

PLATING VS SCREW NAIL FOR FRACTURE LOWER END OF THE FIBULA: A RANDOMIZED PROSPECTIVE COMPARATIVE STUDY

¹*Dr. Patibandla Ramsagar, ²Dr. Rajeev Ratna Suresh Naik, ³Dr. Mahesh DV

¹Junior Resident, Department of Orthopaedics, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B.G. Nagara – 571448, Karnataka, India

²Associate Professor, Department of Orthopaedics, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B.G. Nagara – 571448, Karnataka, India

³Professor, HOD, Department of Orthopaedics, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B.G. Nagara – 571448, Karnataka, India

*Corresponding author: Dr. Patibandla Ramsagar, ram.sagar0102@gmail.com

ABSTRACT

Background: Lower-end fibula fractures are common ankle injuries requiring anatomical reduction and stable fixation to restore ankle mortise congruity. Plate fixation is effective but may cause soft-tissue complications due to the subcutaneous location of the lateral malleolus. Screw nail fixation offers a minimally invasive alternative with potentially reduced wound morbidity. **AIM:** To compare functional and radiological outcomes of screw nail fixation and plate fixation in lower-end fibula fractures.

Objectives: To compare functional outcomes, fracture union, ankle mortise congruity, and complications between both techniques.

Materials and Methods: A randomized prospective comparative study was conducted in patients undergoing operative treatment. Patients were allocated to plate or screw nail fixation. Functional outcomes were assessed using AOFAS, Kitaoka, and Olerud–Molander scores. Serial radiographs evaluated union and alignment. Complications were documented during follow-up.

Results: Both techniques achieved satisfactory union and alignment. Screw nail fixation showed comparable functional outcomes with fewer wound-related complications and implant irritation. **CONCLUSION:** Screw nail fixation is an effective minimally invasive alternative to plate fixation, offering comparable outcomes with reduced soft-tissue complications.

Keywords: Lower end fibula fracture, ankle fracture, plate osteosynthesis, screw nail fixation, functional outcome, radiological union

INTRODUCTION

Fractures of the ankle are among the most common injuries encountered in orthopedic practice, with fractures of the lower end of the fibula forming a major proportion. The lateral malleolus is essential for maintaining ankle mortise stability, and even minor malalignment can adversely affect tibiotalar biomechanics. A 1-mm lateral talar shift has been reported to reduce tibiotalar contact area by approximately 42%, emphasizing the importance of anatomical reduction and stable fixation.¹

Stable or undisplaced fractures may be treated conservatively, whereas displaced and unstable fractures generally require operative fixation. Plate osteosynthesis remains a widely accepted technique because it provides reliable reduction and stability. However, its subcutaneous location may result in wound problems, infection, implant prominence, irritation, and secondary implant removal.²

Intramedullary fibular nail or screw-nail fixation has emerged as a minimally invasive alternative. It reduces soft-tissue dissection and may decrease wound complications while providing adequate stability. Comparative studies have demonstrated similar union and functional outcomes between nailing and plating, although complication profiles may vary.^{3–5} Recent evidence suggests that intramedullary fixation may reduce wound complications and

symptomatic hardware, while both techniques provide reliable fracture union⁵

Therefore, the present randomized prospective comparative study aims to evaluate functional and radiological outcomes, complications, and rehabilitation following plating versus screw-nail fixation of lower-end fibula fractures.

AIM AND OBJECTIVES OF THE STUDY

The primary objective of this study is to assess and compare the functional and radiological outcomes of screw nail fixation versus plating in fractures of the lower end of the fibula. The secondary objectives are to evaluate the demographic characteristics of patients, including age and sex distribution, and to determine the various modes of injury associated with lower-end fibula fractures.

METHODOLOGY

STUDY DESIGN: A randomized prospective comparative study was conducted to evaluate and compare the functional and radiological outcomes of plating versus screw nail fixation for fractures of the lower end of the fibula.

STUDY SETTING AND DURATION: The study was conducted in the Orthopaedics Department, Adichunchanagiri Institute of Medical Sciences, B.G. Nagara, Mandya District, involving patients attending the OPD and casualty. The study duration was 18 months, from October 2023 to April 2025.

