionnaire, a validated tool for assessing upper limb function and impairment.
4. **Patient Satisfaction:** A standardised questionnaire intended to measure patients' perceptions of treatment efficacy and postoperative recovery was used to gather information about patient-reported outcomes and satisfaction levels.

Statistical Analysis

Baseline values, fracture characteristics, and patient demographics were compiled using descriptive statistics. Categorical variables were shown as frequencies and percentages, whereas continuous variables were portrayed as means with standard deviations or as medians with interquartile ranges. For continuous variables, the Student's t-test or Mann-Whitney U test was used; for categorical variables, chi-square tests were utilised. At $p < 0.05$, statistical significance was established.

RESULTS

Table 1: Features of the Patient The patient demographics for both therapy groups are shown in this table. The average age in Group A (Bridge Plating) was 42.5 years, with a 6.3-year standard deviation. With a standard deviation of 5.9 years, the mean age of Group B (Interlocking Nailing) was slightly younger at 41.8 years. With 13 men and 7 women in Group A and 12 men and 8 women in Group B, the gender distribution in both groups was identical. In terms of employment, Group B consisted of 11 farmers and 9 labourers, whereas Group A consisted of 9 farmers and 11 labourers.

Table 2: Details of Fracture The features of the fractures in both groups are displayed in this table. The distribution of fracture types is displayed, showing that there were 8 spiral fractures and 12 transverse fractures in Group A and 9 spiral fractures and 11 transverse fractures in Group B, respectively. With a standard deviation of 2.1 hours, Group A's mean time from injury to surgery was 7.6 hours, marginally less than Group B's 8.3 hours with a standard deviation of 1.8 hours.

Table 3: Duration of Union Fracture The evolution of fracture union over time is seen in this table. Ninety percent (18 patients out of 20) in Group A and ninety-five percent (19 patients out of 20) in Group B displayed union at six weeks after surgery. All patients in both groups (100%) showed evidence of fracture union by the 3-month period. At the 6-month evaluation, this pattern persisted, showing total union in every patient in both therapy groups.

Table 4: Range of Motion in the Shoulders Group B (Interlocking Nailing) demonstrated marginally superior results in terms of shoulder range of motion. The flexion range in Group A (Bridge Plating) was 125 degrees with a standard deviation of 8 degrees, while the mean flexion range in this group was 132 degrees with a standard deviation of 10 degrees. Comparably, Group B's mean abduction range was 112 degrees with a 9-degree standard deviation, which was somewhat better than Group A's 105 degrees with a 7-degree standard deviation.

Table 5: Range of Motion of the Elbow Elbow range of motion showed similar results for both treatment groups. For both Group B and Group A, the mean flexion range was 132 degrees with a standard deviation of 10 degrees and 125 degrees with an 8-degree standard deviation, respectively. In terms of extension, Group B performed somewhat better than Group A, which displayed a mean range of 110 degrees with a standard deviation of 9 degrees, with a mean range of 118 degrees and a standard deviation of 7 degrees.

Table 6: DASH Score The upper limb disability scores for both groups are shown in this table. Group B exhibited a somewhat higher mean score of 46.3 with a standard deviation of 5.9, compared to Group A's 45.6 mean and 6.2 standard deviation preoperatively. Significant functional recovery was seen in both treatment cohorts at the 6-month follow-up, with Group A reporting a mean DASH score of 12.8 with a standard deviation of 3.4 and Group B reporting a mean score of 13.5 with a standard deviation of 3.1.

These comprehensive results highlight the relative effectiveness of anterior bridge plating and intramedullary interlocking nailing for midshaft humerus fractures by illuminating a number of factors, including patient demographics, fracture characteristics, fracture union timelines, range of motion in nearby joints, and functional outcomes measured by the DASH score.

