Section: Orthopaedics

Original Research Article

TO COMPARE FUNCTIONAL OUTCOMES OF SHAFT OF HUMERUS FRACTURE TREATED BY ANTERIOR PLATING Vs POSTERIOR PLATING

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ABSTRACT

Background: Humeral shaft fractures constitute about 3–5% of all fractures and commonly result from high-energy trauma such as road traffic accidents, falls, and assaults. Plate osteosynthesis is a widely accepted treatment modality; however, the optimal surgical approach—anterior versus posterior plating—remains controversial. The objective is to compare the functional and radiological outcomes of humeral shaft fractures treated by anterior plating versus posterior plating.

Materials and Methods: This prospective comparative study was conducted in the Department of Orthopaedics at CSS Hospital, Subharti Medical College, Meerut. Thirty patients with humeral shaft fractures were divided into two groups: 15 underwent anterior plating and 15 underwent posterior plating. Patients were followed up at 4, 8, and 12 weeks, and at 6 months postoperatively. Functional outcomes were assessed using the Visual Analog Scale (VAS), Disabilities of the Arm, Shoulder and Hand (DASH) score, and range of motion. Radiological union, operative duration, intraoperative blood loss, and complications were also evaluated. Statistical analysis included independent t-test, paired t-test, and chi-square test.

Results: Both groups showed progressive improvement in functional outcomes with no significant difference between them. Radiological union rates were comparable. Posterior plating was associated with longer operative time and greater intraoperative blood loss. Complication rates were higher in the posterior group but not statistically significant.

Conclusion: Both anterior and posterior plating techniques yield satisfactory outcomes in humeral shaft fractures. However, anterior plating offers advantages of shorter operative duration and less blood loss, making it a safe and effective approach in suitable cases.

Keywords: Humeral shaft fracture, anterior plating, posterior plating, plate osteosynthesis, functional outcome, DASH score, Visual Analog Scale, fracture union.

INTRODUCTION

Fractures of the humeral shaft account for approximately 3–5% of all fractures and represent a significant proportion of long bone injuries encountered in orthopedic practice. These fractures commonly occur due to high-energy trauma such as road traffic accidents, falls from height, assaults, and sports injuries.[1] In younger individuals, high-velocity trauma is the most frequent cause, whereas in elderly patients low-energy trauma such as simple falls is more common due to osteoporosis and reduced bone strength. Humeral shaft fractures may also be associated with complications such as radial nerve injury because of the close anatomical relationship between the radial nerve and the humeral shaft along the spiral groove.[2]

Most humeral shaft fractures were traditionally treated conservatively using methods such as hanging casts, functional braces, and splints. Conservative

management has shown satisfactory union rates in many cases because of the rich vascular supply of the humerus and the ability of the surrounding musculature to provide adequate fracture stabilization. Functional bracing introduced by Sarmiento demonstrated high union rates with acceptable functional outcomes in many patients.[3] However, conservative treatment may also be associated with several limitations including prolonged immobilization, malunion, delayed union, and poor patient compliance, especially in polytrauma patients or individuals requiring early mobilization.[4,5]

Surgical fixation provides stable fracture reduction, allows early mobilization of the shoulder and elbow joints, and facilitates faster return to daily activities. Various surgical options are available for fixation of humeral shaft fractures, including plate osteosynthesis, intramedullary nailing, and external fixation. Among these methods, open reduction and internal fixation with plate osteosynthesis remains a widely accepted treatment option for many types of humeral shaft fractures because it provides rigid fixation, high union rates, and good functional outcomes.[5,6]

Plate fixation of humeral shaft fractures can be performed using different surgical approaches, most commonly the anterior or anterolateral approach and the posterior approach. The posterior approach allows direct visualization of the radial nerve and provides excellent exposure of the posterior surface of the humerus, which is considered the tension side of the bone. However, this approach may be associated with increased soft tissue dissection and risk of iatrogenic radial nerve injury. The anterior approach provides access to the anterolateral surface of the humerus without extensive triceps dissection and may reduce operative morbidity in suitable fracture patterns.[7,8]

Various studies have compared functional outcomes, complication rates, radiological union, operative time, and blood loss between anterior and posterior plating techniques. Some studies have suggested that anterior plating may result in lower complication rates and shorter operative time, while others have reported no statistically significant difference in functional outcomes between the two approaches.[1,8,9] Functional outcome assessment using the Visual Analog Scale, Disabilities of the Arm, Shoulder and Hand score, and range of motion provides objective comparison of surgical approaches and helps guide clinical decision making.[10] Therefore, the present study was conducted to compare functional and radiological outcomes of shaft of humerus fractures treated by anterior plating versus posterior plating technique.

