

DISPLACED MIDSHAFT CLAVICLE FRACTURES TREATED WITH INTRAMEDULLARY TITANIUM ELASTIC NAIL SYSTEM VERSUS PLATE OSTEOSYNTHESIS: A COMPARATIVE STUDY

Aravindan K¹, Ezhilmaran R¹, Mahesh Babu B², Narayanan AR¹

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Corresponding Author:

Dr. Narayanan AR,
Email: narayanan.koyel@gmail.com

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¹Assistant Professor, Department of Orthopaedics, Government Chengalpattu Medical College Hospital, Tamilnadu, India

²Associate Professor, Department of Orthopaedics, Government Chengalpattu Medical College Hospital, Tamilnadu, India

Abstract

Background: Midshaft clavicular fractures are commonly observed around the shoulder, and conservative treatment methods are associated with high complication rates (10-15%). Surgical options have shown better results when managed using clavicular plating or nailing. Aim: This study aimed to compare the postoperative functional outcomes after internal fixation of displaced midshaft clavicle fractures using an intramedullary Titanium Elastic Nail System versus plate osteosynthesis. **Materials and Methods:** Forty patients with midshaft clavicle fractures admitted between October 2020 and September 2021 who fulfilled the inclusion criteria were recruited for the study. The type of surgical intervention for the patient, either TENS nail or plating, was determined using a randomised double-blind technique. Postoperative functional outcomes after six months in both patient groups were analysed and compared using the Constant Score. **Result:** The study included 40 patients, 78% male and 22% female. Regarding the outcome, 35% were classified as good and 65% as excellent. The mean Constant Score was 94.1 for patients who underwent TENS. In patients who underwent plating, the mean constant score was 89.25. The analysis of results indicated a statistically significant difference between the LCP and TENs groups in terms of the outcome. In the "Good" category, 11 cases belonged to the LCP group, while three were in the TENs group ($p = 0.008$). For the "Excellent" category, nine cases were in the LCP group, and 17 were in the TENs group. **Conclusion:** Functional outcomes after a six-month postoperative period were significantly better for patients with TENS nailing than those with plating.

INTRODUCTION

Midshaft clavicle fractures comprise about 3-5% of all fractures and around 45% around the shoulder.^[1] Nowadays, surgery is accepted as the primary treatment for displaced midshaft clavicle fractures, mainly because the results of non-operative treatment are interpreted as inferior to operative treatment clinically, functionally and sometimes cosmetically.^[2] The following fixation methods are available: Plate, Intramedullary, and External. A satisfactory outcome is possible in many complex clavicle fractures with a low complication rate by plate fixation using a locked compression plate.^[3] Midclavicular fracture fixation has recently gained attention over the years, with its better clinico-radiological outcome being titanium elastic nailing (TENS).^[4]

Clavicle fractures are frequently occurring injuries, constituting a 2.6-10% incidence among all fractures.^[5] The midshaft is involved in approximately 80% of these fractures, with more than half displaced. Historically, conservative management using a sling or figure-of-eight bandage has been the traditional approach for midshaft clavicle fractures.^[6,7] Two frequently employed surgical techniques for internally fixing displaced midshaft clavicle fractures (DMCF) are plate fixation and intramedullary nailing using a titanium elastic nail (TEN).^[8] Recent prospective randomized studies have demonstrated superior functional outcomes with both techniques compared to conservative treatment for DMCF.^[4] A recent meta-analysis indicated a significantly lower nonunion rate following surgical interventions.^[9] Plate fixation reduces the nonunion and symptomatic malunion rates, establishing it as a favourable option

for addressing displaced midshaft clavicle fractures. While both intramedullary fixation using titanium elastic nails (TENs) and plate fixation appear as viable treatments for managing complex midshaft clavicle fractures, the selection of an appropriate treatment should be influenced by factors such as fracture characteristics, patient comorbidities, and expectations for functional outcomes.¹⁰ Our study compared the postoperative functional outcome after Internal fixation of displaced midshaft clavicle fractures with intramedullary titanium elastic nail system versus plate osteosynthesis.

MATERIALS AND METHODS

This prospective cohort study was conducted on patients with displaced midshaft clavicle fractures who were seen at the OPD or Casualty or admitted to the Ortho ward of the Orthopaedics Department of Chengalpattu Govt. Medical College Hospital, for 12 months from October 2020 to September 2021.

Inclusion Criteria

Patients aged >20 and < 2 weeks, displaced fracture mid 1/3rd of the clavicle > 2 cm, tenting of the skin at the fracture level, willingness to provide written consent, and medical fit for surgery were included.

Exclusion Criteria

Patients aged > 60 years; time since injury more than two weeks, pre-existing morbidities of the ipsilateral arm, shoulder, or hand; fracture involving the medial and lateral 1/3rd of the clavicle; pathological fractures; medically unfit for surgery; fractures with neurovascular compromise; infected fractures; and patients not willing to provide written consent were excluded.

Forty patients who fulfilled the inclusion criteria were recruited for this study. Patients were evaluated using clinical examination and radiological imaging. Half of the patients (n=20) were treated with TENS nailing and half (n=20) with clavicular plating. The intervention method for the patient was selected using a randomised, double-blind method, and patients were regularly followed up. All cases were analysed based on the following data: age distribution, sex distribution, side affected, Robinson classification, and a Constant Score.

The patients were discharged and followed up at regular intervals. Functional outcomes of all patients after a six-month postoperative period in each group were analysed using the Constant Score and compared with the other groups.

Statistical analysis

Patient data, including outcomes concerning LCP and TENS, were classified as good or bad. The statistical

significance of the differences in primary and secondary outcome measures between the two groups after the follow-up period was assessed using independent group means comparison. The analysis of variance aimed to evaluate the distinctions between the two proportions, and significance was considered for P-values less than 0.05.



