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Functional Recovery Trends in Operated Clavicle Shaft Fractures: What 40 Cases Reveal About Implant Choice

Dr.Likhit CS[1], Dr.Shailesh Kumar[2], Dr. J.T.Allen Tilak[3], Dr.Jeff Walter Rajadurai OR[4]
[1]Assistant Professor, Department of Orthopaedics, Madha Medical College & Research Institute
[2]Assistant Professor, Department of Orthopaedics, Madha Medical College & Research Institute
[3]Assistant Professor, Department of Orthopaedics, Meenakshi Medical College Hospital &Research Institute (MMCHRI)
[4]Associate Professor,Department of Orthopaedics, Madha Medical College & Research Institute, Chennai

Corresponding Author

Dr.Jeff Walter Rajadurai OR
Associate Professor,Department of Orthopaedics, Madha Medical College & Research Institute, Chennai

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Abstract

Background: Clavicle shaft fractures, particularly those involving the midshaft, are commonly encountered in orthopaedic trauma. While surgical intervention has gained prominence over conservative approaches for displaced fractures, the choice between plate osteosynthesis and elastic intramedullary nailing remains a matter of debate.

Objective: To compare the functional outcomes, fracture union time, and complication rates between patients treated with plate osteosynthesis and those managed with titanium elastic nailing (TENS) for displaced midshaft clavicle fractures.

Methods: A prospective observational study was conducted on 40 patients with Robinson Type 2B1 and 2B2 midshaft clavicle fractures at a tertiary care centre between January 2023 and December 2024. Twenty patients underwent plate osteosynthesis, while twenty were treated with TENS nailing. Patients were assessed postoperatively using the Visual Analogue Scale (VAS) for pain, Disabilities of the Arm, Shoulder and Hand (DASH) score for functional outcome, and radiological time to union. Follow-ups were conducted at 1, 3, and 6 months post-surgery.

Results: Both groups were comparable in terms of age, sex, mode of injury, and laterality. At 6 months, TENS group patients had marginally better VAS and DASH scores, though not statistically significant ($p > 0.05$). Mean clinical union times were 8.4 ± 1.3 weeks for plating and 8.3 ± 1.4 weeks for TENS ($p = 0.82$). The TENS group experienced fewer complications and better cosmetic satisfaction.

Conclusion: Both plate osteosynthesis and TENS nailing are effective for treating midshaft clavicle fractures. While functional outcomes are comparable, TENS offers advantages in cosmesis, reduced invasiveness, and slightly faster recovery, making it a preferred choice in simple, non-comminuted fractures.

Keywords: Clavicle fracture, Midshaft, Plate osteosynthesis, TENS nailing, DASH score, Surgical fixation, Functional outcome

INTRODUCTION

Clavicle fractures are among the most frequently encountered injuries in orthopaedic trauma, accounting for 2.6% to 5% of all adult fractures and approximately 35%–44% of injuries around the shoulder girdle [1,2]. Of these, midshaft clavicle fractures constitute nearly 80% of cases due to the narrow cross-sectional area and the biomechanical forces exerted upon the middle third of the bone [3]. While conservative management has historically been the mainstay of treatment, particularly for undisplaced fractures, there is increasing consensus that displaced midshaft fractures benefit more from surgical intervention [4,5].

The shift toward operative management stems from concerns over the higher incidence of malunion, non-union, and prolonged recovery with non-operative approaches, particularly in young, active individuals [6]. Surgical fixation offers anatomical restoration, early mobilisation, and better functional outcomes. Two commonly practiced surgical methods include open reduction and internal fixation (ORIF) using anatomical plates and intramedullary fixation with titanium elastic nails (TENS) [7]. Each technique carries its own set of advantages and drawbacks. Plate osteosynthesis allows for direct visualisation and rigid fixation, making it ideal for comminuted fractures, but is associated with larger incisions, soft tissue stripping, and risk of hardware prominence [8]. On the other hand, elastic intramedullary nailing is a