MATERIALS AND METHODS

Study design: Prospective comparative study.

Study setting: Department of Orthopaedics, CSS Hospital, Subharti Medical College, Meerut.

Study duration: The study was carried out over a period of two years. All patients were followed for a minimum period of six months after surgery to assess fracture union and functional outcomes.

Study population: Patients diagnosed with fractures of the shaft of the humerus who presented to the Department of Orthopaedics during the study period. Both male and female patients aged above 18 years were included in the study.

Sample size: A total of 30 patients with shaft of humerus fractures were included. Patients were divided into two groups: Group A included patients treated with anterior plating (15 patients), and Group B included patients treated with posterior plating (15 patients).

Inclusion criteria:

- Patients aged more than 18 years
- Patients with acute shaft of humerus fractures
- Closed fractures of the humeral shaft
- Fractures less than three weeks old
- Patients medically fit for surgery
- Patients willing to participate in the study and provide informed consent

Exclusion criteria:

- Undisplaced humeral shaft fractures
- Patients unfit for surgery
- Patients younger than 18 years of age
- Pathological fractures
- Chronic fractures
- Patients with active infection at the fracture site

Ethical considerations: Ethical approval for the study was obtained from the Institutional Ethical Committee of Subharti Medical College, Meerut. Informed consent was obtained from all patients after explaining the nature, purpose, and possible risks of the study.

Clinical evaluation: All patients were asked to provide a detailed history of how the injury occurred, the time since injury, and associated symptoms. General examination and systemic examination were carried out. The affected limb was examined for swelling, deformity, tenderness, crepitus, abnormal mobility, and loss of function. Neurovascular status was carefully assessed with special focus on radial nerve function.

Radiological evaluation: Radiographic examination was performed in all patients using anteroposterior and lateral views of the humerus. These radiographs were used to confirm the diagnosis, determine fracture pattern, and plan the surgical procedure.

Preoperative investigations: All patients underwent routine preoperative investigations including complete blood count, random blood sugar, blood urea and serum creatinine, serum calcium and Vitamin D3, prothrombin time/INR, viral markers including HIV and HBsAg, and electrocardiogram.

Operative management: Surgical management was performed using plate osteosynthesis through anterior or posterior plating technique. During surgery, duration of surgery in minutes, intraoperative blood loss in milliliters, and intraoperative complications were recorded.

Postoperative protocol: After surgery, the operated limb was supported in an arm sling for 3 to 5 days. Intravenous antibiotics were administered for three days postoperatively. Postoperative radiographs were obtained to assess fracture alignment and fixation. Passive and active shoulder mobilization exercises were initiated on the third postoperative day under supervision, and gradual mobilization of the elbow joint was encouraged as tolerated by the patient.

Follow-up: Patients were followed up at 4 weeks, 8 weeks, 12 weeks, and 6 months. At each follow-up visit, clinical and radiological assessments were performed.

Outcome measures: Functional outcomes were evaluated using the Visual Analog Scale for pain, Disabilities of the Arm, Shoulder and Hand score for upper limb disability, and range of motion of shoulder and elbow joints. Radiological union was assessed using follow-up radiographs and was defined as presence of bridging callus across the fracture site with absence of pain during limb movement. Postoperative complications such as infection, delayed union, non-union, radial nerve palsy, stiffness, and implant failure were recorded.

Statistical analysis: All collected data were entered in a spreadsheet and analyzed using proper statistical software. Continuous variables were presented as mean and standard deviation, and categorical variables were presented as frequencies and percentages. Comparisons between anterior and posterior plating groups were performed using independent samples t-test for continuous variables. Comparisons of preoperative and postoperative outcomes within the same group were made using paired t-test. Categorical data such as union rates and complications were compared using chi-square test. The p value of <0.05 was considered statistically significant.

