

## Comparative Study between Plating and Titanium Elastic Nailing System for Mid-Clavicular Fractures in Maharashtra Population

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### Abstract:

**Background:** As the clavicle lies horizontally in the body, it is more susceptible to fracture. As it does not have a medullary cavity for the union of a mid-clavicular fracture, new techniques are required.

**Method:** Out of 60 patients with mid-clavicular fractures, 30 were treated with TENS and 30 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 1<sup>st</sup>, 2<sup>nd</sup>, and 6<sup>th</sup> months was highly significant in nailing technique ( $p < 0.001$ ).

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

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

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### Introduction

The mid-shaft of the clavicle is the most frequently affected site, encompassing 69–82% of all clavicle fractures, and most fractures that occur in the mid-shaft are displaced [1]. Mid-shaft clavicle fractures in adults have traditionally been treated non-operatively.

However, displaced or comminuted fractures carry a risk of symptomatic mal union, non-union, and poor functional outcome with cosmetic deformity [2]. Early surgical intervention of mid-shaft clavicle fractures has resulted in improved outcomes and a decreased rate of non-union and symptomatic mal-union compared with non-operative treatment [3].

Operative treatment of displaced mid-shift clavicle fractures can be achieved successfully using plates or inter-medullary implants like rush pins, Kirschner wires, or nails, a new intra-medullary technique in which single titanium elastic nailing is widely used [4]. The prospective study was

designed to compare the efficacy of plating and titanium elastic nailing systems (TENS) techniques.

### Material and Method

60 (sixty) adult patients aged between 20 to 45 years admitted to the orthopaedic department of DY Patil Medical College Hospital and Research centre, Pimpri Pune, Maharashtra-411018 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.

**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 60 patients, 30 were selected for TENS (titanium elastic stable intramedullary nail) and 30

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 3<sup>rd</sup> post-operative day, and an x-ray was taken to study the alignment of fracture fragments and sutures removed on the 10<sup>th</sup> 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 3<sup>rd</sup>, every week, until radiological reports were found to be complete. After the 6<sup>th</sup> month, 9<sup>th</sup> month, and 12<sup>th</sup> 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 June 2023 to January 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.

