



A PROSPECTIVE COMPARATIVE STUDY OF TITANIUM ELASTIC NAILING VERSUS PLATING IN MIDSHAFT CLAVICLE FRACTURES.

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ABSTRACT

Background: Midshaft clavicle fractures are common injuries of the shoulder girdle, particularly in young and active adults. While conservative treatment is effective for minimally displaced fractures, displaced midshaft fractures are increasingly managed surgically due to higher rates of non-union and functional impairment. Plate fixation and the Titanium Elastic Nailing System are widely used operative techniques, but the optimal modality remains a subject of debate. **Aim:** To compare the clinical, radiological, and functional outcomes of titanium elastic nailing and plate fixation in patients with midshaft clavicle fractures. **Materials & methods:** This prospective comparative study was conducted in the Department of Orthopaedics, Government Medical College, Kamareddy, for 24 weeks and included 60 patients with displaced midshaft clavicle fractures. 14 patients underwent TENS, and 46 patients were treated with plate fixation. Patients were followed up at 6, 12, and 24 weeks. Pain was assessed using the VAS scale, functional outcome using Constant Murley scores, and radiological union was evaluated using serial radiographs. **Results:** Both treatment groups achieved satisfactory fracture union, with 83.33% uniting within eight weeks. The TENS group demonstrated significantly lower postoperative pain scores and superior functional outcomes at follow-up compared to the plating group ($p < 0.05^*$). Plate fixation provided stable anatomical reduction but was associated with a higher incidence of implant-related complications. **Conclusion:** TENS offers advantages of reduced postoperative pain, earlier functional recovery, and minimal soft-tissue disruption in selected midshaft clavicle fractures, while plate fixation remains a reliable option for complex fracture patterns.

KEYWORDS : Midshaft clavicle fracture; Plate fixation; Radiological union; Titanium Elastic Nailing System.

INTRODUCTION

Clavicle fractures constitute a significant proportion of skeletal injuries, accounting for approximately 2.6–10% of all fractures and nearly one-third of injuries involving the shoulder girdle.^{1,2} Among these, fractures of the midshaft clavicle are the most common, representing nearly 70–85% of all clavicular fractures.³ The midshaft region is particularly susceptible to injury due to its anatomical narrowness and lack of reinforcement by surrounding ligaments and musculature, making it vulnerable to both direct and indirect trauma. These fractures are most frequently encountered in young and middle-aged adults and are commonly associated with high-energy mechanisms such as road traffic accidents, sports injuries, and falls.⁴

Traditionally, midshaft clavicle fractures were treated conservatively with slings or figure-of-eight bandages, based on the assumption that these fractures unite reliably with satisfactory functional outcomes. While conservative management yields acceptable results in minimally displaced fractures, several studies have demonstrated higher rates of non-union, malunion, cosmetic deformity, persistent pain, and functional impairment in displaced fractures managed non-operatively.^{5,6,7} This evidence has led to a paradigm shift toward operative fixation for displaced midshaft clavicle fractures.

Surgical management aims to restore clavicular length, alignment, and shoulder biomechanics, thereby facilitating early mobilization and improved functional recovery. Plate fixation has been widely accepted as a standard surgical method due to its ability to provide rigid fixation and anatomical reduction; however, it is associated with complications such as extensive soft-tissue dissection, surgical site infection, implant prominence, hardware irritation, and the need for secondary implant removal.⁸ Titanium elastic nailing system (TENS) has emerged as a minimally invasive intramedullary alternative that offers biological fixation with minimal periosteal stripping, smaller incisions, and improved cosmetic outcomes.^{9,10,11}

Although concerns exist regarding rotational stability and implant migration in comminuted fractures, several studies have reported favorable outcomes with TENS in selected fracture patterns.¹² In view of these considerations, the present prospective comparative study was undertaken to evaluate and compare the clinical, radiological, and functional outcomes of titanium elastic nailing and plate fixation in midshaft clavicle fractures.

MATERIALS & METHODS

This prospective comparative clinical study was conducted in the Department of Orthopaedics at Government Medical College, Kamareddy, over a period of 24 weeks. Ethical approval was obtained before the commencement of the study. A total of 60 patients diagnosed with midshaft clavicle fractures and satisfying the inclusion criteria were enrolled in the study after obtaining informed consent. Adult patients with displaced midshaft clavicle fractures who were willing to undergo regular follow-up were included, while patients with pathological fractures, open fractures with severe contamination, associated neurovascular injuries requiring emergency intervention, and those medically unfit for surgery were excluded.