Table 1: Patient Characteristics

Characteristic	Group A (Bridge Plating)	Group B (Interlocking Nailing)
Age (years)	Mean \pm SD: 42.5 \pm 6.3	Mean \pm SD: 41.8 \pm 5.9
Gender (M/F)	13/7	12/8
Occupation	Farmers: 9, Laborers: 11	Farmers: 11, Laborers: 9

Table 2: Fracture Details

Parameter	Group A (Bridge Plating)	Group B (Interlocking Nailing)
Fracture Type	Spiral: 8, Transverse: 12	Spiral: 9, Transverse: 11
Mean Time to Surgery (hrs)	7.6 ± 2.1	8.3 ± 1.8

Table 3: Time to Fracture Union

Time Point	Group A (Bridge Plating)	Group B (Interlocking Nailing)
6 Weeks	18/20 (90%)	19/20 (95%)
3 Months	20/20 (100%)	20/20 (100%)
6 Months	20/20 (100%)	20/20 (100%)

Table 4: Shoulder Range of Motion

ROM Parameter	Group A (Bridge Plating)	Group B (Interlocking Nailing)
Flexion (degrees)	125 ± 8	132 ± 10
Abduction (degrees)	105 ± 7	112 ± 9

Table 5: Elbow Range of Motion

ROM Parameter	Group A (Bridge Plating)	Group B (Interlocking Nailing)
Flexion (degrees)	125 ± 8	132 ± 10
Extension (degrees)	110 ± 9	118 ± 7

Table 6: DASH Score

Time Point	Group A (Bridge Plating)	Group B (Interlocking Nailing)
Preoperative	Mean ± SD: 45.6 ± 6.2	Mean ± SD: 46.3 ± 5.9
6 Months Post-op	Mean ± SD: 12.8 ± 3.4	Mean ± SD: 13.5 ± 3.1

DISCUSSION

Fracture Management and Surgical Techniques: Because of the intricate anatomy and biomechanics of the humerus, surgical management of midshaft humerus fractures is difficult. Stable fixation and fracture healing are the goals of well-established surgical procedures such as intramedullary interlocking nailing and anterior bridge plating. Current research supports earlier findings in the literature about how well both strategies work to achieve fracture union in reasonable amounts of time. [1,2].

Characteristics of Fractures and Surgical Considerations

Current research's fracture type distribution is consistent with earlier publications; both treatment groups had a mix of spiral and transverse fractures [3]. Based on the characteristics of the fracture and taking into account the prospective benefits of each surgical procedure, the strategy was chosen. When compared to the complications of intramedullary nailing, the somewhat quicker time to surgery in Group A (Bridge Plating) may indicate the viability of direct anterior access for plating [4].

Radiographic Progression and Fracture Union: The radiographic assessment revealed comparable rates of fracture union in both groups, with most exhibiting indicators of union by the 6-week assessment and full union by the 3-month evaluation. These findings confirm that both methods are effective in promoting prompt fracture healing, which is essential for both functional recovery and reducing problems related to non-union or delayed union [5, 6].

Joint Function and Range of Motion: Analysing the range of motion in nearby joints showed some intriguing patterns. When it came to shoulder flexion and abduction, Group B (Interlocking Nailing) performed marginally better than Group A (Bridge Plating). Improved early mobilisation may result from the intramedullary technique's advantages in maintaining soft tissue attachments and minimising disturbance to the surrounding musculature [7, 8].

Although there may be subtle variations in shoulder mobility, the effect on elbow function may be less significant between the two approaches, as both groups showed similar results in elbow range of motion despite this trend [9].

Functional Results and Measures Provided by Patients

Significant postoperative improvements in functional outcomes were noted in both groups according to the DASH score evaluation. While Group B had marginally higher preoperative scores, suggesting a little larger beginning impairment, both procedures produced significant and similar improvements at the 6-month follow-up. These outcomes highlight how well both surgical techniques work to improve upper limb functionality and lessen impairment [10, 11].

Patient Satisfaction and Workplace Consequences: The evaluation of patient satisfaction, especially among labourers and farmers, produced a variety of interesting findings. Subjective assessments of treatment success differed, despite comparable quantitative metrics like fracture union and functional results. Patient satisfaction may be impacted by occupational demands, as various professions place varying emphasis on specific functional requirements. Compared to labourers, farmers may view treatment effectiveness differently because they place a higher value on upper limb strength when performing agricultural chores [12, 13].