RESULTS

Thirty patients were included in the study, with 15 patients in the posterior plating group and 15 patients in the anterior plating group. Baseline demographic and injury characteristics were comparable between both groups. The mean age of patients in the posterior group was 44.7 years, whereas in the anterior group it was 38.9 years. The median age was 45 years in the posterior group and 38 years in the anterior group. The standard deviation was 11.1 years for the posterior group and 10.3 years for the anterior group. The minimum and maximum ages were 26 and 61 years in the posterior group, and 24 and 58 years in the anterior group, respectively. Overall, the study included 17 males and 13 females. Among females, 8 belonged to the posterior plating group and 5 belonged to the anterior plating group, while among males, 7 belonged to the posterior group and 10 belonged to the anterior group. Road traffic accident was the most common mode of injury in both groups, accounting for 7 cases in the posterior group and 7 cases in the anterior group. Fall was observed in 4 cases in each group, assault in 3 cases in each group, and other causes in 1 case in each group.

Follow-up status showed that most participants completed the study up to six months. In the posterior plating group, 11 patients completed follow-up till six months, 2 patients had non-union at six months, and 2 patients did not complete follow-up beyond three months. In the anterior plating group, 12 patients completed follow-up till six months, 1 patient had non-union at six months, and 2 patients did not complete follow-up beyond three months.

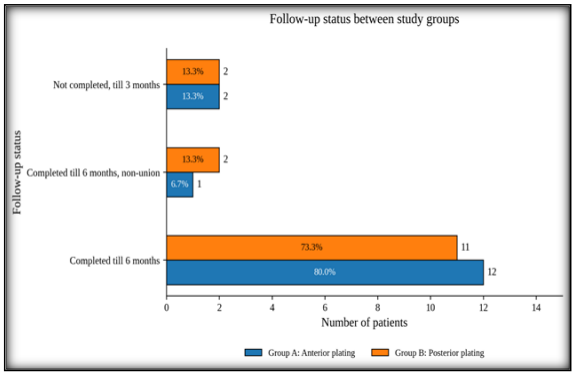

Figure 1: Follow-up status between anterior and posterior plating groups.

Table 1: Comparison of functional outcomes between posterior and anterior plating groups

Outcome parameter	Follow-up interval	Posterior plating Mean ± SD	Anterior plating Mean ± SD	p-value
VAS score	Preoperative	7.53 ± 0.915	7.73 ± 0.799	0.529
VAS score	4 weeks	4.67 ± 0.816	4.07 ± 0.799	0.051
VAS score	8 weeks	3.33 ± 1.447	2.67 ± 0.976	0.150
VAS score	12 weeks	2.47 ± 1.767	1.73 ± 1.163	0.190
VAS score	6 months	2.00 ± 2.198	1.00 ± 1.472	0.186
DASH score	Preoperative	65.5 ± 3.42	66.5 ± 3.66	0.417
DASH score	4 weeks	44.8 ± 4.06	41.9 ± 4.22	0.068
DASH score	8 weeks	34.9 ± 8.58	29.9 ± 7.49	0.104
DASH score	12 weeks	26.9 ± 11.23	21.1 ± 9.11	0.132
DASH score	6 months	20.8 ± 13.77	14.1 ± 10.46	0.176
Range of motion	Preoperative	36.5 ± 5.64	40.3 ± 5.86	0.081
Range of motion	4 weeks	65.3 ± 10.15	72.1 ± 9.68	0.068
Range of motion	8 weeks	96.4 ± 20.13	108.3 ± 15.95	0.084
Range of motion	12 weeks	116.1 ± 24.76	126.9 ± 16.18	0.166
Range of motion	6 months	124.7 ± 28.81	135.7 ± 16.84	0.246

The comparison of VAS scores, DASH scores, and range of motion between the posterior and anterior plating groups was performed using the independent samples t-test. Both groups showed progressive improvement during follow-up. Although the anterior plating group demonstrated slightly lower mean VAS and DASH scores and slightly higher range of motion values during follow-up, the differences between the two groups were not statistically significant at any time point.

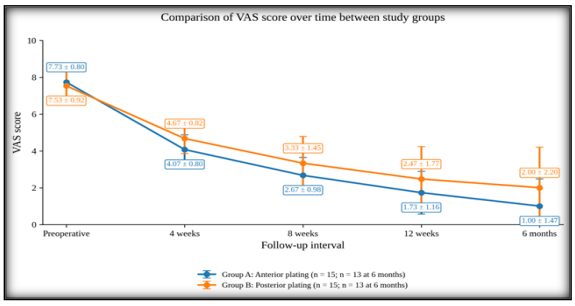

Figure 2: Comparison of VAS score over time between anterior and posterior plating groups

