

Comparative Study Between Plating and Titanium Elastic Nailing System in Mid-Clavicular Fractures

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Received: 27-05-2023 / Revised: 26-06-2023 / Accepted: 25-07-2023

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Conflict of interest: Nil

Abstract:

Background: Fracture of the clavicle is one of the most common bony injuries. The clavicle lacks a medullary cavity and is late to heal. Hence, proper technique is mandatory to heal the fracture as soon as possible. Hence, it has become a challenge for orthopaedic surgeons.

Method: Out of 30 patients with clavicle fractures, 15 were treated with TENS and 15 with plating. Routine blood examination (CBC), an ECG, radiological study was carried out, and general anaesthesia 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 nail technique ($p < 0.001$).

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

Keywords: TENS-Titanium, elastic nailing system, Plating technique, Fluoroscopy, DASH score, Maharashtra.

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Introduction

A clavicle fracture is one of the most common bony injuries. Due to its shape, it has a Roman key-like structure (clavus=Roman key) and ossifies in the membrane, no-medullary cavity [1]. Approximately 2% to 5% of all fractures in adults and 10 to 15% in children are in the clavicle [2].

A weak spot in the mid-clavicular region is more prone to fractures. Despite the high frequency, the choice of proper treatment is still a challenge for orthopaedic surgeons [3]. Still, it is a matter of debate whether surgery produces better outcomes than non-surgical management.

In recent years, two techniques have been in practice to heal clavicle fractures, i.e., plating and the titanium elastic nail system (TENS). Hence, an attempt is made to evaluate and compare the pros and cons of both techniques because the clavicle is a horizontally placed bone without a medullary cavity; hence it is late to get healed.

Materials and Method

30 (thirty) patients aged between 20 to 45 years admitted to the orthopaedics department of Dr. DY Patil Medical College and the research centre Sant Tukaram Nagar Pimpri – 411018, Maharashtra, were studied.

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

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

Method: Out of 30 patients, 15 were selected for TENS (titanium elastic stable intramedullary nail) and 15 patients with plate technique. Routine haematological 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 anaesthesia.

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 scapula, 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, One third tubular plate was contoured with bending for application to the superior surface of the clavicle or antero-inferior surface. In cases of long oblique fractures or wedge comminuted fractures. 1 lag screw was used, and care was taken to preserve soft tissue attachment. For comminuted fractures, a sufficiently long plate with 9 (nine) or 12 (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 sterno-clavicular joint. A TEN (titanium elastic stable intermedullary 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 flattened 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 manoeuvring 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 minimise the soft tissue irritation. At

the same time, sufficient length was left 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, then changed to oral antibiotics for 7 days. The operative limb was immobilised 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 2nd 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 measured clinically, the linear difference of clavicle lengths from the sternum and to the acromial end between the operated and normal sides. The efficacy of both methods was compared.

The duration of the study was from July 2020 to June 2023.

Statistical analysis: parameters of both 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.