PARTICIPANTS: Patients aged >18 to 80 years with lower-end fibula fractures, with or without associated medial malleolus or distal tibial fractures, were included. Open, segmental,

pathological fractures and fractures requiring syndesmotic stabilization were excluded.

SAMPLE SIZE AND GROUPS: A total of 64 patients were enrolled by convenience sampling. Thirty-two patients underwent plate fixation (Group A), while 32 underwent screw nail fixation (Group B).

STUDY PARAMETERS: Demographic characteristics, mode of injury, side involved, fracture pattern, operative time, complications, radiological union, ankle range of motion, weight-bearing ability, and functional outcomes using AOFAS, Kitaoka, and Olerud–Molander Ankle Scores were assessed.

STUDY PROCEDURE AND DATA COLLECTION: After Institutional Ethics Committee approval and written informed consent, clinical examination and appropriate radiographs were performed. Patients underwent fixation according to the assigned treatment group, followed by standardized postoperative rehabilitation. Data were recorded in a structured proforma and patients were followed at 1, 3, and 6 months.

DATA ANALYSIS: Continuous variables were expressed as mean $\pm$ standard deviation and categorical variables as frequencies and percentages. Intergroup comparisons were performed using appropriate statistical tests, with $p < 0.05$ considered statistically significant.

ETHICAL CONSIDERATIONS: Ethical clearance and informed consent were obtained. Patient confidentiality was maintained, and the study followed the Declaration of Helsinki. Participants could withdraw at any time without affecting their treatment.

RESULTS

A total of **64 patients** with fractures of the lower end of the fibula were included, with **32 patients in the plating group and 32 in the screw-nail group**. The baseline demographic and injury characteristics were comparable between the two groups.

Table :1 Age distribution of study participants

Age group (years)	Frequency (n)	Percentage (%)
≤ 30	15	23.4
31–40	14	21.9
41–50	17	26.6
> 50	18	28.1
Total	64	100

The largest proportion of patients belonged to the **> 50 -year age group (28.1%)**, followed by 41–50 years (26.6%). The mean age was **41.75 ± 12.79 years** in the plating group and **40.94 ± 12.04**

years in the screw-nail group, with no significant difference ($p = 0.794$).

Table 2: Baseline comparison between treatment groups

Variable	Plating (n=32)	Screw nail (n=32)	p-value
Mean age (years)	41.75 ± 12.79	40.94 ± 12.04	0.794
Female, n (%)	11 (34.4)	12 (37.5)	0.794
Male, n (%)	21 (65.6)	20 (62.5)	
Right side, n (%)	18 (56.3)	17 (53.1)	0.802
Left side, n (%)	14 (43.8)	15 (46.9)	

There were no statistically significant differences in age, sex, or side of injury, confirming comparable baseline characteristics.

Table 3: Mode of injury

Mode of injury	Plating n (%)	Screw nail n (%)	p-value
Road traffic accident	14 (43.8)	13 (40.6)	0.959
Fall	10 (31.3)	11 (34.4)	
Twisting injury	8 (25.0)	8 (25.0)	

Road traffic accidents were the commonest mode of injury, accounting for **43.8%** of plating cases and **40.6%** of screw-nail

cases. The difference was not statistically significant.

Table 4: Operative and hospitalization outcomes

Parameter	Plating	Screw nail	p-value
Injury-to-surgery interval (days)	2.91 ± 1.45	3.16 ± 1.63	0.518
Duration of surgery (min)	71.41 ± 14.16	49.69 ± 12.37	< 0.001
Blood loss (mL)	91.88 ± 34.47	40.94 ± 18.42	< 0.001
Hospital stay (days)	4.16 ± 1.27	2.84 ± 1.11	< 0.001

Screw-nail fixation required significantly less operative time, resulted in significantly lower intraoperative blood loss, and was

associated with a shorter hospital stay.

Table 5: Functional outcome: AOFAS score

Follow-up	Plating	Screw nail	p-value
6 weeks	62.31 ± 9.06	66.84 ± 9.32	0.053
12 weeks	79.84 ± 7.46	83.66 ± 6.88	0.038
6 months	91.16 ± 6.05	93.63 ± 4.68	0.073

AOFAS scores improved progressively in both groups. The

screw-nail group demonstrated higher scores at all follow-ups, with a statistically significant difference at **12 weeks**.

