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Original Research Article

Comparative Study of Plating and Titanium Elastic Nailing System in Mid-Clavicular Fractures in Andhra Pradesh Population

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Abstract

Background: As clavicle is subcutaneous bone, without medullary cavity, lying horizontally. If it is fractured does not heal early. Hence new techniques are required for early union.

Method: Out of 50 patients with mid-clavicular fractures, 25 were treated with TENS and 25 with plating. A routine blood examination and an ECG and radiological study were carried out, and general anesthesia was given.

Results: Mean blood loss, timing for surgery, and size of wound were quite low in the nailing technique as compared to the plating technique, and the p value was highly significant ($p<0.00$). Surgical complications were also the least common with nailing techniques. The rate of union was 100% in both techniques. The mean dash square rate in the 1st, 2nd, and 6th months was highly significant in nailing technique ($p<0.001$).

Conclusion: Both techniques have a 100% union rate of fracture and are equally effective in treating displaced mid-clavicular fractures, but owing to the least post-surgical complications, the TENS technique is preferred over the plating technique.

Keywords: plating technique, fluoroscopy, DASH score, TENS.

Introduction

The clavicle is bent in the middle 2/3, the normal length of the clavicle is 12 cm to 14 cm. The name "clavicle" is derived from the Latin word. Clavus means Raman key-like appearance [1]. As it is bent in the middle 1/3, without a medullary cavity, it moreover lies horizontally; hence it is more prone to get fractured [2].

Moreover, the clavicle keeps the upper limb away from the body trunk and helps in body weight transmission, hence it is more active in the movement of the shoulder girdle and shoulder joint; therefore, it is more likely to get fractured, especially in the middle 1/3rd.

Due to lack of medullary cavity, it is devoid of bone marrow; hence, it is a challenge for orthopedic surgeons to treat the fracture of the clavicle [3]. It is also not clear whether surgery produces better outcomes than non-surgical management. In this scenario, a comparative randomized study is planned to compare plating versus the titanium elastic nail system (TENS) for clavicle fractures and compare with respect to incidence of non-union, shortening, functional outcome, cosmetic aspects, and complication [4]. The pros and cons of both technical methods were evaluated, compared, and recorded.

Material and Method

50 (fifty) adult patients aged between 20 to 50 years admitted to the orthopaedic department of Santhiram Medical College Hospital, Nandyal, Andhra Pradesh-518502 were studied.

Inclusive Criteria: The patients having displaced and isolated fractures of the middle third clavicle Duration of fracture less than 2 weeks (<2 weeks) were selected for study. The patients who gave their consent in writing for study were selected.

Exclusion: Fracture was more than 2 weeks old; open fractures. Pre-existing morbidity of the ipsilateral arm, shoulder, or hand involvement of neuro-vascular injury was excluded.

Method: Out of 50 patients, 25 were selected for TENS (titanium elastic stable intramedullary nail) and 25 patients with plate technique. Routine hematological investigations and urine, stool, ECG, and radiological studies were carried out pre- and post-surgery. The fractures of the clavicle, classified as AO and OTA, were carried out under general anesthesia.

Surgical technique for plating: Prophylactic antibiotics were given to every patient. Each patient was placed in a supine position with a large blump placed between the scapulas, allowing the injured shoulder girdle to fall posteriorly, helping to restore length, and exposed to the clavicle. Reduction was done, and a 3.5-mm reconfigured LCP was contoured with bending for application to the superior surface of the clavicle or antero-inferior surface. In the case of long oblique fractures or wedge-commutated fractures. 1 ag screw was used, and care was taken to preserve soft tissue attachment. For commutated fractures, a sufficiently long plate with nine (nine) or twelve (twelve) holes was used to bridge the fracture and obtain at least six cortex fixations on each side of the fracture.

Surgical technique for TENS: Each patient was placed in a supine position. A small incision was made approximately 1 cm lateral to the steno-clavicular joint. A TEN (titanium elastic stable inter-medullary nail) was inserted (the diameter varied from 2 to 2 mm depending upon the width of the bone). Before introduction, the original curvature of the small and flattered nail tip was straightened slightly to allow better gliding in the small medullary canal. Closed reduction was performed under fluoroscopic control using two percutaneously introduced pointed reduction clamps. The nail was advanced manually until it was just medial to the sterno-clavicular joint. Accurate maneuvering of the nail tip was necessary under fluoroscopic control to avoid penetration of the thin dorsal cortex. After reaching the end point, the fracture was compressed, and the nail was cut close to the entry point to minimize the soft tissue irritation. At the same time, leave sufficient length behind for easy extraction later on. The fascia and skin were closed in layers.