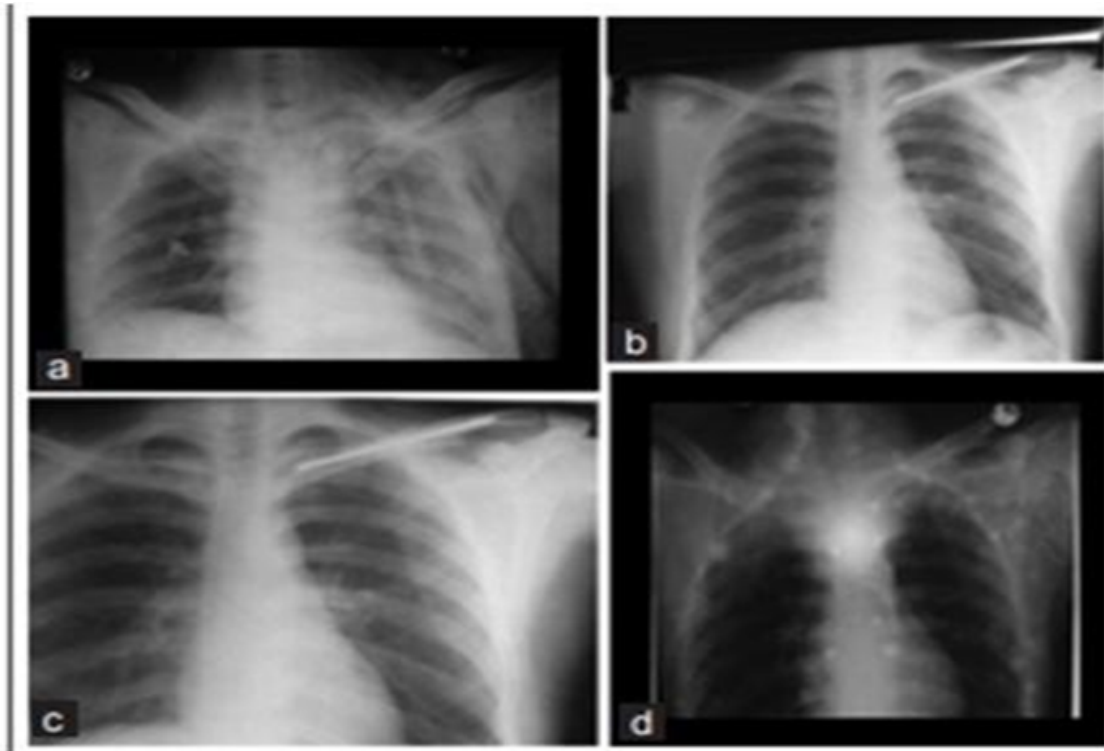


Figure-1: TENS nailing group-1 (a) Pre-operative X-ray, (b) Immediate post-operative, (c) 6 month post-operative (d) After implant removal

Figure 1:

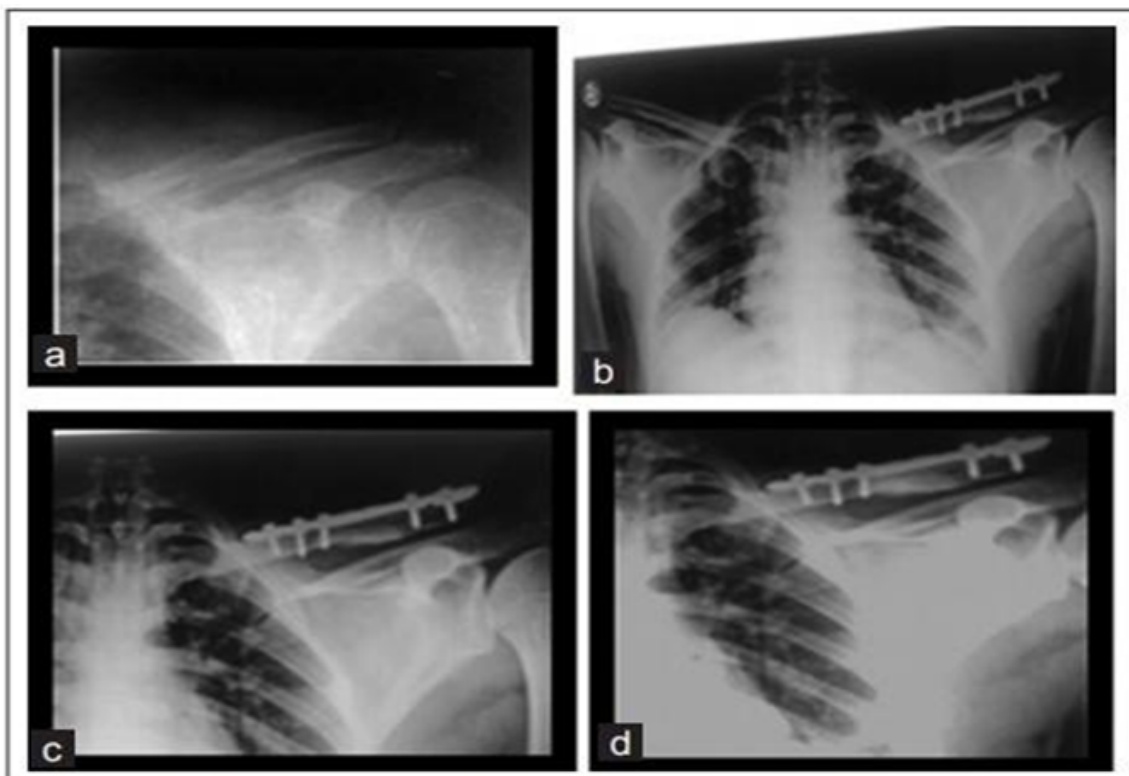


Figure-2: Plate technique (a) Pre-operative X-ray, (b) Immediate post-operative, (c) 3 months post-operative, (d) 12 months post-operative

Figure 2:

**Observation and Results**

**Table 1:** Comparative study of operative details in both techniques

- Mean blood loss: 92 (±1.2) in plating, 55 (±2.6) in nailing, t test: 31.6, and p<0.001
- Mean operation time: 73 (±2.6) in the plating group, 56 (±1.4) in the nailing group; t test: 3.33 and p<0.001
- Mean size of wound: 6.84 (±1.2) in plating techniques and 4.45 (±1.4) in nailing; t test: 7.09 and p<0.001
- Mean closed reduction: 5 (±0.3) in nailing technique only
- Mean open reduction: 23 (±1.2) in plating, 14 (±1.5) in nailing, t test: 25.6, and p<0.001

**Table 2:** Comparative study of hospital stay in both groups (in days): 6.5 (±0.5) in plating technique patients, 5.3 (±0.3) technique patients, t test 11.2 and (p<0.001) p value is highly significant

**Table 3:** Comparison of post-surgical complications

- Superficial infection: 5 (16.6%) in plating technique and 2 (6.6%) in nailing technique patients

- Implant infection: 5 (16.6%) in plating, 2 (6.6%) in nailing technique
- Mean shorting (mm): 4.2 (14%) in plating, 4.5 (15%) in nailing patients

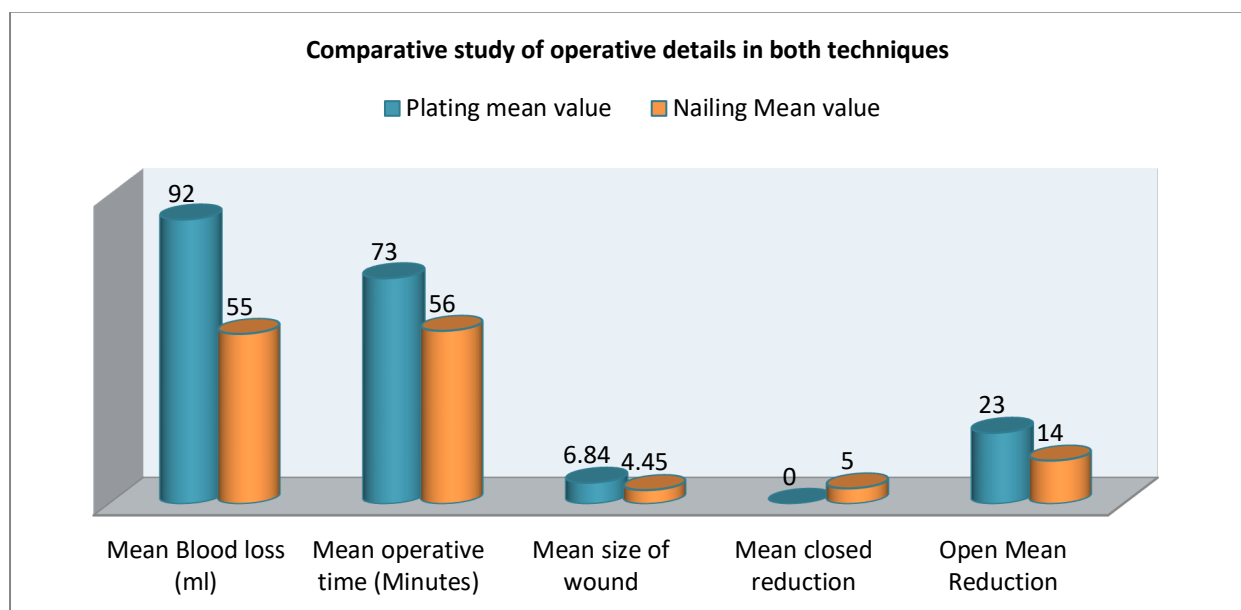
**Table 4:** Comparison of outcomes in both techniques

- The union rate was 100% for both techniques.
  - Radiological union: (weeks) 14 (±0.5) in the plating, 13 (±0.3) in the nailing; t test: 9.93 and (<0.001) p value is highly significant.
  - Clinical union: 7.6 (±0.3) in plating, 7.4 (±0.2) in nailing, t test 3.03, and (p<0.004) p value is highly significant.
- Mean quick:
  - Dash score study In one month: 21.5 (±1.5) in plating, 15.25 (±0.4) in nailing, t test: 22, and (p<0.001) p value is highly significant.
  - 2<sup>nd</sup> months: 2.53 (±1.3) in plating, 7.80 (±0.3) in nailing, t test 21.6, (p<0.001) p value is highly significant.
  - 6<sup>th</sup> months: 1.20 (±1.2) in plating, 6.12 (±0.4) in nailing, t test was 21.3 and (p<0.001) p value is highly significant.