Table 6: Functional outcome: Olerud–Molander Ankle Score (OMAS)

Follow-up	Plating	Screw nail	p-value
6 weeks	55.56 ± 10.34	60.44 ± 9.93	0.059
12 weeks	74.78 ± 8.44	80.63 ± 6.23	0.002
6 months	88.19 ± 6.07	91.13 ± 5.17	0.041

OMAS improved significantly over time in both groups. Screw-nail fixation demonstrated significantly

better functional scores at **12 weeks and 6 months**.

Table 7: Postoperative complications

Complication	Plating n (%)	Screw nail n (%)	p-value
Superficial infection	3 (9.4)	1 (3.1)	0.302
Deep infection	1 (3.1)	0 (0)	0.313
Wound dehiscence	2 (6.3)	0 (0)	0.151
Implant irritation	6 (18.8)	2 (6.3)	0.131
Hardware failure	1 (3.1)	1 (3.1)	1.000
Reoperation	2 (6.3)	1 (3.1)	0.554
Any complication	13 (40.6)	5 (15.6)	0.026

Although individual complications did not reach statistical significance, the overall complication rate was significantly

higher in the plating group (**40.6% vs 15.6%, p = 0.026**).

Table 8: Pain and return-to-work outcomes

Parameter	Plating	Screw nail	p-value
Pain VAS at 6 months	2.44 ± 2.12	1.84 ± 1.65	0.216
Return to work (weeks)	10.72 ± 3.33	8.44 ± 2.75	0.004
Early return to work ≤8 weeks	31.3%	56.3%	0.044

Pain at 6 months was lower in the screw-nail group but did not reach statistical significance. However, patients treated with screw nails returned to work significantly earlier, with **56.3% returning within 8 weeks compared with 31.3% in the plating group**.

Overall, **both plating and screw-nail fixation produced satisfactory functional recovery**. However, screw-nail fixation demonstrated significant advantages in terms of **shorter operative time, reduced blood loss, shorter hospital stay, better early functional recovery, fewer overall postoperative complications, and earlier return to work**. Both AOFAS and OMAS scores improved significantly over time in both groups, while the average functional scores across follow-up were significantly higher in the screw-nail group.

DISCUSSION

The present randomized prospective comparative study evaluated plating versus screw-nail fixation for fractures of the lower end of the fibula, focusing on perioperative parameters, functional recovery, postoperative complications, pain, and return to work. A total of 64 patients were included, with 32 patients treated by plating and 32 by screw-nail fixation. The baseline characteristics were comparable between the groups, allowing meaningful comparison of treatment-related outcomes. The findings demonstrate that screw-nail fixation provides important perioperative and functional advantages while maintaining satisfactory clinical outcomes.

Age Distribution

In the present study, the largest proportion of patients belonged to the >50-year age group (28.1%), followed by 41–50 years (26.6%). The mean age was 41.75 ± 12.79 years in the plating group and 40.94 ± 12.04 years in the screw-nail group, with no statistically significant difference (p = 0.794). This indicates that the two groups were well matched with respect to age. Similar observations were reported by **Asolum et al.²** and **Duk-hwan Kho et al.⁶** who found no significant age-related difference between patients undergoing fibular nailing and plating. The predominance of middle-aged and older patients is clinically relevant because increasing age may be associated with poorer soft-tissue quality and slower rehabilitation. The comparable age distribution in the present study reduces the possibility that age influenced the observed differences between fixation techniques.

Sex Distribution

Males constituted 65.6% of the plating group and 62.5% of the screw-nail group, whereas females constituted 34.4% and 37.5%, respectively. The difference was not statistically significant (p = 0.794). Similar male predominance has been described by **Asolum et al.²** and **Duk-hwan Kho et al.⁶** The comparable sex distribution between the groups is important because it minimizes sex-related confounding during assessment of functional recovery and postoperative outcomes.