Post-operative protocol and follow-up for both groups – Intravenous antibiotics were given for 3 days, and then they were changed to oral antibiotics for 7 days. The operative limb was immobilized in an arm sling. The wound was inspected on the 3rd post-operative day, and an x-ray was taken to study the alignment of fracture fragments and sutures removed on the 10th post-operative day. The patients were in arm slings. Rehabilitation of the affected arm was started at the end of the second week. A gentle pendulum exercise of the shoulder was allowed, but abduction was limited to 80 to 90 degrees. At 6 to 8 weeks, active range of motion in all planes was allowed.

Every post-operative patient was assessed on day 3rd, every week, until radiological reports were found to be complete. After the 6th month, 9th month, and 12th month after surgery, follow-up was done radiologically.

Radiography healing was defined as evidence of a bridging callus across the fracture site or obliteration of the fracture line. Clinically, healing of a fracture is the absence of tenderness with firm palpation over the fracture site, full range of motion, and the presence of normal strength of the upper extremity. After union shortening of clavicular length was measured clinically, the linear difference of clavicle lengths from the sternum and to the acromial end between the operated and normal sides was compared.

The duration of the study was from January 2023 to July 2024.

Statistical Analysis: Parameters of surgical techniques, hospital stay, and post-operative complications were compared. The statistical analysis was done in SPSS software. The ratio of males and females is 2:1.

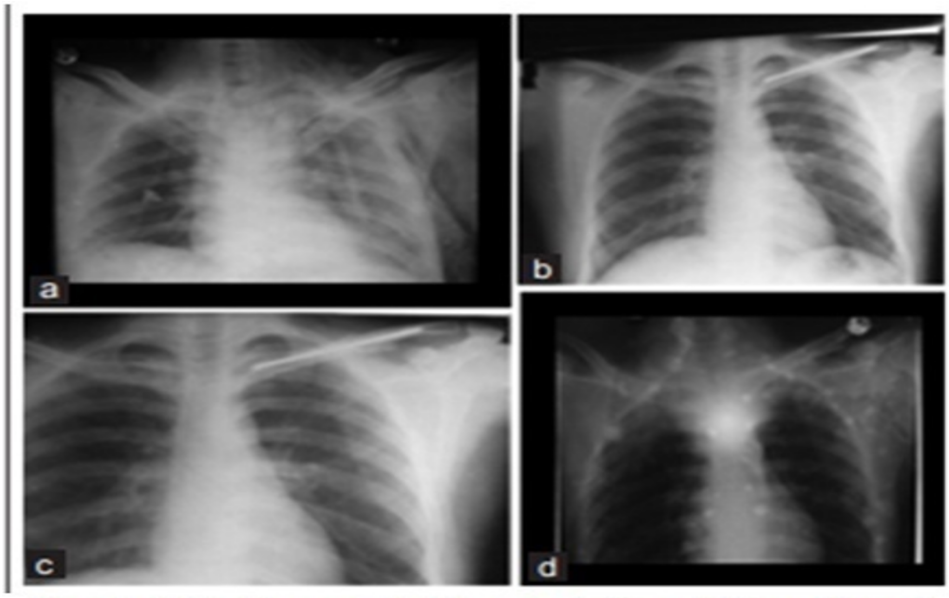

Figure-1: TENS nailing group-1 (a) Pre-operative X-ray, (b) Immediate post-operative, (c) 6 month post-operative (d) After implant removal