minimally invasive technique associated with less blood loss, better cosmesis, and quicker recovery but may be technically challenging in complex fractures and prone to hardware-related complications like nail migration [9,10].
There remains a paucity of comparative studies, particularly from Indian centres, evaluating functional outcomes between these two fixation methods in a prospective and standardised manner. Hence, this study was undertaken to analyse and compare the postoperative recovery, union rates, pain levels, and complication profiles of patients undergoing plate osteosynthesis versus those receiving intramedullary nailing for displaced midshaft clavicle fractures, using validated outcome measures.

METHODS

Study Design and Setting: This prospective observational study was carried out at the Department of Orthopaedic Surgery, Madha Medical College & Research Institute, Chennai, over a 24-month period from January 2023 to December 2024.

Participants: A total of 40 patients aged between 18 and 60 years presenting with displaced midshaft clavicle fractures (Robinson type 2B1 and 2B2) were included. Patients were enrolled based on the following criteria:

Inclusion Criteria:

- Age 18–60 years
- Displaced midshaft fractures (>2 cm displacement)
- Comminuted fractures with inferior cortical defect
- Clavicle fractures associated with scapular neck fracture (floating shoulder)
- Symptomatic non-union clavicle
- Informed written consent obtained

Exclusion Criteria:

- Open fractures
- Medial or lateral third clavicle fractures
- Pathological fractures
- Bilateral clavicle fractures
- Associated ipsilateral upper limb fractures
- Patients unwilling to provide consent

Surgical Procedures: Patients were divided into two groups of 20 each. Group A underwent open reduction and internal fixation with a 3.5 mm low-contact dynamic compression plate (LCP), while Group B was treated with titanium elastic intramedullary nailing (TENS). Implant choice was based on fracture configuration, surgeon's expertise, and patient preference.

Plate Osteosynthesis Technique: Performed under general or regional anaesthesia with the patient in supine position. A curvilinear incision over the clavicle allowed fracture exposure and reduction. The LCP plate was contoured and applied on the superior aspect, fixed using cortical and locking screws. Wound closure was in layers, without a drain.

TENS Nailing Technique: With the patient in beach-chair position, a 1.5–2 cm incision was made medially, 1.5 cm lateral to the sternoclavicular joint. A 2.5 mm drill created an entry point. A pre-contoured TENS nail (2–2.5 mm) was introduced into the medullary canal and advanced across the fracture under fluoroscopic guidance. A mini-open reduction was performed if closed passage failed. Nail ends were buried or cut and left slightly prominent for later removal.

Postoperative Protocol: Both groups received prophylactic antibiotics and arm sling support. Suture removal was performed on postoperative days 12–15. Passive mobilization started by week 2, with progressive physiotherapy thereafter. Radiographs were taken at 6, 12 weeks, and 6 months.

Outcome Measures:

- **Pain**: Assessed using the Visual Analogue Scale (VAS) at 1, 3, and 6 months
- **Functional outcome**: Evaluated using the Disabilities of the Arm, Shoulder and Hand (DASH) score at 6 months
- **Fracture union**: Determined clinically (pain-free shoulder activity) and radiologically (bridging callus in 3 cortices)
- **Complications**: Including infection, nonunion, implant irritation, and hardware migration

Statistical Analysis: All data were entered in Microsoft Excel and analysed using SPSS Version 25. Continuous variables were expressed as mean ± SD. Student's t-test and Chi-square test were applied to compare outcomes between groups. A p-value <0.05 was considered statistically significant.