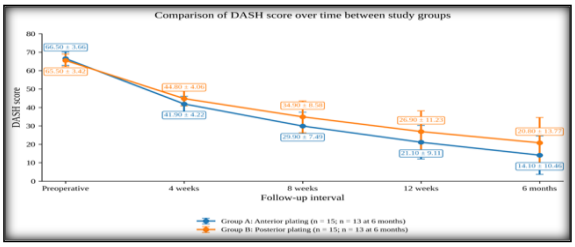

Figure 3: Comparison of DASH score over time between anterior and posterior plating groups

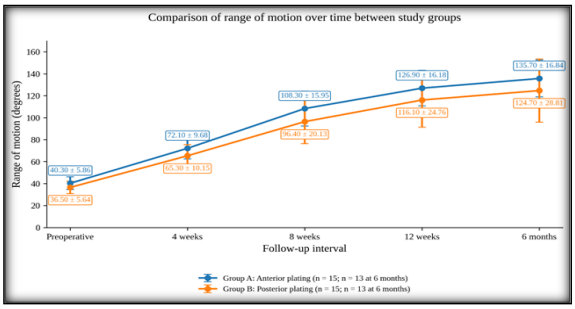

Figure 4: Comparison of range of motion over time between anterior and posterior plating groups

Table 2: Paired comparison of preoperative and six-month functional outcomes

Parameter	N	Preoperative Mean ± SD	6-month Mean ± SD	Mean difference	p-value
VAS score	26	7.58 ± 0.857	1.50 ± 1.903	6.08	<.001
DASH score	26	65.77 ± 3.409	17.42 ± 12.458	48.35	<.001
Range of motion	26	37.62 ± 5.664	130.19 ± 23.791	-92.58	<.001

The paired samples t-test showed statistically significant improvement from the preoperative period to six months after surgery in the overall study population. The mean VAS score decreased from 7.58 ± 0.857 to 1.50 ± 1.903, the mean DASH score decreased from 65.77 ± 3.409 to 17.42 ± 12.458, and the mean range of motion improved from 37.62 ± 5.664 degrees to 130.19 ± 23.791 degrees. All these changes were statistically significant with p <.001.

Table 3: Comparison of operative and radiological outcomes between posterior and anterior plating groups

Parameter	Posterior plating	Anterior plating	p-value
Duration of surgery	98.4 ± 7.64 minutes	85.9 ± 7.90 minutes	<.001
Intraoperative blood loss	279.7 ± 27.80 ml	236.0 ± 28.36 ml	<.001
Radiological union	13/15 (86.7%)	14/15 (93.3%)	0.543
Fracture union time	16.7 ± 2.29 weeks	14.7 ± 2.73 weeks	0.053

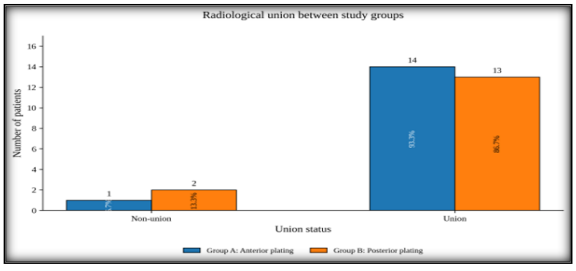

Figure 5: Comparison of radiological union between anterior and posterior plating groups

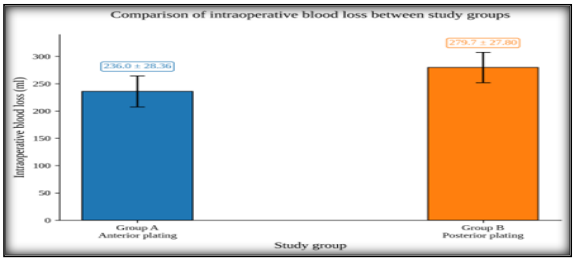

Figure 7: Comparison of intraoperative blood loss between anterior and posterior plating groups

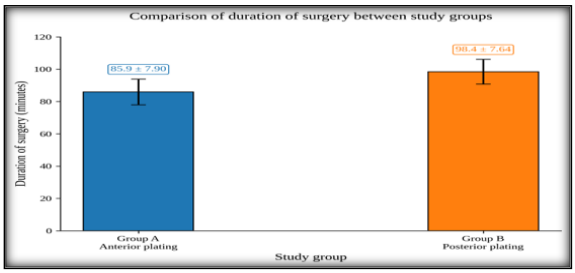

Figure 6: Comparison of duration of surgery between anterior and posterior plating groups

