Original Article

Comparative Evaluation of Screw Elastic Intramedullary Nailing and Talwarkar Square Nailing in Adult Diaphyseal Forearm Fractures: A Prospective Observational Study

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Abstract

Background: Diaphyseal fractures of the forearm in adults pose a therapeutic challenge due to their impact on forearm function. Elastic intramedullary fixation techniques are increasingly preferred over conventional square nails, yet comparative evidence remains limited. The aim is to compare clinical, radiological, and functional outcomes of screw elastic intramedullary nailing (SEI) and Talwarkar square nailing (TSN) in adult diaphyseal forearm fractures. **Material and Methods:** This prospective observational study included 60 patients, equally divided into SEI (Group A) and TSN (Group B). Demographic details, fracture characteristics, visual analogue scale (VAS) for pain, complications, and functional outcomes (Anderson/Grace–Eversmann criteria) were assessed. Statistical analysis included chi-square and Fisher's exact test were applicable. **Results:** Of 60 patients, 38 (63.3%) were male and 41 (68.3%) had right-sided fractures. Road traffic accidents were the leading mechanism of injury (50%), and the middle third of the forearm was most commonly involved (61.7%). Based on AO/OTA classification, simple ulna fractures (22A1) predominated (58.3%). At final follow-up, most patients reported no or mild pain, with severe pain noted only in the TSN group (n=2). Complications were fewer with SEI, which had no non-unions or infections, whereas TSN recorded one non-union, three delayed unions, and two infections. Functional outcomes were excellent in 24 SEI and 20 TSN cases, with satisfactory recovery in 14 patients overall. Unsatisfactory results occurred only in TSN (n=2). No failures were observed. **Conclusion:** SEI provides better outcomes over TSN in terms of pain relief, complication profile, and functional recovery, making it a favourable option for treating adult diaphyseal forearm fractures. However the difference was not statistically significant.

Keywords: Forearm fractures; Intramedullary nailing; Screw elastic nail; Talwarkar square nail; Functional outcome; Complications.

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Introduction

Forearm diaphyseal fractures in adults pose a considerable orthopedic challenge owing to the critical role of the radius and ulna in preserving pronation–supination and upper limb functionality. These fractures account for nearly 3–6% of all skeletal injuries in adults, showing a bimodal distribution—commonly affecting young males following high-energy trauma and elderly individuals after low-energy falls.[1,2] The forearm functions as a paired anatomical unit, and anatomical reduction with stable fixation is essential to restore optimal biomechanics.[3]

Conventionally, plate osteosynthesis has been the preferred method, offering rigid fixation and reliable union rates. However, this approach often necessitates extensive soft-tissue dissection, carries an elevated risk of infection, and predisposes to refracture after implant removal.[4] Intramedullary nailing has been explored as a minimally invasive alternative, with the advantage of preserving periosteal blood supply and reducing surgical morbidity.[5] Among these devices, the Talwarkar square nail (TSN) has gained popularity in resource-limited settings due to its affordability and ease of application, but its shortcomings include inadequate rotational stability, higher incidence of non-union, and implant-related complications such as migration and entry site irritation.[6]

The present study was undertaken to compare the clinical, radiological, and functional outcomes of SEI and TSN in adult diaphyseal forearm fractures, with a specific focus on pain relief, complication rates, and functional recovery.

Materials and Methods

Study Design and Setting: This was a prospective observational study conducted at the Department of Orthopaedics, KIMS & RF, Amalapuram, over a period of 1 year. Ethical clearance was obtained from the Institutional Ethics Committee prior to commencement of the study. Written

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informed consent was obtained from all participants.

Study Population: A total of 60 adult patients with diaphyseal fractures of the radius and/or ulna were enrolled and allocated into two groups of 30 each, based on the fixation method used:

Group A: Screw Elastic Intramedullary (SEI) nailing

Group B: Talwarkar Square Nailing (TSN)

Inclusion Criteria

- Patients aged 18–60 years
- Closed diaphyseal fractures of the radius, ulna, or both bones
- Fresh fractures (<2 weeks old)
- Patients fit for surgery and consenting for follow-up

Exclusion Criteria

- Open fractures
- Pathological fractures
- Associated neurovascular injuries
- Patients unwilling for follow-up
- Surgical Technique

All patients underwent surgery under regional or general anesthesia. For Group A, screw elastic intramedullary nails were used. For Group B, conventional Talwarkar square nails were employed. Entry for ulna fixation was taken through radial aspect of tip of olecranon using an awl in both the groups. Entry for radius screw nail was taken through radial styloid and radius square nail was taken dorsally ulnar to Lister's tubercle. Nails were passed across the fracture site under C-arm guidance. Closed procedure was performed in majority of cases. However 1 case of SEI and 4 cases of TSN required opening at fracture site for negotiation of nail. Screw nails were buried flush to the bone in metaphyseal area using 3.5 screw driver and it added compression at fracture site. Talwarkar nails were left few mm outside the bone to facilitate removal in future. Postoperatively, limb immobilization with plaster was given for 4–6 weeks depending on fracture stability.