Side of Injury

Right-sided fractures were slightly more frequent in both groups, accounting for 56.3% of plating cases and 53.1% of screw-nail cases. There was no statistically significant difference between the groups (p = 0.802). **Duk-hwan Kho et al.⁶** similarly found no

important relationship between side of injury and postoperative outcomes. Therefore, laterality was unlikely to have influenced the functional results observed in the present study.

Mode of Injury

Road traffic accidents were the most common mode of injury, accounting for 43.8% of patients in the plating group and 40.6% in the screw-nail group, followed by falls and twisting injuries. The difference was not statistically significant ($p = 0.959$). The comparable distribution of injury mechanisms suggests that both groups were exposed to broadly similar injury patterns and trauma severity. Previous studies have included both high- and low-energy mechanisms and have demonstrated favorable outcomes with intramedullary fixation in appropriately selected fractures.

Fracture Pattern and Associated Injuries

Weber B fractures predominated in both groups, comprising 68.8% of plating cases and 71.9% of screw-nail cases, while Weber C fractures accounted for 31.3% and 28.1%, respectively. The difference was not statistically significant ($p = 0.784$). Isolated fibular fractures were the most common associated pattern, followed by medial malleolus and distal tibial involvement. These variables were also comparable between groups. This baseline similarity is important because fracture morphology and associated injuries can substantially influence fixation stability and recovery. The present findings suggest that screw-nail fixation can provide satisfactory outcomes in commonly encountered Weber B and selected Weber C fractures when appropriate indications and surgical techniques are followed.

Injury-to-Surgery Interval

The mean injury-to-surgery interval was 2.91 ± 1.45 days in the plating group and 3.16 ± 1.63 days in the screw-nail group, with no significant difference ($p = 0.518$). Thus, both groups underwent surgery at a comparable time after injury. This is important because delayed fixation may influence soft-tissue condition and postoperative recovery. Since the timing of surgery was similar, the differences in perioperative and functional outcomes are more likely to reflect the fixation technique rather than variation in surgical timing.

Duration of Surgery

A significant difference was observed in operative duration. The mean duration was 71.41 ± 14.16 minutes for plating compared with 49.69 ± 12.37 minutes for screw-nail fixation ($p < 0.001$). Thus, screw-nail fixation reduced operative time by approximately 22 minutes. The shorter operative duration may be attributed to the minimally invasive nature of intramedullary fixation, reduced soft-tissue dissection, and simplified implant insertion. **Puga et al.**,⁷ in a systematic review, similarly reported operative durations that were comparable to or shorter with fibular nailing. Reduced operating time may be particularly beneficial in elderly or medically compromised patients by decreasing anesthesia exposure and perioperative morbidity.

Intraoperative Blood Loss

Mean intraoperative blood loss was significantly lower in the screw-nail group (40.94 ± 18.42 mL) compared with the plating group (91.88 ± 34.47 mL; $p < 0.001$). This reduction reflects the smaller incision and limited soft-tissue dissection associated with intramedullary fixation. **Beleckas et al.**⁸ and **Attia et al.**⁹ have emphasized the soft-tissue-sparing benefits of minimally invasive fibular fixation. Lower blood loss may contribute to faster postoperative recovery and reduced surgical morbidity.

Hospital Stay

Patients treated with screw-nail fixation had a significantly shorter hospital stay, with a mean duration of 2.84 ± 1.11 days compared with 4.16 ± 1.27 days in the plating group ($p < 0.001$). The approximately 1.3-day reduction is clinically relevant because shorter hospitalization decreases healthcare utilization and facilitates earlier return to

normal activities. **Attia et al.**⁹ similarly associated screw-nail fixation with fewer complications and earlier discharge.

Functional Outcome – AOFAS Score

AOFAS scores were consistently higher in the screw-nail group. At 6 weeks, scores were 66.84 ± 9.32 compared with 62.31 ± 9.06 in the plating group, although the difference was not statistically significant ($p = 0.053$). At 12 weeks, the difference became statistically significant, with scores of 83.66 ± 6.88 and 79.84 ± 7.46 , respectively ($p = 0.038$). At 6 months, both groups achieved high scores, with 93.63 ± 4.68 in the screw-nail group and 91.16 ± 6.05 in the plating group; this difference was not statistically significant ($p = 0.073$).