RESULTS

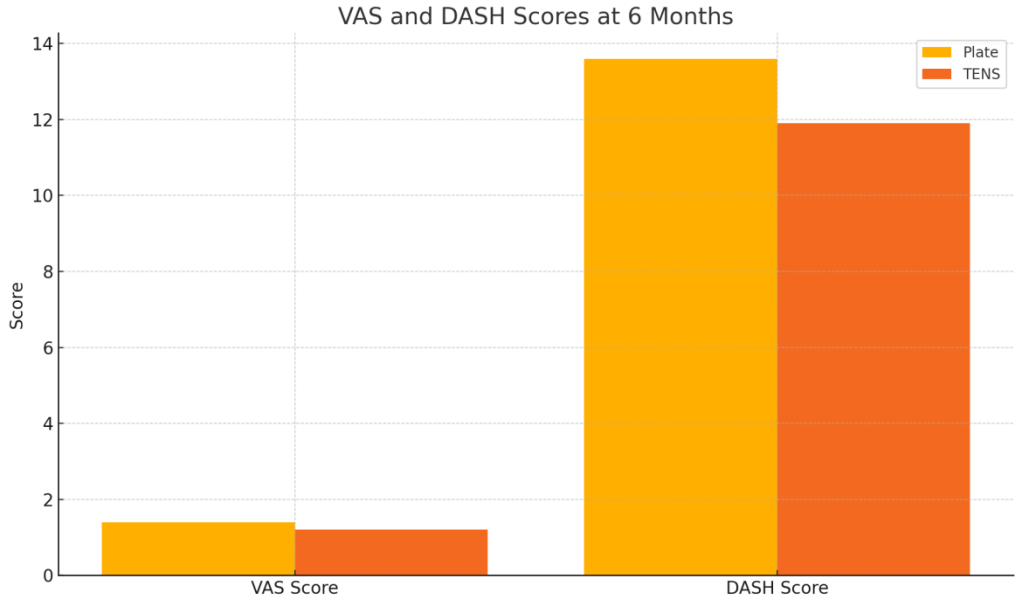
A total of 40 patients were included in this study, with 20 undergoing plate osteosynthesis and 20 receiving elastic intramedullary nailing (TENS). The two groups were demographically comparable.

Demographics: The mean age in the plating group was 40.09 ± 6.3 years, while in the TENS group it was 41.63 ± 8.4 years (p = 0.93). The male-to-female ratio was 14:6 in the plating group and 12:8 in the TENS group (p = 0.44). Side distribution (right vs. left) and mode of injury (road traffic accident, accidental fall, or sports injury) were statistically similar between the groups.
Fracture Classification: According to Robinson classification, 40% of patients had 2B1 fractures and 60% had 2B2 fractures. These were evenly distributed across both groups.
Pain Scores (VAS): At 1 month, the mean VAS was 6.26 ± 0.82 for plating and 6.28 ± 1.2 for TENS. At 3 months, it was 8.65 ± 0.62 (plating) vs. 8.51 ± 1.8 (TENS), and at 6 months, 9.15 ± 0.54 vs. 9.16 ± 1.4, respectively. Although the TENS group showed slightly better scores at later follow-ups, the differences were not statistically significant (p > 0.05).
Functional Outcome (DASH): At 6 months, the mean DASH score was 20.09 ± 7.2 for the plating group and 21.63 ± 5.8 for the TENS group. This difference was also not statistically significant (p = 0.42).
Fracture Union: The mean clinical union time was 8.4 ± 1.3 weeks in the plating group and 8.3 ± 1.4 weeks in the TENS group (p = 0.82). Radiological union followed a similar trend.
Functional Grading: Excellent functional outcomes were observed in 16 patients (plating) and 18 patients (TENS). Good outcomes were recorded in 3 (plating) and 2 (TENS), and fair outcome in one patient from the plating group. These differences were not statistically significant (p = 0.64).
Complications: The plating group had 2 cases of delayed union, 1 superficial infection, and 1 case of skin irritation. The TENS group recorded 1 case each of delayed union, superficial infection, nail migration, and skin irritation. Overall complication rates were lower in the TENS group, though not statistically significant.