Outcome Measures: Patients were assessed clinically and radiologically at regular intervals (2, 6, 12, 24 and 36 weeks). The following parameters were recorded:

Demographic variables (age, sex, side, mechanism of injury, associated injuries)

Fracture characteristics (AO/OTA classification, anatomical site)

Pain assessment using Visual Analogue Scale (VAS)

Complications (malunion, delayed union, non-union, infection)

Functional outcome assessed by Anderson/Grace–Eversmann criteria

Statistical Analysis: Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Comparative analysis between the two groups was performed using Chi-square test or Fisher's exact test for categorical data. A p value <0.05 was considered statistically significant.

Results

A total of 60 patients with diaphyseal forearm fractures were included in the study, with 30 patients treated using screw elastic intramedullary nailing (SEI, Group A) and 30 with Talwarkar square nailing (TSN, Group B).

Demographic and Injury Characteristics: The study cohort comprised 38 males (63.3%) and 22 females (36.7%). Right-sided fractures were more frequent (68.3%) compared to left-sided (31.7%). Road traffic accidents were the leading cause of injury (50%), followed by accidental falls (40.1%). Other mechanisms included assault (3.3%), falls from height (3.3%), and domestic falls (3.3%). Associated injuries were observed in 43.3% of cases, with head injury being the most common (26.6%), while 56.7% had no additional trauma [Table 1].

Table 1: Demographic Characteristics of Study Population (N = 60)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	38	63.3
	Female	22	36.7
Side of involvement	Right	41	68.3
	Left	19	31.7
Mechanism of Injury	Road traffic accidents	30	50.0
	Accidental fall	24	40.1
	Assault	2	3.3
	Fall from height	2	3.3
	Fall at home	2	3.3
Associated Injuries	Head injury	16	26.6
	Fracture of leg bone	5	8.3
	Supracondylar femur fracture	3	5.0
	Chest injury	1	1.7
	Humerus with intercondylar fracture	1	1.7
	None	34	56.7

Fracture Characteristics: According to AO/OTA classification, the majority of cases were simple ulna fractures (22A1, 58.3%), followed by simple radius fractures (22A2, 26.7%) and combined radius–ulna fractures (22A3, 15%). The middle third of the forearm was the most frequently involved site (61.7%), while the proximal third accounted for 38.3% of cases [Table 2].

Table 2: Fracture Characteristics (AO/OTA and Bone Involvement)

Characteristic	Category	Frequency (n)	Percentage (%)
Fracture type (AO/OTA)	22A1 (simple ulna)	35	58.3
	22A2 (simple radius)	16	26.7
	22A3 (radius & ulna)	9	15.0
Part of forearm bone	Middle third	37	61.7
	Proximal third	23	38.3

Pain Assessment: At final follow-up, the majority of patients in both groups reported either no pain or only mild pain. In Group A, 24 patients were pain-free compared to 20 in Group B. Moderate pain was reported in one case of Group A and three cases of Group B, while severe pain was observed exclusively in the TSN group (n=2). However, the overall difference in pain distribution between the groups was not statistically significant (p = 0.34) (Table 3).

Table 3: VAS Pain Score at Final Follow-up

VAS Category	Group A (SEI)	Group B (TSN)	Statistical Analysis
No pain	24	20	Chi square value :3.36, df : 3, Overall p-value = 0.34
Mild pain	5	5	
Moderate pain	1	3	
Severe pain	0	2	

Complications: The overall complication rate was low. In Group A, one case each of malunion and delayed union were noted, with no instances of non-union or surgical site infection. In contrast, Group B had three delayed unions, one malunion, one non-union, and two infections. Patients without any complications were more frequent in the SEI group (93.3%) compared with the TSN group (76.7%). The difference in complication rates was not statistically significant (p = 0.34) (Table 4).

Table 4: Complications

Complication	Group A (SEI)	Group B (TSN)	Statistical analysis
Malunion	1	1	Chi square value :4.49, df : 4, Overall p-value = 0.34
Delayed union	1	3	
Non-union	0	1	
Surgical-site infection	0	2	
No complication	28	23	

Functional Outcomes: Functional outcomes, assessed using the Anderson/Grace–Eversmann criteria, demonstrated superior performance with SEI. Excellent results were achieved in 24 cases of Group A and 20 cases of Group B. Satisfactory outcomes were recorded in 6 and 8 cases, respectively. Unsatisfactory outcomes were observed only in the TSN group (n=2), while no failures were recorded in either group. Overall, excellent and satisfactory outcomes accounted for 96.7% of patients, indicating high functional recovery rates across both groups. Although functional outcomes numerically favored SEI, the difference was not statistically significant (p = 0.27) [Table 5, Figure 1 to 5].