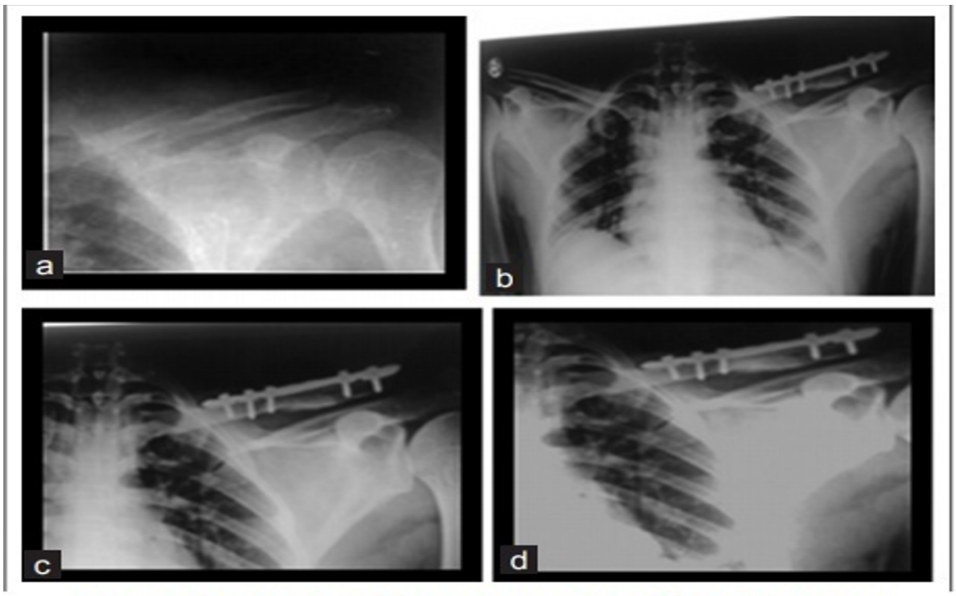

Figure-2: Plate technique (a) Pre-operative X-ray, (b) Immediate post-operative, (c) 3 months post-operative, (d) 12 months post-operative

Observation and Results

Table 1:

Comparative study of operative details in both techniques

- Mean blood loss: 90 (±1.5) in plating group, 56 (± 2.3) in nailing, t test was 61.9 and p<0.001
- Mean operation duration (time) (minutes): 72 (±2.5) in the plating group, 55 (±1.5) in the nailing group; t test was 30.6 and p<0.001
- Mean size of wound (mm): 6.82 (±1.3) in plating techniques and 4.42 (±1.2) in nailing; t test as 6.78 and p<0.001.
- Mean closed reduction only observed: 5 (±0.2) in nailing technique only
- Mean open reduction: 22 (±1.2) in plating, 13 (±1.5) in nailing, t test was 23.4 and p<0.001

Table 2: Comparative study of hospital stay in both groups (in days): 6.5 (± 0.3) in plating technique patients, 5.2 (±0.2) in nailing group, t test was 18.02 and (p<0.001).

Table 3: Comparison study of post-surgical complications

- Superficial infection: 4 (16%) in plating technique, 1 (4) in nailing technique patients
- Implant infection: 4 (16%) in plating technique group, 1 (4%) in nailing technique group.
- Mean shorting (mm): 3.5 (14%) in plating group, 3.8 (15.2%) in nailing patients

Table 4:

Comparison of outcomes in both techniques

1. The union rate was 100% for both techniques.

- Union observed in radiological study: 14 weeks (±0.3) in the plating, 13 weeks (±0.2) in the nailing group, t test was 13.8 and (<0.001).
- Clinical union study: 7.5 week (±0.2) in plating technique group, 7.4 (±0.1) in nailing technique, t test was 2.23 and p<0.004.

1. Mean quick:

- Dash score: 1st month 21.3 (±1.5) in plating technique, 15.24 (±0.2) in nailing technique, t test was 20.02 and (p<0.001).
- Dash score: 2nd months 2.52 (±1.2) in plating technique group, 7.88 (±1.4) in nailing technique group, t test was 14.5 and p<0.001.
- 6th months: 1.22 (±1.0) in plating technique group, 6.13 (±0.2) in nailing technique group, t test was 24.07 and p<0.001.

Table 1: Comparative study of operative details in both techniques (Total No. of patients: 50)

Sl. No	Details	Plating mean value (±SD) (25)	Nailing Mean value (±SD) (25)	t test	p value
1	Mean Blood loss (ml)	90 (±1.5)	56 (±2.3)	61.9	P<0.001
2	Mean operative time (Minutes)	72 (±2.5)	55 (±1.2)	30.6	P<0.001
3	Mean size of wound	6.82 (±1.3)	4.42 (±1.2)	6.78	P<0.001
4	Mean closed reduction	--	5 (±0.2)		-
5	Open Mean Reduction	22 (±1.2)	13 (±1.5)	23.4	P<0.001