**Table 1: Comparative study of operative details in both techniques (Total No. of patients: 60)**

Sl. No	Details	Plating mean value (±SD) (30)	Nailing Mean value (±SD) (30)	t test	p value
1	Mean Blood loss (ml)	92 (±1.2)	55 (±2.5)	31.6	P<0.001
2	Mean operative time (Minutes)	73 (±2.6)	56 (±1.4)	3.33	P<0.001
3	Mean size of wound	6.84 (±1.2)	4.45 (±1.4)	7.09	P<0.001
4	Mean closed reduction	--	5 (±0.3)	-	-
5	Open Mean Reduction	23 (±1.2)	14 (±1.5)	25.6	P<0.001

P<0.001 = p value is highly significant

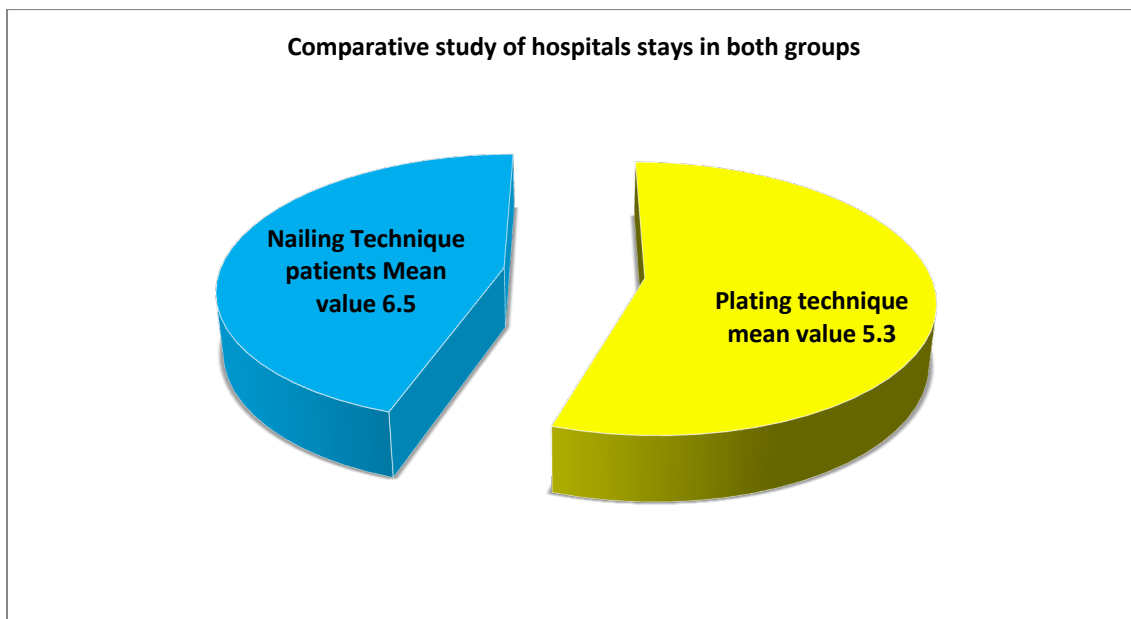


**Figure 3: Comparative study of operative details in both techniques**

**Table 2: Comparative study of hospitals stays in both groups**

No	Particulars	Plating technique mean value (30)	Nailing Technique patients Mean value (30)	t test value	p value
1	Hospital stay (in days)	6.5 (±0.5)	5.3 (±0.3)	11.2	P<0.001