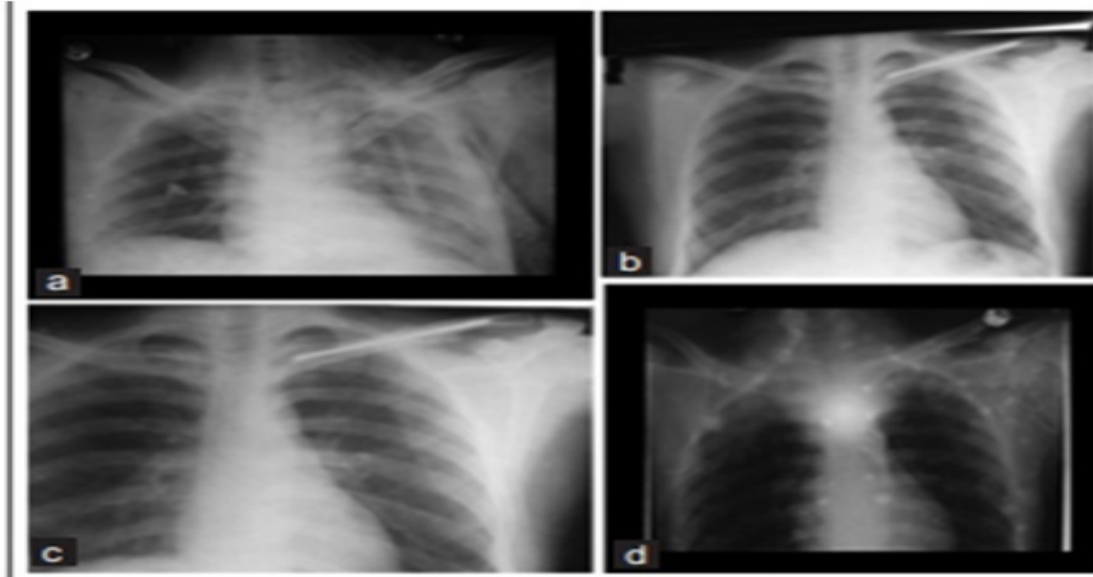


Figure-1: TENS nailing group-1 (a) Pre-operative X-ray, (b) Immediate post-operative, (c) 6 month post-operative (d) After implant removal

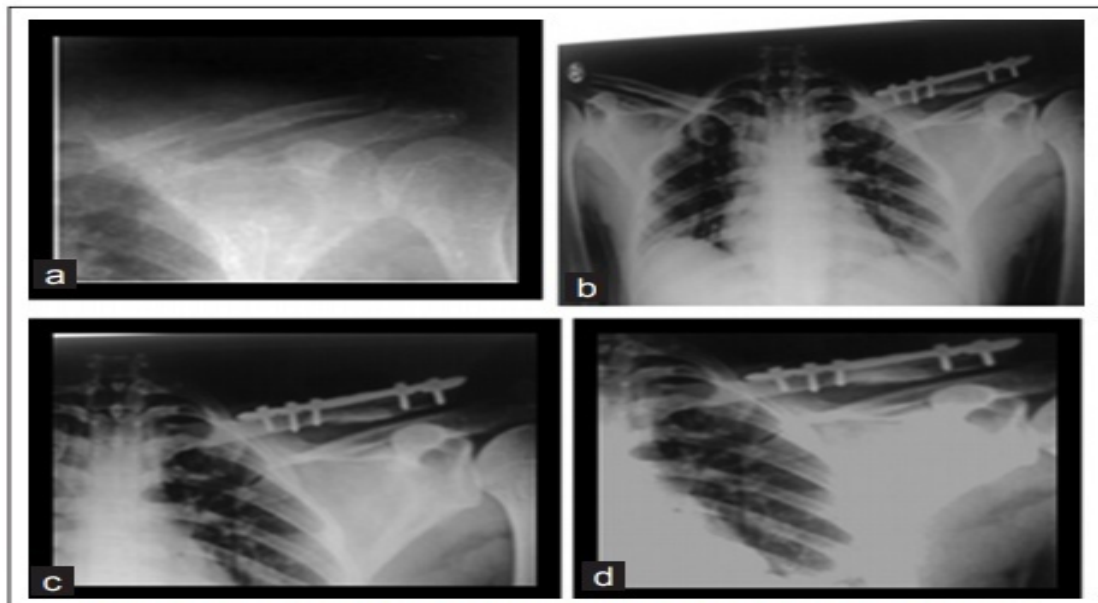


Figure-2: Plate technique (a) Pre-operative X-ray, (b) Immediate post-operative, (c) 3 months post-operative, (d) 12 months post-operative

Observation and Results

Table-1: Comparative study of operative details in both techniques.

1. Mean blood loss – 92 (± 1.6) in plating, 56 (± 2.4) in Nailing, t test 48.3 and $p < 0.001$
2. Mean operation time (minutes) – 74 (± 2.2) in plating group, 59 (± 1.6) in nailing group, t test 21.3 and $p < 0.001$
3. Mean size of wound 6.88 (± 1.4) in plating 4.50 (± 1.2) in Nailing group, t test 4.99 and $p < 0.001$

4. Mean closed reduction observed only in nailing patients 5 (± 0.2)
5. Mean open reduction (in mm) 20 (± 1.2) in plating group, 12 (± 1.8) in nailing group, t test 14.3 and $p < 0.001$

Table-2: Comparative study of hospital stay – 6.2 (± 0.5) in plating group, 5.2 (± 0.3), t test 6.6 and $p < 0.001$

Table-3: Comparison of post-surgical complication

1. Superficial infection – 2 (13.3%) in plating, 1 (6.6%) in nailing

- 2. Implant infection – 2 (13.3%) in plating technique, 1 (6.6%) in nailing technique
- 3. Mean shorting (mm) – 4.4 (29.3%) in plating, 4.6 (34.6%) in nailing technique

- b) Clinical union – 7.7 (±0.2) in plating, 7.48 (±0.2) in nailing, t test 0.7 and p>0.49 p value is insignificant