Figure 1: Clavicle # - plate fixation



Figure 2: Clavicle # - tens

RESULTS

The study included 40 patients, 78% male and 22% female. Regarding age distribution, 68% were below 30 years, 22% were in the 31-40 age group, and 10% were over 40. The affected side was predominantly on the right side in 70% of the cases, while 30% were on the left. Robinson's classification revealed 25% in category 2B1 and 75% in category 2B2. Regarding the outcome, 35% were classified as good and 65% as excellent [Table 1].

Postoperative functional outcomes were assessed using the Constant Score at six months post-operatively. For patients who underwent TENS, the mean Constant Score was 94.1. In patients who underwent plating, the mean constant score was 89.25.

The analysis of results indicated a statistically significant difference between the LCP and TENS groups in terms of the outcome. In the "Good" category, 11 cases belonged to the LCP group, while three were in the TENS group ($p = 0.008$). For the "Excellent" category, nine cases were in the LCP group, and 17 were in the TENS group [Table 2].

Table 1: Patient characteristics

		Number of patients	Percentage
Sex	Male	31	78%
	Female	9	22%
Age in years	< 30	27	68%
	31-40	9	22%
	>40	4	10%

Side affected	Right	28	70%
	Left	12	30%
Robinson classification	2B1	10	25%
	2B2	30	75%
Result	Good	14	35%
	Excellent	26	65%

Table 2: Type of implant vs outcome based on constant score

Result	Implant		P-value
	LCP	TENS	
Good	11	3	0.008
Excellent	9	17	

Table 3: Clavicle plate fixation pros & cons

The advantages of plate fixation are	The disadvantages of plate fixation are
<ul style="list-style-type: none"> Anatomical reduction possible under direct visualisation Stable fixation More opted for comminuted fractures Length and alignment can be maintained No hardware migration 	<ul style="list-style-type: none"> Needs open surgery with a lengthy incision Postoperative scar is large compared to TENS fixation More blood loss Implant is costlier than TENS Needs resurgery for implant removal

Table 4: Clavicle fracture tens fixation pros & cons

The advantages of TENS fixation are	The main disadvantages of TENS fixation are
<ul style="list-style-type: none"> Small Incision only needed Limited blood loss Reduced chances of neurovascular injury Reduced chances of wound infection Cosmetically acceptable scar Reduced Hospital Stay Implant exit can be done under LA 	<ul style="list-style-type: none"> Needs fluoroscopic assistance Chances of medial hardware migration

DISCUSSION

The current study reports surgical intervention for clavicle fractures among 40 patients randomised using the LCP and TENS methods. The study included a high incidence of clavicle fracture among male patients (78%), also reported by several other studies.^[11-13] We have also reported that young adult patients were more prone to clavicle fractures, as seen in other prospective studies.^[12,13] Plating of acute clavicle fractures is advocated as the preferred fixation method by many authors. Biomechanically, plate fixation is superior to intramedullary fixation because it better resists bending and torsional forces during upper extremity elevation above shoulder level. Patients treated with plate fixation are allowed a full range of motion once their soft tissues have healed. The disadvantages of plate fixation include the necessity for increased exposure and soft-tissue stripping, increased risk of damage to the supraclavicular nerve, slightly higher infection rates, and risk of refracture after plate removal. Nidhi et al. 2014 suggested that Antegrade flexible intramedullary nailing techniques have advantages like less soft tissue injury, shorter operating time and hospital stay, less blood loss, more cosmetic satisfaction and minor surgery needed to remove the implant.^[14] Ishwar Bohra et al. 2018 suggested that intramedullary nailing would be a superior option because of less soft tissue damage, blood loss, surgical time, cosmetically better scar, shorter hospital stay and better shoulder score.^[15]

Our study showed excellent outcomes among patients who underwent TENS compared with those who underwent LCP ($p = 0.008$). This finding can be correlated with a prospective study conducted by Yadav et al. among 62 patients who underwent TENS. Such patients had lesser union times, with early recovery and minimal surgical complications compared to LCPs.^[16] TENS also provide secure fixation, enabling axial compression and promoting healing by maintaining the integrity of soft tissues, bone surface membranes, and the vascular structure at the fracture site.^[17]

Our study also reported minimal surgical complications with TENS, resulting in excellent patient outcomes. This was also seen in Kadakia AP et al. and Gao Y et al., who reported that the use of the plating method or LCPs resulted in major surgical complications when compared to TENS.^[9,18]

In our study, the functional outcomes of the patients in the TENS group were significantly better than those in the plating group. Smaller postoperative scarring, lesser soft tissue stripping, preservation of the supraclavicular nerve, and the possibility of early postoperative rehabilitation without risk of implant failure were the factors that resulted in better functional outcomes in TENS fixation than in plate osteosynthesis.

CONCLUSION

After a six-month postoperative period, the functional outcome was significantly better for patients with TENS nailing than those with plating.

The investigation of intramedullary TENs and plate osteosynthesis for displaced midshaft clavicle fractures yielded significant results. The demographic composition is primarily comprised of young adults, predominantly male participants. Evaluating functional outcomes using the Constant Score six months post-operatively revealed a marked superiority in the TENS group over plating. The TENS method exhibited advantages such as reduced postoperative scarring, minimised soft tissue disruption, and prospects for early rehabilitation without implant failure, collectively influencing more favourable overall outcomes.

Limitation

The primary limitation of our study was that it was a small prospective comparative study that included a small number of patients and was performed at a single centre. Larger randomised controlled trials are needed to evaluate the outcomes and complications of precontoured plates and TENS in displaced midshaft clavicle fractures.

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