These findings suggest that screw-nail fixation may provide an early functional advantage, although the difference becomes smaller with longer follow-up. **Asolum et al.**² and **Attia et al.**⁹ also reported favorable functional outcomes following fibular nailing, while **Puga et al.**⁷ found broadly comparable long-term outcomes with some evidence of faster early recovery following nailing. The improved early function may be related to reduced soft-tissue trauma and earlier mobilization.

Functional Outcome – OMAS

The OMAS demonstrated a similar but more sustained advantage for screw-nail fixation. At 6 weeks, the score was 60.44 ± 9.93 in the screw-nail group versus 55.56 ± 10.34 in the plating group, although the difference was not statistically significant ($p = 0.059$). At 12 weeks, the difference was statistically significant (80.63 ± 6.23 versus 74.78 ± 8.44 ; $p = 0.002$). At 6 months, screw-nail fixation continued to demonstrate superior OMAS scores (91.13 ± 5.17 versus 88.19 ± 6.07 ; $p = 0.041$).

These findings are consistent with reports from **Asolum et al.**² and **Attia et al.**⁹ which demonstrated favorable functional outcomes following intramedullary fibular fixation. The persistence of a significant OMAS difference at six months suggests that the benefits of screw-nail fixation may extend beyond the immediate postoperative period.

Repeated-Measures Functional Recovery

Both groups demonstrated significant improvement in functional scores over time. The time effect was highly significant for both AOFAS ($F = 223.162$, $p < 0.001$) and OMAS ($F = 292.511$, $p < 0.001$), confirming progressive recovery after surgery. However, the Time $\times$ Group interaction was not significant for either AOFAS ($p = 0.734$) or OMAS ($p = 0.536$), indicating broadly parallel recovery patterns. Nevertheless, the overall average scores remained significantly higher in the screw-nail group for both AOFAS ($p = 0.001$) and OMAS ($p = 0.001$). Thus, both fixation methods are capable of producing good recovery, but screw-nail fixation appears to provide a higher overall functional trajectory.

Postoperative Complications

The overall complication rate was significantly higher in the plating group, occurring in 40.6% compared with 15.6% in the screw-nail group ($p = 0.026$). Wound complications and implant irritation were particularly more frequent following plating. These findings are consistent with the known soft-tissue disadvantages of lateral plating, where the implant lies beneath relatively thin soft-tissue coverage. **Asolum et al.**² and **Attia et al.**⁹ similarly reported higher complication rates following plating, while **Beleckas et al.**⁸ emphasized the value of minimally invasive fixation in patients at increased risk of wound complications. The reduced complication burden observed with screw-nail fixation represents an important clinical advantage.

Pain and Return to Work

At six months, pain scores were lower in the screw-nail group, although the difference was not statistically significant. Mean VAS was 1.84 ± 1.65 compared with 2.44 ± 2.12 in the plating group ($p = 0.216$). In contrast, return to work was significantly faster following screw-nail fixation. Patients returned to work

after a mean of 8.44 ± 2.75 weeks compared with 10.72 ± 3.33 weeks following plating ($p = 0.004$). Furthermore, 56.3% of screw-nail patients returned to work within eight weeks compared with only 31.3% of plating patients ($p = 0.044$). This finding highlights an important patient-centered and socioeconomic advantage of minimally invasive fixation.

Overall Interpretation

Overall, the present study demonstrates that both plating and screw-nail fixation provide satisfactory treatment for lower-end fibula fractures. However, screw-nail fixation showed significant advantages in operative duration, blood loss, hospital stay, overall complication rate, functional recovery, and return to work. The principal advantage appears to arise from reduced soft-tissue disruption. Plate fixation remains a reliable technique, particularly when direct visualization and rigid fixation are required, whereas screw-nail fixation offers an attractive minimally invasive alternative in appropriately selected patients. The findings support the use of screw-nail fixation as an effective treatment option while emphasizing the importance of fracture pattern, associated injuries, bone quality, and surgeon experience in selecting the most appropriate fixation method.