Table-4: Comparison of outcome

- 1. Union rate was 100% in both techniques
- 2. Mean Union rate
- a) Radiological union- 14 weeks (±0.8) in plating group, 13 week (±0.4) in nailing technique, t test 4.33 and p<0.004

- 3. Mean quick –
 - a) Dash score (1st month) – 21.8 (±1.5) in plating, 16.28 (±0.5) in nailing group, t test 13.5 and p<0.001
 - b) 2nd months – 2.56 (±1.2) in plating group, 7.80 (±0.6) in nailing group, t test 15.5 and p<0.001
 - c) 6th months – 1.20 (±1.2) in plating group, 6.12 (±0.5) in nailing technique, and p<0.001.

Table 1: Comparative study of operative details in both techniques

No	Particulars	Plating mean value	Nailing Mean value	t test	p value
1	Mean Blood loss (ml)	92 (±1.6)	56(±2.4)	48.3	P<0.001
2	Mean operative time (Minutes)	74 (±2.2)	59 (±1.6)	21.3	P<0.001
3	Mean size of wound	6.88 (±1.4)	4.50 (±1.2)	4.99	P<0.001
4	Mean closed reduction	--	5 (±0.2)	-	-
5	Open Mean Reduction	20 (±1.2)	12 (±1.8)	14.3	P<0.001

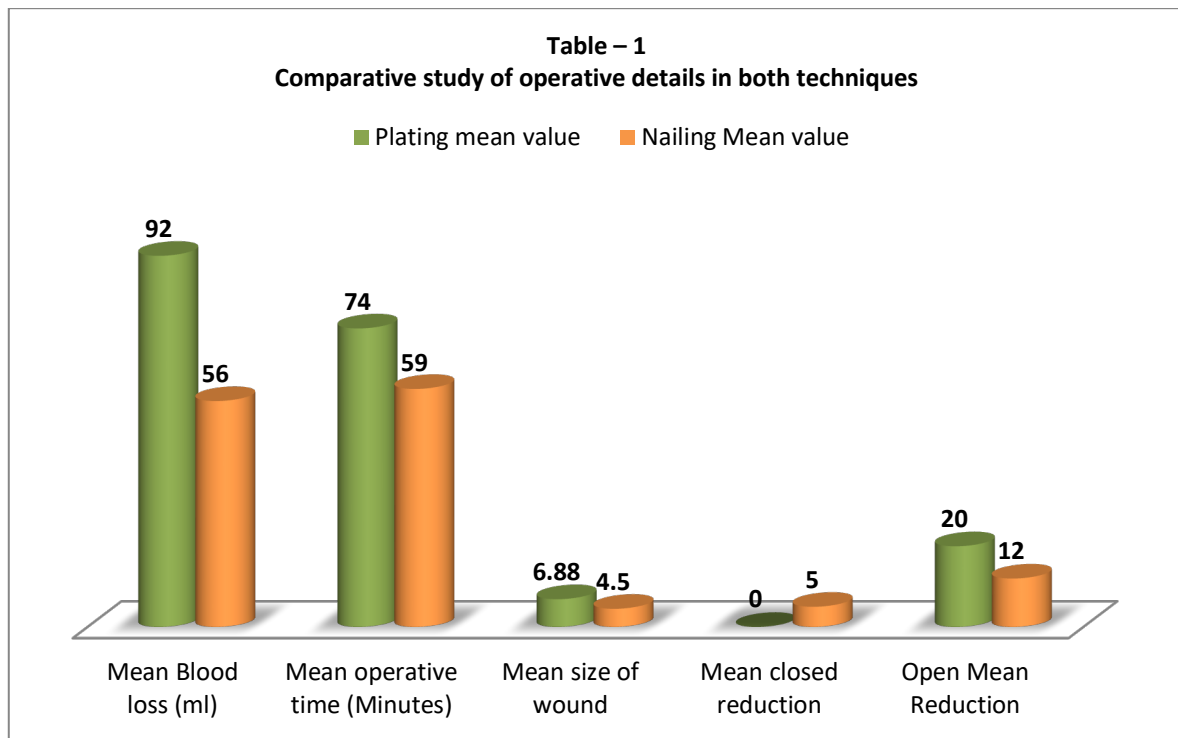


Figure 1:

Table 2: Comparative study of hospitals stay

No	Particulars	Plating technique mean value	Nailing Technique patients Mean value	t test value	p value
1	Hospital stay (in days)	6.2 (±0.5)	5.2 (±0.3)	6.6	P<0.001