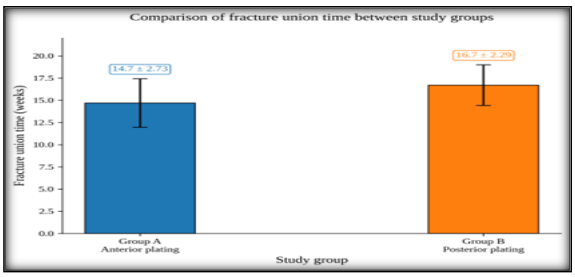

Figure 8: Comparison of fracture union time between anterior and posterior plating groups

Operative duration and intraoperative blood loss were significantly higher in the posterior plating group compared to the anterior plating group. The mean duration of surgery was 98.4 ± 7.64 minutes in the posterior group and 85.9 ± 7.90 minutes in the anterior group (p <.001). The mean intraoperative blood loss was 279.7 ± 27.80 ml in the posterior group and 236.0 ± 28.36 ml in the anterior group (p <.001). Radiological union was achieved in 13 patients (86.7%) in the posterior group and 14 patients (93.3%) in the anterior group, with no statistically significant difference (p = 0.543). Mean fracture union time was 16.7 ± 2.29 weeks in the posterior group and 14.7 ± 2.73 weeks in the anterior group; this difference was not statistically significant (p = 0.053).

Table 4: Follow-up status and complications among study participants

Parameter	Posterior plating	Anterior plating	p-value
Completed till 6 months	11 (36.7%)	12 (40.0%)	—
Completed till 6 months, non-union	2 (6.7%)	1 (3.3%)	—
Not completed, till 3 months	2 (6.7%)	2 (6.7%)	—
Complications present	11/15 (73.3%)	6/15 (40.0%)	0.065
No complications	4/15 (26.7%)	9/15 (60.0%)	0.065

Complications were observed more frequently in the posterior plating group compared with the anterior plating group. In the posterior plating group, complications were observed in 11 patients (73.3%), while 4 patients (26.7%) did not develop any complications. In the anterior plating group, complications were observed in 6 patients (40.0%), while 9 patients (60.0%) had no complications. The difference in complication rates between the two groups was not statistically significant ($\chi^2 = 3.39$, p = 0.065).

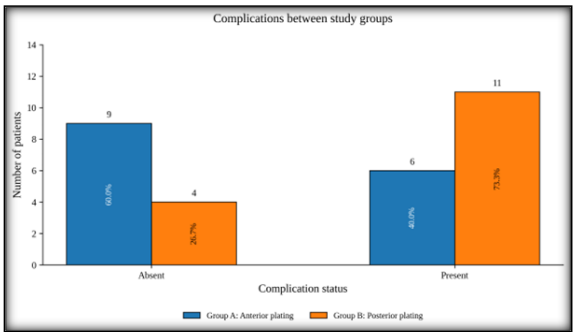

Figure 9: Comparison of complications between anterior and posterior plating groups

DISCUSSION

Humeral shaft fractures are relatively common injuries encountered in orthopedic practice and constitute about 3–5% of all fractures. Treatment has evolved from conservative management to operative fixation methods aimed at stable fixation, early mobilization, and better functional recovery. Plate osteosynthesis is one of the most widely used surgical methods for humeral shaft fractures. However, the optimal approach for plate fixation, particularly anterior versus posterior plating, remains a matter of discussion. The present prospective comparative study evaluated functional outcomes, radiological union, operative duration, blood loss, fracture union time, and complications in patients treated with anterior and posterior plating.

In the present study, the mean age of patients was 44.7 years in the posterior plating group and 38.9 years in the anterior plating group, indicating that most patients belonged to the active adult age group. The study included 17 male and 13 female patients, with males slightly more affected than females. Road traffic accident was the most common mode of injury in both groups, followed by fall and assault. These findings are comparable with Ekholm et al., who reported road traffic accidents, falls, and direct trauma as common mechanisms of humeral shaft fractures.[2] Dalal et al. also reported road traffic accident as a common mode of injury in patients undergoing anterior and posterior plating for shaft humerus fractures.[9]

Pain assessment using the Visual Analog Scale showed progressive improvement in both groups during follow-up. The anterior plating group had slightly lower mean VAS scores during follow-up, but the difference between groups was not statistically significant at any interval. Similarly, DASH scores improved progressively in both groups, indicating improvement in upper limb function after surgical fixation. However, there was no statistically significant difference between anterior and posterior plating groups at any follow-up. These findings are consistent with Lotzien et al., who reported comparable clinical outcomes between anterior and posterior plating techniques for humeral shaft fractures.[1] Shin et al. also reported similar functional outcomes between anterior and posterior plating in extra-articular distal-third diaphyseal humeral fractures.[11]