P<0.001 = p value is highly significant

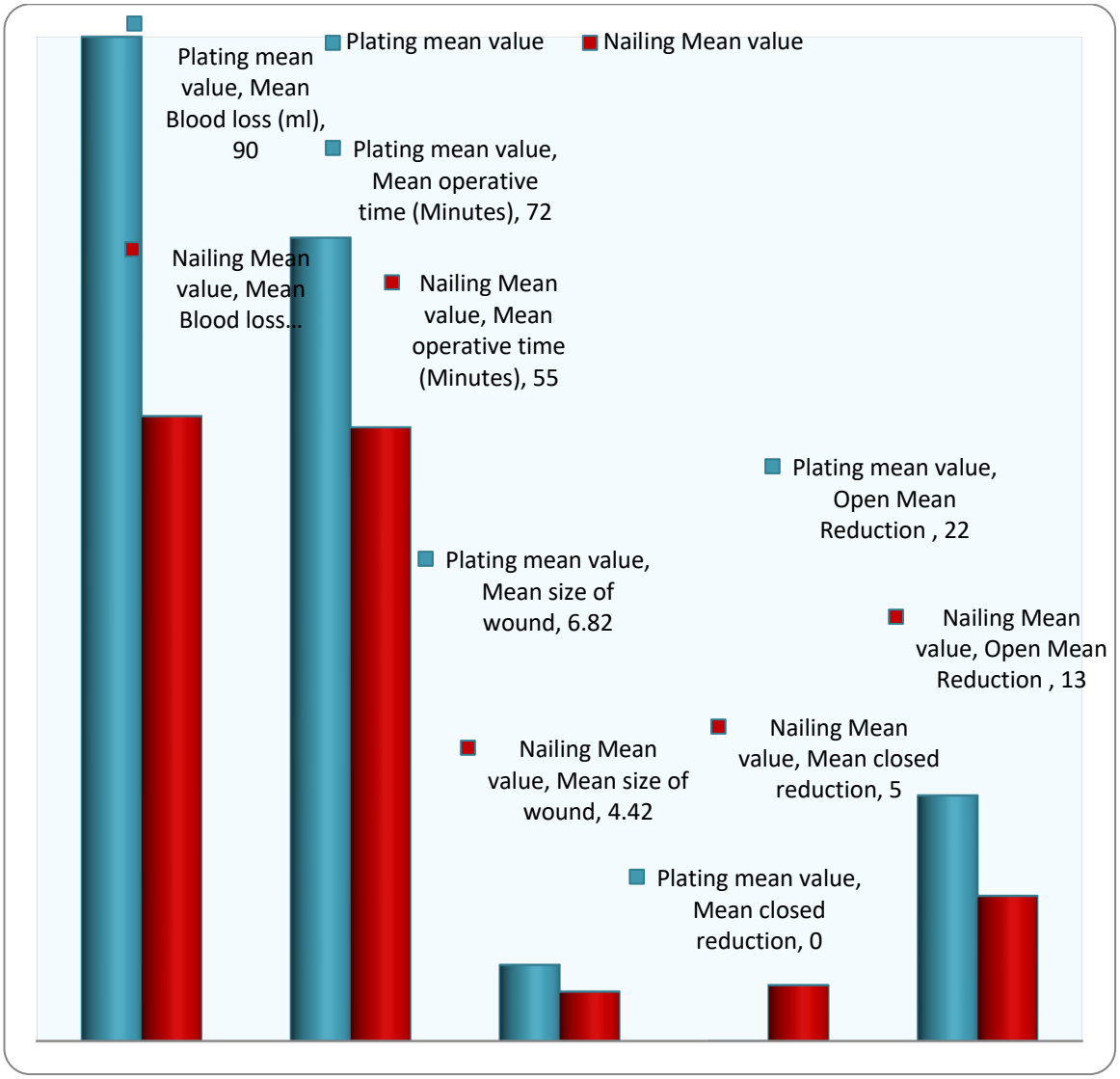

Figure 3: Comparative study of operative details in both techniques

Table 2: Comparative study of hospitals stays in both groups

No.	Particulars	Plating technique mean value (25)	Nailing Technique patients Mean value (25)	t test value	p value
1	Hospital stay (in days)	6.5 (±0.3)	5.2 (±0.2)	18.02	P<0.001