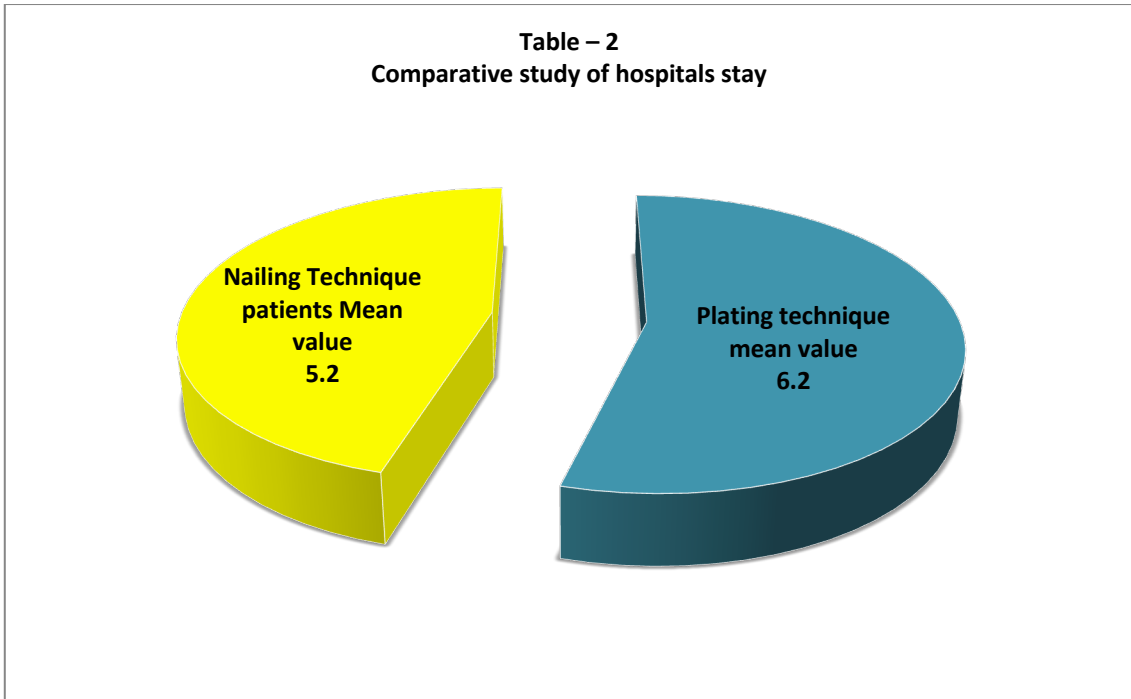


Figure 2:

Table 3: Comparative study of post-surgical complications

SI No	Complications	Plating technique	percentage	Nailing technique	Percentage
		(15)	%	(15)	%
1	Superficial infection	2	13.3	1	6.6
2	Implant irritation	2	13.3	1	6.6
3	Mean Shortening (mm)	4.4	29.3	4.6	30.6