Patients were managed either by titanium elastic nailing or plate fixation based on fracture characteristics and the surgeon's discretion. 14 patients underwent fixation using titanium elastic nailing, while 46 patients were treated with plate osteosynthesis. Standard surgical techniques were followed in all operative cases, and postoperative rehabilitation protocols were uniformly applied.

Patients were followed up at 6, 12, and 24 weeks post-intervention. Pain assessment was performed using the Visual Analogue Scale (VAS), while functional outcomes were evaluated using the Disabilities of the Arm, Shoulder, and Hand (DASH), Quick-DASH, and Constant-Murley scoring systems. Radiological union was assessed using serial radiographs, and complications were documented throughout the follow-up period. Statistical analysis was performed using appropriate tests, with continuous variables

expressed as mean and standard deviation and categorical variables expressed as frequencies and percentages. SPSS software was used for the analysis of the study data, and a p value <0.05* was considered statistically significant.

RESULTS

The study population predominantly comprised young and middle-aged adults, with the highest incidence observed in the 30–39-year age group. Males constituted the majority of patients, reflecting higher exposure to high-energy trauma. [Figure 1,2] Right-sided clavicle fractures were more common, and road traffic accidents were the predominant mechanism of injury. [Table 1]

Pain scores showed a significant reduction in both treatment groups over the follow-up period; however, patients treated with titanium elastic nailing demonstrated consistently lower mean VAS scores at 6, 12, and 24 weeks when compared to those treated with plate fixation. This difference was found to be highly statistically significant. [Table 2]

Radiological union was achieved in the majority of patients within eight weeks, with a smaller proportion requiring up to twelve weeks or more. Functional assessment at the end of twenty-four weeks revealed superior outcomes in the TENS group, with a higher proportion of patients achieving excellent scores on Constant–Murley, DASH, and Quick-DASH scales. [Table 3]

Complications were observed in a minority of patients, with surgical site infections, deformities, and implant failure reported. Most patients, however, had an uncomplicated recovery, and a large proportion returned to their pre-injury functional status by the end of six months. [Table 4]

Figure 3 shows a postoperative radiograph of a 28-year-old male with right-sided titanium elastic nailing, demonstrating satisfactory intramedullary nail placement with restoration of clavicular length and alignment. Figure 4 depicts a 24-year-old male with a left clavicle fracture treated with titanium elastic nailing, showing adequate fracture reduction and stable implant position. Figure 5 illustrates a postoperative anteroposterior radiograph of the left clavicle following plate fixation, demonstrating anatomical alignment of the fracture fragments and a stable plate–screw construct. Figure 6 shows a 26-year-old male with a right clavicular fracture managed by plate fixation with interfragmentary screws, highlighting satisfactory reduction and secure fixation without evidence of immediate hardware-related complications.

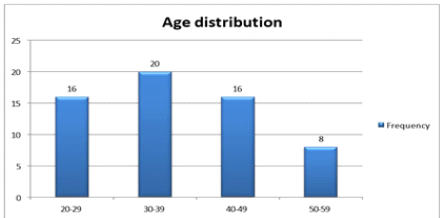


Figure 1: Graph showing the Age distribution of the study population

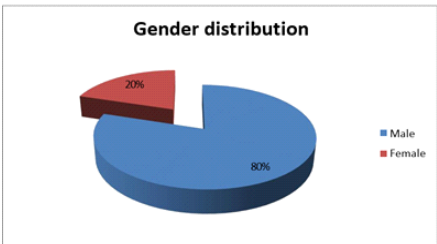


Figure 2: Graph showing the Gender distribution of the study population

Table 1: Showing the type of management employed

Type of management	Frequency	Percentage
TENS	14	23.33%
Plating	46	76.66%
Total	60	100%

Table 2: Showing pre-operative and post-operative VAS scores at 6 weeks

Parameters	TENS		Plating	
	Mean	Standard Deviation	Mean	Standard Deviation
Preoperative VAS score	7.65	1.6	6.89	1.98
Post operative VAS score at 6 weeks	2.4	1.2	3.56	1.56
Post operative VAS score at 12 weeks	1.56	0.9	2.1	1.2
Post operative VAS score at 24 weeks	0.9	0.56	1.1	0.96
p value	<0.000001**	<0.00001*		

Table 3: Showing the radiological union

Radiological union	Frequency	Percentage
Within 8 weeks	50	83.33%
8-12 weeks	06	10%
> 12 weeks	04	6.66%
Total	60	100%

Table 4: Showing Constant Murley scoring at the end of 24 weeks according to the mode of management