Range of motion of the shoulder and elbow improved progressively in both groups. Although the anterior plating group demonstrated slightly greater range of motion values at follow-up, the differences were not statistically significant. This suggests that both surgical approaches allow satisfactory restoration of joint mobility when stable fixation and early mobilization are achieved. Similar findings were reported by Shin et al. and Yoon et al., who observed comparable functional outcomes and range of motion between anterior or anterolateral and posterior approaches.[11,12]

Radiological union was achieved in 13 patients (86.7%) in the posterior plating group and 14 patients (93.3%) in the anterior plating group. The difference

in union rate was not statistically significant. Mean fracture union time was 16.7 ± 2.29 weeks in the posterior group and 14.7 ± 2.73 weeks in the anterior group, with no statistically significant difference. These findings are consistent with Lotzien et al., who reported similar union rates between anterior and posterior plate fixation.[1] Zala et al. also observed no significant difference in union time, complication rate, and revision surgery rate between anterior minimally invasive plating and posterior plating techniques.[13]

The most important statistically significant findings in the present study were related to operative parameters. The mean duration of surgery was significantly longer in the posterior plating group than in the anterior plating group (98.4 ± 7.64 minutes vs 85.9 ± 7.90 minutes; p <.001). Intraoperative blood loss was also significantly higher in the posterior group compared to the anterior group (279.7 ± 27.80 ml vs 236.0 ± 28.36 ml; p <.001). These findings are comparable with Huang et al., who reported shorter operative time and less blood loss with the anterolateral approach compared to the posterior approach.[8] Yoon et al. also reported that the anterolateral technique significantly reduced operative time while maintaining comparable functional outcomes.[14] The increased operative time and blood loss associated with posterior plating may be due to greater soft tissue dissection, triceps handling, and careful identification of the radial nerve.

Complications were more frequent in the posterior plating group compared with the anterior plating group, although the difference was not statistically significant (p = 0.065). In the posterior group, complications were observed in 11 patients (73.3%), whereas in the anterior group complications were observed in 6 patients (40.0%). Similar observations were made by Dalal et al., who reported higher complications including iatrogenic radial nerve palsy and infection in the posterior plating group.[9] Shimamoto et al. also reported postoperative radial nerve palsy in patients treated with posterior plating.[14] The higher complication tendency with posterior plating may be related to the close relationship of the radial nerve and greater soft tissue dissection during posterior exposure.

Although the present study provides useful information regarding anterior and posterior plating techniques for humeral shaft fractures, certain limitations should be considered. The sample size was relatively small, with only 30 patients divided into 15 patients in each group. The study was conducted at a single tertiary care center and the follow-up period was limited to six months. Patients were not randomized into anterior and posterior plating groups, which may introduce selection bias. Functional outcomes may also be influenced by patient compliance with physiotherapy and rehabilitation. Quality of life, patient satisfaction, and return to occupational activities were not assessed. Larger multicenter randomized studies with longer follow-up are recommended for stronger evidence.

The findings of the present study suggest that both anterior and posterior plating techniques provide satisfactory functional and radiological outcomes in shaft of humerus fractures. However, anterior plating showed clear operative advantages in terms of shorter surgical duration and lower intraoperative blood loss. Therefore, anterior plating may be preferred in suitable cases where adequate fracture exposure and stable fixation can be achieved, while posterior plating remains an appropriate option depending on fracture characteristics and surgeon experience.

CONCLUSION

The present study demonstrated that both anterior and posterior plating techniques provide satisfactory functional and radiological outcomes in the management of shaft of humerus fractures. VAS score, DASH score, and range of motion improved progressively after surgery in both groups, and there was no statistically significant difference in functional outcomes between anterior and posterior plating at any follow-up interval. Radiological union rates and fracture union time were comparable between the two groups. However, posterior plating was associated with significantly longer operative duration and greater intraoperative blood loss compared with anterior plating. Complications were more frequent in the posterior plating group, although the difference was not statistically significant. Thus, anterior plating appears to be a safe and effective approach in suitable humeral shaft fractures, offering advantages of shorter surgical duration and less blood loss while maintaining comparable functional and radiological outcomes.

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