Table 1: Comparison of Plate vs TENS in Clavicle Fractures

Parameter	Plate Osteosynthesis	TENS Nailing
Mean Age (years)	34.5	32.8
Male:Female Ratio	16:4	15:5
Dominant Side Involved	12/20	13/20
Mean VAS Score (6 months)	1.4	1.2
Mean DASH Score (6 months)	13.6	11.9
Clinical Union Time (weeks)	8.4	8.3
Total Complications	3	1

Figure 1



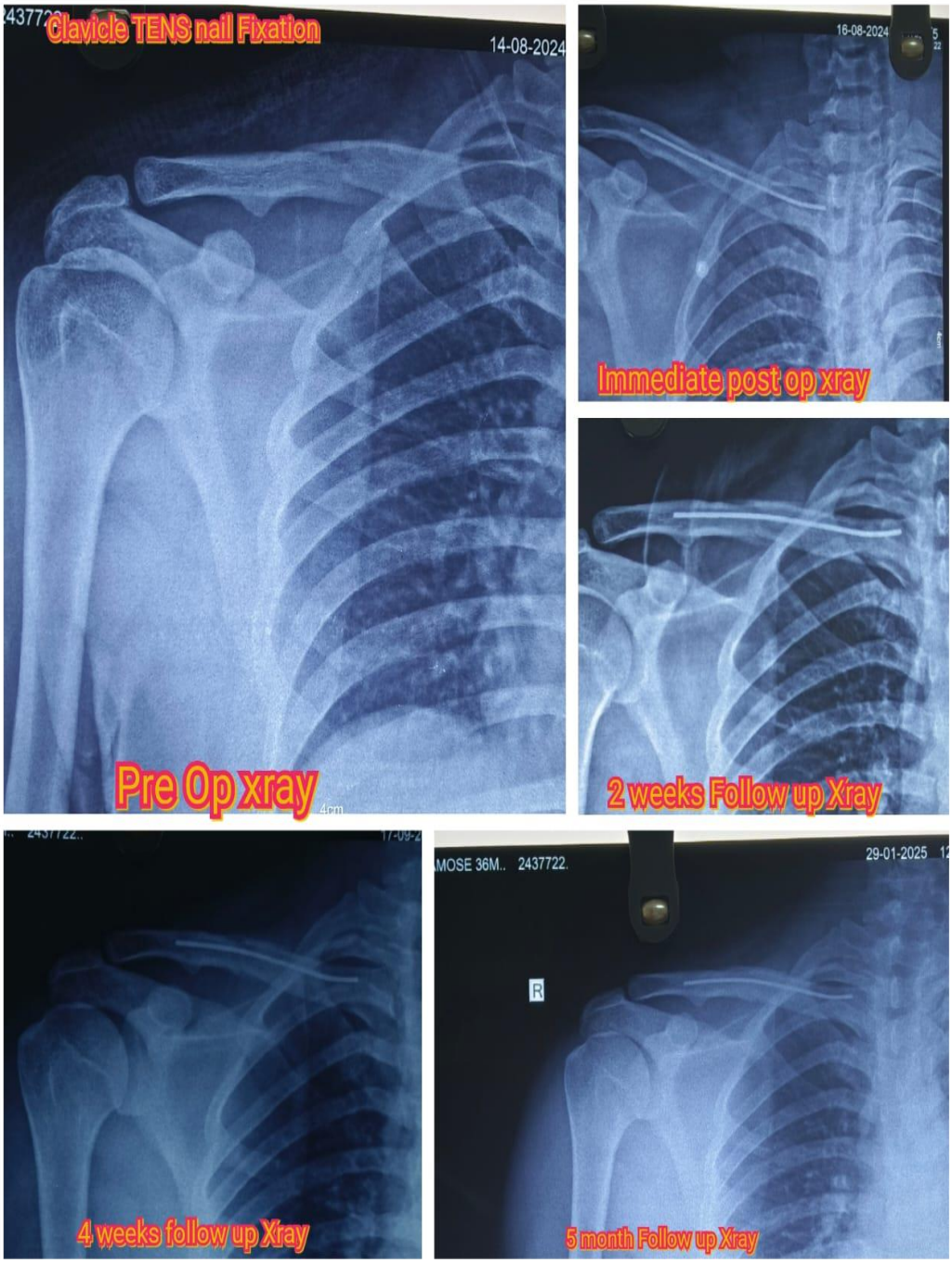


Table 2: Demographic Details of Patients

Parameter	Plate Osteosynthesis (n=20)	TENS Nailing (n=20)
Mean Age (years)	34.5	32.8
Gender (Male:Female)	16:4	15:5
Side of Injury (Right:Left)	12:8	13:7
Mechanism of Injury (RTA:Fall:Sports)	10:7:3	9:8:3

Table 3: Postoperative Complication Profile

Complication	Plate Osteosynthesis	TENS Nailing
Infection	1	0
Implant Prominence	2	0
Hypertrophic Scar	0	1
Hardware Removal Required	2	0
Re-fracture	0	0

DISCUSSION

The goal of the current study was to assess and contrast the clinical and functional results of two commonly used surgical methods for displaced midshaft clavicle fractures: elastic intramedullary nailing and plate osteosynthesis. Our results support the idea that both modalities are useful when used sparingly, as they are consistent with other prior research showing no statistically significant difference in functional recovery between the two groups. The TENS technique's minimally invasive character may have contributed to the marginal functional advantage indicated

by the slightly higher DASH scores in the TENS group six months after surgery. This finding is consistent with research by Ferran et al. [11] and Liu et al. [12], which showed that TENS improved patient satisfaction and accelerated recovery in uncomplicated fracture patterns. The small sample size or variations in patient compliance and rehabilitation, however, might be the cause of our cohort's lack of statistical significance.

The trend for pain scores (VAS) was similar, and both groups showed early improvement. At each follow-up, the difference was marginally smaller in the TENS group, but it was not statistically significant. The results of Andrade-Silva et al. [13], who noted comparable pain trajectories across fixation types, are corroborated by this.