Table 5: Functional Outcome (Anderson/Grace–Eversmann Criteria)

Outcome	Group A (SEI)	Group B (TSN)	Total (N = 60)	Statistical analysis
Excellent	24	20	44	Chi square value :2.65, df : 2 Overall p-value = 0.27
Satisfactory	6	8	14	
Unsatisfactory	0	2	2	

Figure 1: Pre-OP traction x-ray showing segmental fracture ulna with fracture of the shaft of the radius

Figure 2: Immediate post-op x-ray with well-maintained DRUJ and the interosseous space

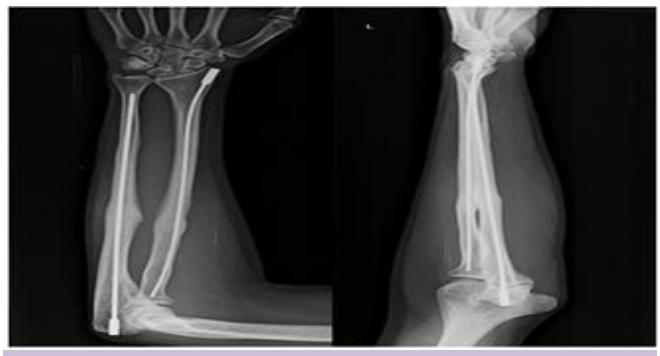

Figure 3: Showing a well healed fracture at 9 months follow up.

Figure 4: Pre-op x-ray showing displaced middle third shaft fracture of radius and ulna.

Figure 5: post-op x-ray of well reduced fractures fixed with square nails.

Discussion

The present prospective observational study demonstrated that screw elastic intramedullary nailing (SEI) offers superior functional and clinical outcomes compared with Talwarkar square nailing (TSN) in the management of adult diaphyseal forearm fractures. These findings are consistent with previous literature emphasizing the evolving role of intramedullary devices in improving stability and reducing complication rates.

Our results showed that patients treated with SEI had lower complication rates, with no non-union or infections recorded. This observation is in line with the work of Blažević et al., who reported that intramedullary nailing achieved satisfactory outcomes with acceptable complication profiles in adult forearm fractures.[7] Furthermore, recent meta-analyses have reinforced that interlocking or modern intramedullary nails provide enhanced rotational stability and lower rates of non-union compared with conventional designs.[8]

When functional recovery was assessed, SEI demonstrated excellent or satisfactory outcomes in almost all patients, which echoes the comparative results reported by Sharma et al., who highlighted improved functional recovery with intramedullary nailing over plate fixation.[9] Although most prior studies have focused on adolescents or pediatric populations, similar biomechanical principles apply. For instance, K S A et al. noted that elastic stable intramedullary nailing in long bone fractures offered advantages in terms of healing and early mobilization compared with plating, supporting the role of elastic nail systems across age groups.[10]

The superiority of SEI over TSN also aligns with more recent comparative work by Polat and Toy, who demonstrated that locked intramedullary nails outperformed conventional plating in both radiological and clinical outcomes for forearm fractures.[11] Early work by Jones and Kakar also underscored the potential of nails as an alternative to plates in adult diaphyseal fractures, especially in cases where soft-tissue preservation was critical.[12] Additionally, Agrawal et al. confirmed that screw nails provided functional outcomes comparable or superior to dynamic compression plating, further supporting the present study's findings.[13]

It is important to note that while most literature supports intramedullary devices, outcomes may vary depending on implant design. Kose et al. observed that plate fixation still yielded reliable results in certain forearm fracture patterns, highlighting the importance of individualized treatment planning.[14]

Overall, the evidence suggests that modern screw-based intramedullary devices overcome many of the shortcomings of traditional square nails by providing better stability, additional compression, lessen chances of irritation thereby minimizing complications, and enabling earlier functional recovery. These findings reinforce the clinical utility of SEI, particularly in settings where plate fixation is not feasible or where minimally invasive approaches are preferred.

Strengths of the Study

The present study has several strengths, including its prospective design, which minimized recall bias and ensured systematic data collection. A uniform surgical protocol was followed in both groups, allowing fair comparison. Multiple

clinically relevant outcomes pain, complication rates, and validated functional criteria were assessed, providing a comprehensive evaluation. Importantly, this is among the few studies offering a direct head-to-head comparison of screw elastic intramedullary nailing and Talwarkar square nailing in adults, yielding practical insights for orthopedic practice.

Limitations: The present study has certain limitations. The sample size was relatively small, and the single-center design may limit the generalizability of the findings. The follow-up period was restricted to nine months, which precluded evaluation of long-term outcomes such as refracture risk, implant-related issues, or functional deterioration over time. Additionally, patients were allocated based on the fixation method used rather than randomized assignment, which may have introduced selection bias. Despite these limitations, the study provides valuable comparative evidence on the performance of SEI and TSN in adult diaphyseal forearm fractures.

Conclusion

This prospective observational study highlights that screw elastic intramedullary nailing (SEI) provides superior outcomes compared with Talwarkar square nailing (TSN) in the management of adult diaphyseal forearm fractures. SEI demonstrated a higher proportion of pain-free patients, fewer complications, and a greater percentage of excellent functional recoveries. However the results are not statistically significant. The study may have been underpowered to detect a small effect. Further studies with a larger sample size are warranted to investigate this potential trend further.

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Conflicts of interest

There are no conflicts of interest.

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