P<0.001 = p value is highly significant

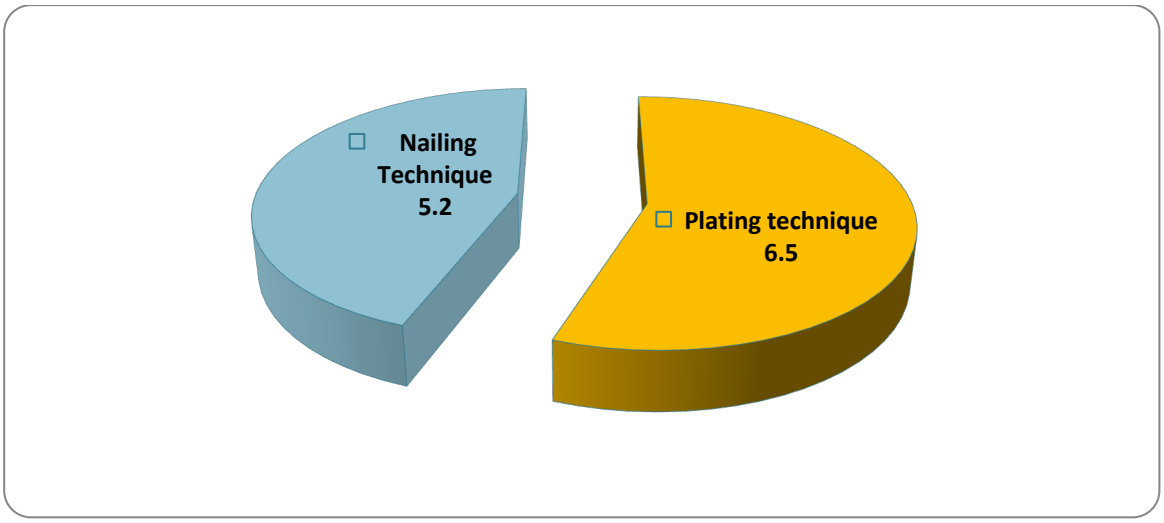

Figure 4: Comparative study of hospitals stays in both groups

Table 3: Comparative study of post-surgical complications

Sl. No.	Complications	Plating technique (25)	percentage %	Nailing technique (25)	Percentage %
1	Superficial infection	4	16%	1	4%
2	Implant irritation	4	16%	1	4%
3	Mean Shortening (mm)	3.5	14%	3.8	15.2%