Clinical Considerations and Comparative Literature

Current results are consistent with a number of studies showing comparable results for intramedullary interlocking nailing and anterior bridge plating in midshaft humerus fractures. The need for customised treatment strategies that take into account patient-specific characteristics, fracture patterns, and functional needs is highlighted by the minor variations in joint mobility and patient satisfaction that have been reported [14,15].

Functional Outcomes' Relevance

The DASH score indicates significant gains in functional outcomes, which are critical to the patient's recovery. Regaining patients' daily activities and quality of life depends critically on the decrease in impairment and improvement in upper limb functionality. However, in certain work or lifestyle circumstances, the subtleties in joint mobility, especially in the shoulder, may have practical ramifications [11-13].

Patient-specific factors and biomechanical considerations

One possible explanation for the disparities in range of motion results between the two methods is the presence of biomechanical variances in the surgical techniques. With direct access to the fracture site made possible by anterior bridge plating, accurate reduction and fixation are possible. Contrarily, intramedullary interlocking nailing reduces soft tissue disturbance and maintains the periosteal blood supply, which may enhance early mobilisation [11-15].

Furthermore, functional outcomes may be impacted by patient-specific variables such as age, bone quality, pre-existing diseases, and postoperative rehabilitation compliance. Although current research may not have fully captured these aspects, they continue to be crucial in clinical decision-making and in predicting the course of a patient's recovery [4,8,6].

Long-Term Problems and Considerations

Although the short-term results up to the 6-month mark were the main focus of current investigation, each technique's long-term consequences and potential difficulties should be taken into account. After the trial is over, complications such as implant-related problems, non-union, malunion, or further treatments could appear. In order to assess the longevity of functional improvements and detect late-onset problems that may have an influence on patient outcomes, longer-term follow-up studies are essential [12,13].

Clinical Decision-Making with a Focus on the Patient

The best surgical approach should be chosen based on the unique needs, fracture patterns, and features of each patient. In order to provide patient-centered treatment, shared decision-making between the physician and the patient is essential, taking into account the subtle variations in results, patient ps, and vocational requirements [6-10].

Future Directions and Research Implications

To fully understand the long-term effects of each approach, future research endeavours should concentrate on larger cohort studies with longer follow-up periods. Further research and development of evidence-based practise in fracture management should be facilitated by comparative analyses incorporating a wider range of patient populations, fracture patterns, and careful evaluation of complications [11-14].

Limitations and Considerations

There are some restrictions on current research. The limited sample size may restrict the findings' generalizability, necessitating larger-scale research to draw reliable conclusions. Furthermore, the brief follow-up period may fail to record long-term functional results and possible issues that may arise after the

six-month mark. To evaluate the longevity of functional gains and potential late-onset problems, more research with longer follow-up times is necessary.

CONCLUSION

In the treatment of midshaft humerus fractures, a comparative research using anterior bridge plating and intramedullary interlocking nailing has shed light on the effectiveness, results, and patient-centered factors of each procedure.

Current research shows that both intramedullary interlocking nailing and anterior bridge plating are useful methods for achieving fracture union, restoring function as assessed by the DASH score, and maximising range of motion in neighbouring joints. The similarity between the observed rates of fracture union and functional gains underscores the efficacy of both surgical techniques in managing midshaft humerus fractures.

Subtle variations in shoulder range of motion were detected, with the intramedullary nailing group exhibiting somewhat better results. Patient satisfaction revealed subjective assessments of treatment success, which may have been impacted by unique functional needs, especially across various occupational groups.

The results highlight the significance of taking into account fracture features, functional requirements, and patient-specific considerations when determining the best surgical approach. In order to provide individualised treatment, clinicians and patients should participate in collaborative decision-making while considering the subtle variations in outcomes and patient ps.

Even though current research offers insightful information, it is important to recognise its limitations, such as the small sample size and the relatively brief follow-up. Subsequent investigations must to concentrate on more extensive cohorts with prolonged follow-up durations in order to thoroughly assess long-term consequences and difficulties linked to every method.

To sum up, the comparative analysis offers physicians information to help them make judgements about how best to treat midshaft humerus fractures. A customised strategy taking into account patient-specific characteristics is essential to optimising outcomes and providing patient-centered care. Both anterior bridge plating and intramedullary interlocking nailing are reasonable alternatives.

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