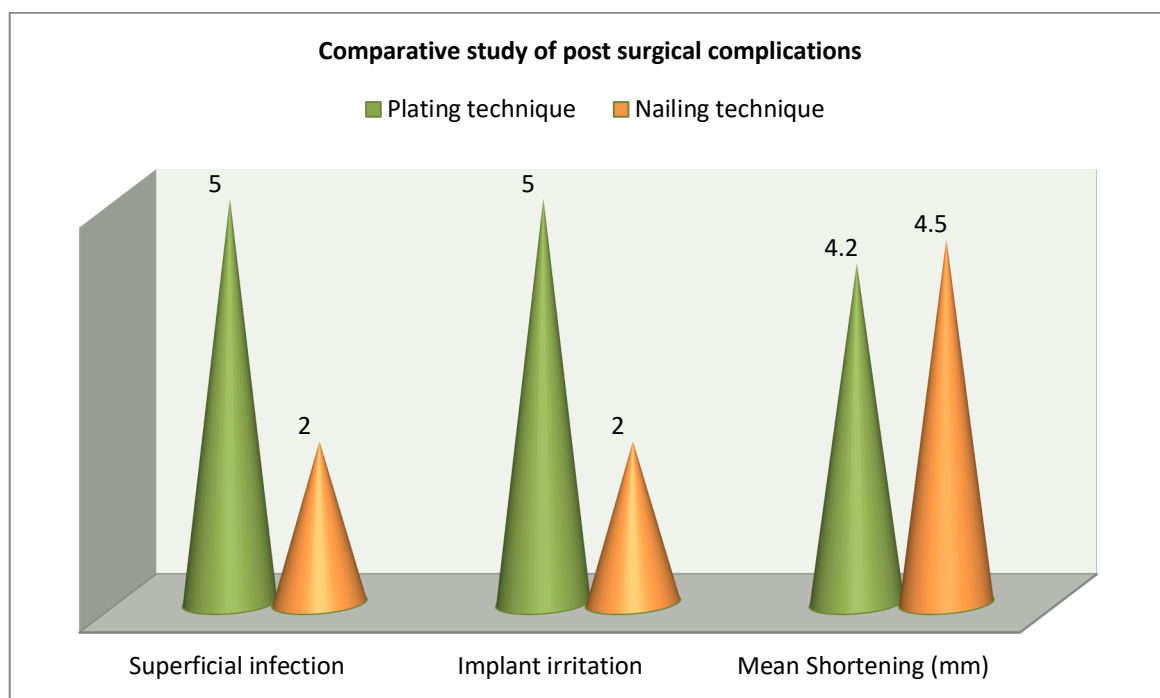
P<0.001 = p value is highly significant



**Figure 4: Comparative study of hospitals stays in both groups**

**Table 3: Comparative study of post-surgical complications**

Sl. No	Complications	Plating technique	percentage	Nailing technique	Percentage
		(30)	%	(30)	%
1	Superficial infection	5	16.6%	2	6.6%
2	Implant irritation	5	16.6%	2	6.6%
3	Mean Shortening (mm)	4.2	14%	4.5	15%



**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 ( $\pm 0.5$ )	13 weeks ( $\pm 0.3$ )	9.93	P<0.001
B	Clinical Union	7.5 week ( $\pm 0.3$ )	7.4 ( $\pm 0.2$ )	3.03	P<0.004
3	Mean Quick				
A	Dash Score 1 <sup>st</sup> month	21.5 ( $\pm 1.5$ )	15.25 ( $\pm 0.4$ )	22	p<0.001
B	2 <sup>nd</sup> month	2.53 ( $\pm 1.3$ )	7.88 ( $\pm 0.3$ )	21.6	p<0.001
C	6 <sup>th</sup> Month	1.20 ( $\pm 1.2$ )	6.12 ( $\pm 0.4$ )	21.3	p<0.001

## Discussion

Present comparative study between plating and titanium elastic nailing systems for mid-clavicular fractures in the Maharashtra 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 tertiary 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 DY Patil Medical College Hospital and Research Center, Pimpri, Pune, Maharashtra 411018.

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