Constant Murley score	TENS		Plating	
	Frequency	Percentage	Frequency	Percentage
Excellent	42	70%	08	13.33%
Good	02	3.33%	02	3.33%
Fair	02	3.33%	04	6.66%
Poor	0	0%	0	0%
Total	46	76.66%	14	23.33%

Table 5: Showing complications

Complications	Frequency	Percentage
Surgical site infection	08	13.33%
Deformity	04	6.66%
Implant failure	02	3.33%
None	46	76.66%
Total	60	100

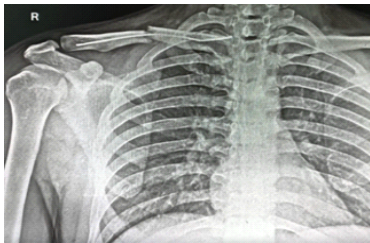


Figure 3: Showing a 28-year-old male with right tens nailing

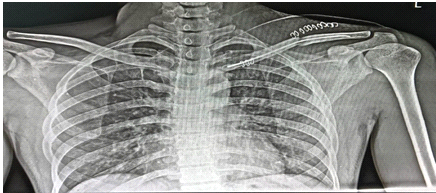


Figure 4: Showing a 24-year-old male with left clavicle tens nailing

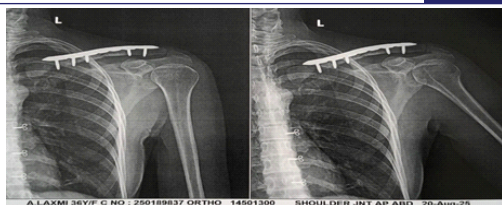


Figure 5: Postoperative AP Radiograph of Left Clavicle Showing Plate Fixation with Satisfactory Alignment

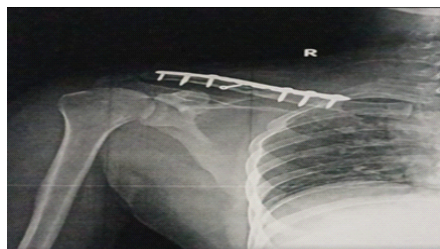


Figure 6: Showing a 6-year-old male with right clavicular plating and interfragmentary screws

DISCUSSION

The present study contributes to the growing body of evidence supporting the operative management of displaced midshaft clavicle fractures. The demographic profile observed in this study, including male predominance and higher incidence in young adults, is consistent with previous epidemiological reports.¹³ Road traffic accidents were identified as the most common mechanism of injury, which aligns with findings from several earlier studies conducted in similar populations.^{14,15}

Postoperative pain relief was significantly better in patients treated with titanium elastic nailing. This can be attributed to the minimally invasive nature of the procedure, reduced soft-tissue dissection, and preservation of periosteal blood supply. Similar observations have been reported by Smekal et al.,¹⁶ and Chen et al.,¹¹ who demonstrated lower postoperative pain scores and earlier functional recovery with intramedullary fixation techniques when compared to plate fixation.

Radiological union rates in the present study were comparable between both treatment modalities and consistent with union rates reported in earlier studies evaluating operative fixation of midshaft clavicle fractures.¹⁷ Functional outcomes, assessed using Constant-Murley and DASH scores, were superior in the TENS group, indicating better shoulder mobility and patient satisfaction. Plate fixation, although providing rigid stabilization, was associated with a higher incidence of implant-related complications, including infection and hardware failure, as previously documented by the Canadian Orthopaedic Trauma Society and other authors.^{18,19}

Overall, the findings of this study suggest that titanium elastic nailing offers distinct advantages in appropriately selected midshaft clavicle fractures, particularly in terms of reduced postoperative pain, faster functional recovery, and improved cosmetic outcomes, while plate fixation remains an effective option for comminuted fractures requiring absolute stability.

CONCLUSION

This prospective comparative study demonstrates that both titanium elastic nailing and plate fixation are effective surgical modalities for the management of midshaft clavicle fractures, with satisfactory radiological union and functional outcomes. However, titanium elastic nailing provides superior advantages in terms of reduced postoperative pain, earlier functional recovery, better shoulder function, and improved patient comfort owing to its minimally invasive nature. Plate fixation, while offering rigid anatomical stabilization, is

associated with a higher incidence of implant-related complications and soft-tissue morbidity. Therefore, titanium elastic nailing can be considered a preferred treatment option in carefully selected patients with simple, displaced midshaft clavicle fractures, whereas plate fixation should be reserved for complex or comminuted fracture patterns requiring enhanced stability.

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