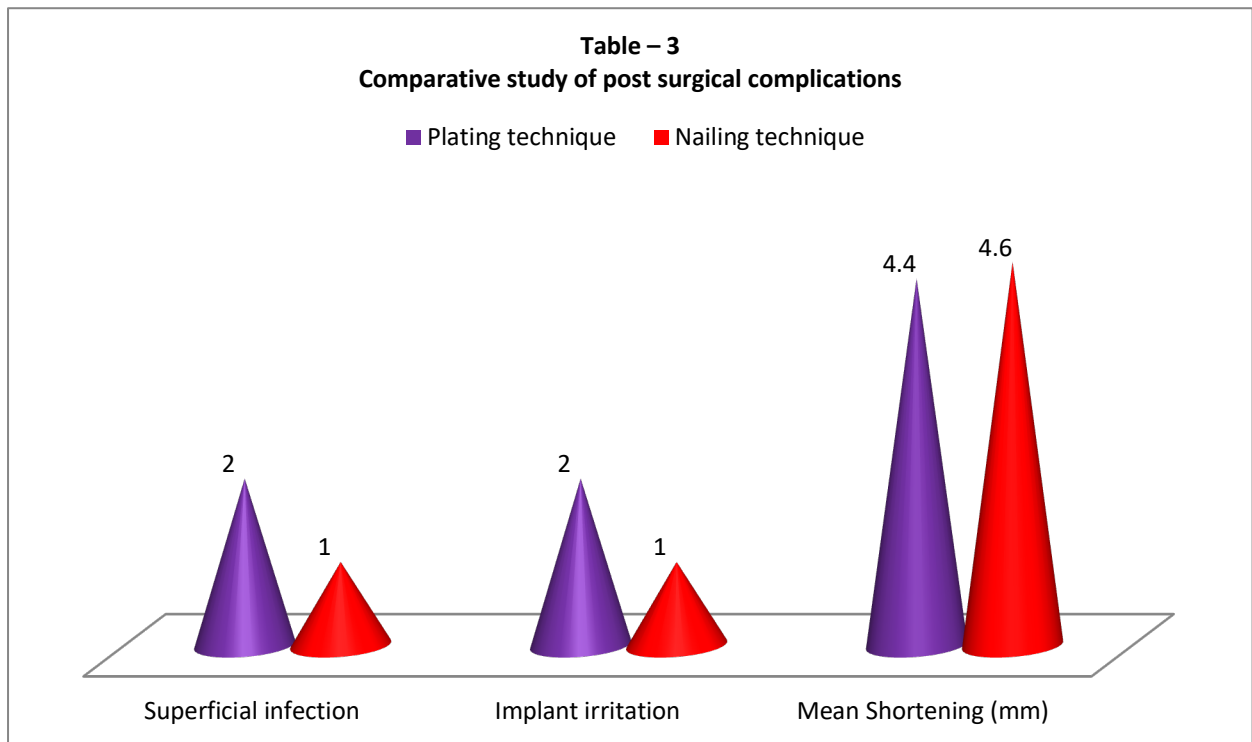


Figure 3:

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 (± 0.8)	13 weeks (± 0.4)	4.33	P<0.004
B	Clinical Union	7.7 week (± 0.2)	7.48 (± 0.2)	0.7	p>0.49
3	Mean Quick				
A	Dash Score 1 st month	21.8 (± 1.5)	16.28 (± 0.5)	13.5	p<0.001
B	2 nd month	2.56 (± 1.2)	7.80 (± 0.6)	15.1	p<0.001
C	6 th Month	1.20 (± 1.2)	6.12 (± 0.5)	14.6	p<0.001

Discussion

Presents a comparative study of plating and TENS in mid-clavicular fractures in the Maharashtra population. Mean blood loss (ml), 92 (± 1.6) in plating group, 56 (± 2.4) in TENS group, t test 48.3 and p<0.001 Mean operation times (minutes) 74 (± 2.2) in the plating group, 59 (± 1.6) in TENS, t test: 21.3; and p<0.001. Mean size of wound 6.88 (± 1.4) in plating group, 4.58 (± 1.2) in TENS group, t test 4.99 and p<0.001 The mean closed reduction was 5mm in TENS. The mean open reduction (mm) was 20 (± 1.2) in plating, 12 (± 1.8) in TENS, t test was 14.3 and p > 0.001 (Table 1). The hospital stay (in days) was 6.2 (± 0.5) in the plating group, 5.2 (± 0.3) in the TENS group, t test 6.6, and p<0.001 (Table 2).

The post-surgical complications, i.e., superficial infection 2 (13.3%) in plating and 1 (6.6%) in TENS. Implant infections were 2 (13.3%) in plating, 1 (6.6%) in TENS Mean shorting was 4.4 (29.3%) in plating, 4.6 (30.6%) in TENS (Table 3). In the comparison of outcomes in both techniques, there was a 100% union rate in both techniques. The radiological union (in weeks) was 14 (± 0.8) in plating, 13 (± 0.4) in the TENS group, t test was 4.33 and p<0.002.

Clinical union was (in weeks) 7.7 (± 1.2) in plating group, 7.48 (± 0.2) in TENS group, t test was 0.7 and p>0.49 (p value was insignificant) Mean Quick-Dash Score: 1st month: 21 (± 1.5) in plating group, 16.28 (± 0.5) in TENS, t test was 13.5 and p<0.001, 2nd month – 2.56 (± 1.2) in plating group, 7.80 (± 0.6) in TENS, t test was 15.1 and p<0.001, 6rd month – 1.20 (± 1.2) in plating group, 6.12 (± 0.5) in TENS, t test was 14.5 and pM0.001 (Table-4). These findings are more or less in agreement with previous studies [5,6,7].

Clavicle plays an integral role not only in the mechanics of pectoral girdle but also in the function of 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, implant irritation are more common in 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 favourable. 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 Dr. DY Patil Medical College and the research centre in Sant Tukaram Nagar, Pimpri, and Maharashtra – 411018.

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