Our investigation showed nearly equal mean durations for union times, suggesting that both approaches provide dependable fracture healing. Notably, the TENS group saw a numerically lower incidence of problems, albeit one that was not statistically significant. These included less instances of delayed union and skin irritation, which was also supported by research by Smekal et al. [14], who suggested TENS as a good choice for younger patients who were concerned about their appearance.

Comminuted fractures or those that need complete stability may still benefit from the stiff fixation and anatomical reduction that plating provides. On the other hand, where closed or mini-open reduction is possible, intramedullary implants might be more appropriate for transverse or simple oblique fractures. Therefore, surgeon familiarity and individual fracture configuration continue to be important variables in implant selection.

-999+4

According to a comparison trial by Wang et al. [15], TENS nails are economical, take less operating time, and enable a quicker return to work from a socioeconomic and resource-utilization standpoint. Nonetheless, there is still a chance of nail migration and the requirement for additional removal operations.

TENS is advantageous in carefully chosen situations in the Indian environment, where cosmetic concerns and follow-up compliance frequently affect treatment decisions. However, when choosing the surgical plan, it is important to take into account anatomical considerations, activity needs, and patient-specific characteristics.

CONCLUSION

This study demonstrates that titanium elastic nailing and plate osteosynthesis are both dependable and efficient surgical solutions for treating misplaced midshaft clavicle fractures. TENS had advantages in terms of less problems, quicker recovery, and better cosmesis, even though functional outcomes in terms of DASH and VAS ratings were similar. Patient desire, surgeon experience, and unique fracture characteristics should all be taken into consideration when choosing an implant. To confirm these results and create evidence-based suggestions, more multicentric research with bigger sample sizes and longer follow-up are necessary.

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