Strengths of the Study

This study has several methodological and clinical strengths. Its randomized prospective comparative design minimizes selection bias and enables direct comparison of plating and screw-nail fixation. Equal group allocation and comparable baseline characteristics strengthen internal validity. Standardized surgical, perioperative, and rehabilitation protocols reduced procedural variability. Validated AOFAS and OMAS scores provided objective functional assessment at multiple follow-ups. The study also evaluated operative parameters, complications, pain, and return to work, providing comprehensive clinical and socioeconomic outcomes. Repeated-measures analysis further strengthened assessment of functional recovery over time.

Implications

The findings have important implications for the surgical management of distal fibular fractures. Screw-nail fixation demonstrated reduced operative time, blood loss, hospital stay, complications, and earlier functional recovery compared with plating. Earlier return to work also suggests potential socioeconomic benefits, particularly for working-age patients. Comparable long-term functional outcomes indicate that screw-nail fixation does not compromise final ankle function. Its minimally invasive nature may be particularly beneficial for elderly patients and those at increased risk of wound complications. These findings support screw-nail fixation as a patient-friendly alternative, with appropriate patient selection and surgical expertise.

LIMITATIONS

Despite its strengths, this study has certain limitations. The relatively small sample size may limit detection of uncommon complications and subgroup-specific effects. The intermediate follow-up period may be insufficient to assess late complications such as post-traumatic osteoarthritis and implant-related problems. Blinding was not feasible, potentially introducing performance or assessment bias. Detailed radiological assessment of alignment and syndesmotism reduction was not performed. Being a single-center study, generalizability may be limited. Furthermore, formal economic and cost-effectiveness analyses were not undertaken. Therefore, the findings should be interpreted within the study's design and clinical setting.

Future Scope

Future research should include multicenter randomized controlled trials with larger sample sizes to validate findings across diverse populations and healthcare settings. Long-term studies are needed to evaluate post-traumatic arthritis, implant longevity, and quality of life. Cost-effectiveness analyses should assess the economic impact of screw-nail fixation compared with plating. Advanced imaging may provide better assessment of

reduction, alignment, and syndesmotism stability. Research should also examine patient-specific factors such as bone quality, activity level, and comorbidities to develop personalized treatment algorithms. Further evaluation of implant designs and fixation-specific rehabilitation protocols may optimize recovery and improve patient-centered outcomes.

CONCLUSION

The present randomized prospective comparative study evaluated the clinical, functional, peri operative, and complication-related outcomes of plating versus screw screw nail fixation for fractures of the lower end of the fibula. The findings demonstrate that both fixation techniques are effective in achieving satisfactory fracture stabilization and progressive functional recovery; however, distinct advantages were observed with screw screw nail fixation. Baseline demographic variables, injury mechanisms, fracture patterns, associated injuries, and timing of surgery were comparable between the two groups, ensuring that observed outcome differences were attributable to the fixation method rather than confounding factors. Screw screw nail fixation demonstrated clear peri-operative advantages, including significantly shorter operative duration, reduced intra-operative blood loss, and shorter hospital stay, reflecting the minimally invasive nature of the technique and reduced soft-tissue disruption. Functional recovery assessed using AOFAS and OMAS scores showed consistently higher values in the screw nail group, with statistically significant superiority during early and intermediate follow-up periods. Although long-term functional scores approached convergence between groups, the earlier recovery observed with screw nail fixation represents a clinically meaningful benefit, particularly in facilitating faster rehabilitation and return to daily activities. The overall complication rate was significantly lower in the screw nail group, highlighting the reduced morbidity associated with screw nail fixation, especially regarding wound-related complications and implant irritation. Pain relief at final follow-up was comparable between groups, indicating that both fixation methods provide effective long-term symptom control. Importantly, screw nail fixation was associated with significantly earlier return to work, emphasizing its socioeconomic advantage and relevance in active and working-age populations. In conclusion, screw screw nail fixation represents a safe, effective, and minimally invasive alternative to traditional plate fixation for fractures of the lower end of the fibula. While plating remains a reliable and established method, screw screw nail fixation offers superior early functional recovery, lower complication burden, and faster return to work without compromising long-term outcomes. Appropriate patient selection, meticulous surgical technique, and adherence to standardized rehabilitation protocols are essential to maximize the benefits of each fixation method. The findings of this study support the expanded use of screw screw nail fixation as a preferred treatment option in selected distal fibular fractures.

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