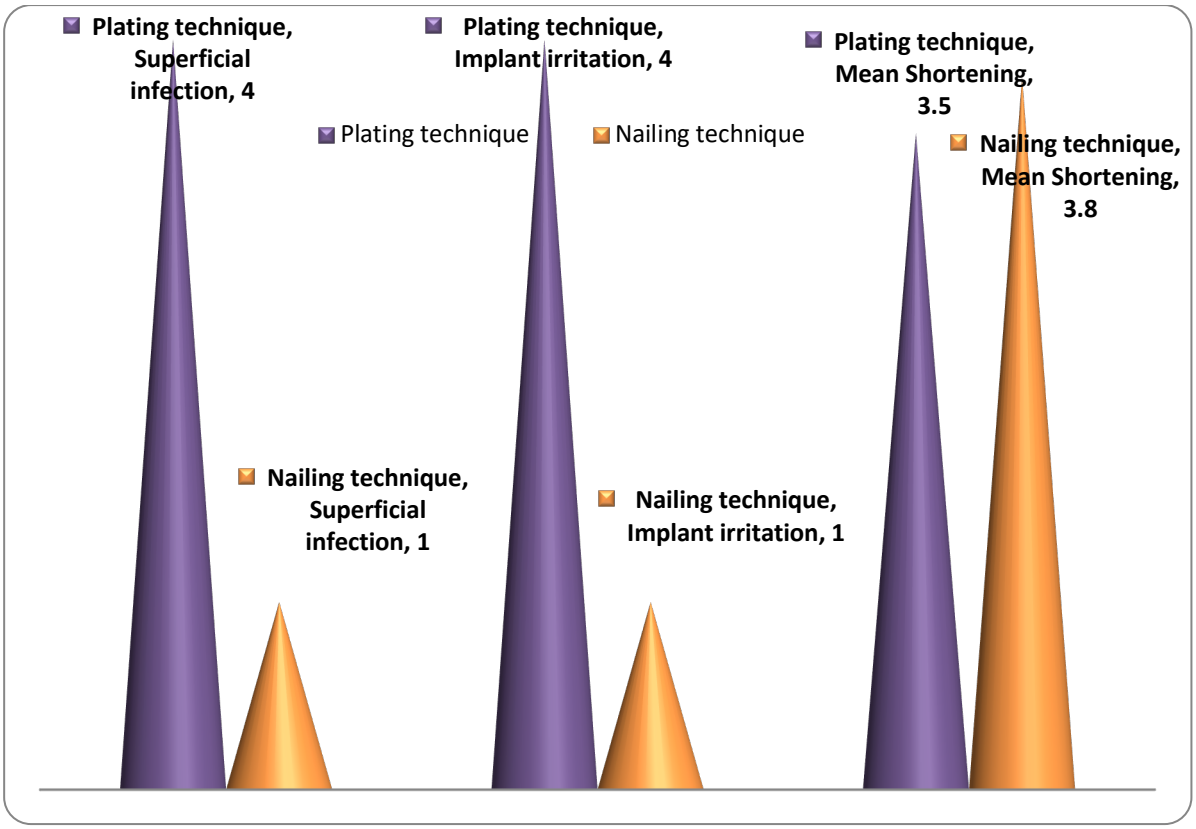

Figure 5: Comparative study of post-surgical complications

Table 4: Comparison of outcome in both techniques

Sl. No.	Parameter	Plating technique	Nailing technique	t test	p value
1	**Union rate**	100%	100%	--	--
2	**Mean Union rate**				
A	Radiological union	14 weeks (±0.3)	13 weeks (±0.2)	13.8	P<0.001
B	Clinical Union	7.5 week (± 0.2)	7.4 (±0.1)	2.23	P<0.004
3	**Mean Quick**				
A	Dash Score 1st month	21.3 (±1.5)	15.24 (±0.2)	20.02	p<0.001
B	2nd month	2.52 (±1.2)	7.88 (±1.4)	20.02	p<0.001
C	6th Month	1.22 (±1.0)	6.13 (±0.2)	24.07	p<0.001

Discussion

Present comparative study between plating and titanium elastic nailing systems for mid-clavicular fractures in the Andhra Pradesh population. In operative details comparison mean blood loss (ml): mean operative times, mean sized wound. The mean closed reduction has a significant p value (p<0.001), which is highly significant (Table 1). Hospital stay were compared in both groups, and the p value was highly significant (p<0.001) (Table 2). In a comparative study of post-surgical complications like superficial infection and implant irritation, A mean shorting (mm) least percentage was observed in Nailing technique patients as compared to plating technique (Table 3). In the comparison of outcomes in both techniques, the union rate was 100% in both techniques.

The radiological union clinical union, Dash scores of 1st month, 2nd month, and 6th month have a significant p value (p<0.001) (Table 4) (Figures 1 and 2). These findings are more or less in agreement with those of previous workers [5,6,7]. Clavicle plays an integral role not only in the mechanics of the pectoral girdle but also in the function of the upper extremity. The majority of clavicle fractures, around 85%, occur in the mid-shaft of the clavicle, where the compressive forces applied to the shoulder and narrow cross section of the bone combine and result in a bone fracture [8]. A biomechanical study suggests that plate fixation results in more rigid fixation as compared to nailing, and this helps in rehabilitation [9].

Plate fixation is technically easy to perform and provides rotational control. Disadvantages include large wound sizes and implant prominence. On the other hand, TENS is less invasive, has a lower rate of implant prominence, and after union, implant removal can be done as an outpatient procedure with minimal dissection [10]. In nailing, if closed reduction is achieved, this has the advantage of preserving fracture hematoma, which speeds up fracture healing. The disadvantages are that it does not provide rotational control, and TENS protrusion leads to implant irritation.

There was no difference between the two techniques in terms of the rate of union. As it was 100% in both groups, there was a difference in union duration. An earlier union was observed in the nailing technique. Post-surgical complications like superficial infection and implant irritation are more common with the plating technique.

Summary and conclusion

Both techniques are equally effective at treating displaced mid-clavicular fractures and give better function and fewer complications than non-operative treatment. The TENS technique has more advantages and fewer complications than plating, making its use more favorable. It is recommended for athletes and young, active individuals and can be used as an alternative to conservative treatment or plate fixation.

Limitation of study: Due to the remote location of the present institution, the small number of patients, and the lack of the latest technologies, we have limited results.

This research paper was approved by the ethical committee of Santhiram Medical College, Nandyal, and Andhra Pradesh-518502.

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