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# Comparison between plating and titanium elastic nailing system in mid-clavicular fractures in Telangana population-retrospective study

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**Abstract**
**Background:** The clavicle is the most commonly fractured bone which accounts for 5 – 10% of all fractures and 44% of shoulder injuries. Previous treatment methods had a high rate of malunion and non-union. Hence both new techniques - nailing and plating were performed and compared.
**Method:** Out of 40 patients 20 were treated with TENS and 20 with plating. Haematological, ECG, cardiology examinations and other necessary investigations were carried out preoperatively. Both groups were operated under general anaesthesia.
**Results:** Mean blood loss, mean operative times, mean size of wound, mean open reduction, were highly significant ($p<0.00$) in nailing group of patients. Post-surgical complications were least in the nailing system. The union rate was 100% in both the techniques but clinical union, radiological union, mean Dash score rates in 1st, 3rd and 6th months were higher in nailing group which were statistically significant ($p<0.001$).
**Conclusion:** Nailing Technique was proved to be better than plating system because of less blood loss, less infection rates and less implant irritation whereas, mean shortening is little more in nailing compared to plating technique.

**Keywords:** tens, plating, fluoroscopy, dash score, general anaesthesia, Telangana state

## Introduction
The name 'Clavicle' is derived from the Roman word "Clavus" which means 'Key like structure' (1). The length of the clavicle varies from 12 to 14cms. It ossifies in the membrane and creates a space which allows easy passage of neuro-vascular structures between brain and upper extremity through the neck (2). On the other hand, it has two primary functions like, keeping the bones of the upper limb away from the axial skeleton and transmitting forces from the upper extremity to the axial skeleton. As it has no medullary cavity and because of its unique configuration and shape biomechanical studies reveal that the middle one third of the clavicle is the weakest point and accounts for 80% of the clavicle fractures and more than 50% of these are displaced [3, 4]. The rate of mid-clavicular fractures is more than two times higher in men compared to women. The peak incidence occurs in the third decade of life Available treatment options for acute clavicle fractures are nonoperative and operative. The non op treatment mostly consists of sling or figure of eight bandage. Commonly performed operative procedures consist of open reduction and internal fixation with plates and screws or closed or open reduction and internal fixation with intra medullary devices (wire, pin or nail). Hence an attempt was made to compare both these latest techniques to see which one proves better.

## Materials and methods
40 patients aged between 19 to 50 years of age with middle third Clavicle fractures visiting the orthopaedic department of Surabhi Institute of Medical Sciences, Siddipet, Telangana State in India were studied.

### Inclusive Criteria
The patients having displaced and isolated fractures of the middle third clavicle were selected for study.

### Exclusive Criteria
The patients not fit for surgery, pathological fractures, fractures with neuro-vascular injuries, delayed or non-union were excluded.

### Method
Out of 40 patients, 20 patients were selected for TENS (Titanium Elastic Nailing System) and remaining 20 patients for plating. Each patient had routine haematological investigations, Urine examination, ECG and Cardiological examination. The fractures of the displaced midshaft clavicle were classified as per AO/OTA classification and were operated either with a plate or TENS nail under general anaesthesia.

**Surgical technique for plating** - All the patients were given preoperative dosage of prophylactic antibiotics. All the patients were placed in a supine position with a large bump placed between the scapulae, allowing injured shoulder girdle to fall posteriorly which helps to restore length and facilitates exposure

of the clavicle. Reduction was done with appropriate manoeuvres and either a 3.5mm Recon plate, LCP or a one third tubular plate was used after contouring with bending irons or a pre-contoured plate was used. Plate was applied to either the superior surface or antero-inferior surface of the clavicle. In cases of long oblique fractures or wedge communited fractures, lag screws were used wherever possible, with due care to preserve soft tissue attachments. For communited fractures sufficiently longer plates with 9 (Nine) or 12 (Twelve) holes were used to bridge the fracture with an aim to obtain fixation of at least six cortices on each side of fracture.

**Surgical technique for TENS** – All the patients were placed in supine position. A small incision was made approximately 1 cm lateral to the sterno-clavicular joint. A TENS (Titanium elastic nail system) nail was inserted (The diameter varied from 2 to 3mm depending upon the diameter 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 then advanced manually until it was just medial to the acromio-clavicular joint. Accurate manoeuvring of 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 leaving 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. Operated limb was immobilised in an arm sling. The wound was inspected at 3rd postoperative day and x-rays were taken to study the alignment of fracture fragments. Sutures removed on 10th postoperative day. Rehabilitation of the affected arm was started at the end of 2 weeks. A gentle pendulum exercises of the shoulder were allowed but abduction was allowed to 80 to $90^0$ (degrees). At 6 to 8 weeks active range of motion in all the planes were allowed. All the post-operative patients were assessed on day 3, day 10 and after that every 3 weeks till radiological evidence of complete union was found. After that follow-up was continued with 3 monthly intervals for at least a year.

Radiographic healing was defined as evidence of bridging callus across the fracture site or obliteration of fracture line. Clinical healing of fracture was defined as absence of tenderness with firm palpation over the fracture site, full range of motion and the presence of normal strength of upper extremity. Shortening of clavicular length was measured clinically as the linear difference of clavicle lengths from sternal and acromial ends in both operated and normal sides. Efficacy of both methods was compared. The duration of study was from January, 2016 to December, 2018 (3 years).

**Statistical analysis**

The parameters of both surgical techniques, hospital stay, post-operative complications in both groups of patients were compared by‘t’ test. The statistical analysis was carried out in SPSS software. The ratio of male and females was 2:1

**Observation and Results**

**Table 1:** Comparison of intraoperative details in both techniques

1. Mean loss of blood (in ml) in plating was 95 ml (SD±1.5) and 60 ml (SD±2.0) in nail, t test value was 29.4 and p value was highly significant.
2. The mean operation time in plating was 75 (SD±2.2) minutes and 59 (SD±1.2) minutes in nailing, t test was 21.8 and p value was highly significant (p<0.00).
3. Mean size of the wound (in centimetres) 6.90 (SD±1.8) in plating and 4.50 (SD±1.2) in nailing, t test value was 4.9 and p value was highly significant.
4. Closed reduction was observed only in Nailing - Mean value was 5 (SD±0.5)
5. Mean open reduction in plating technique was 20 (SD±1.3) and 11 (SD±1.8), t test was 18.1 and (p<0.01) highly significant.

**Table 2:** Duration of hospital stay in patients of plating technique was 6.1 days (SD±0.8) and 5.2 days (SD±0.1) in nailing technique, t test value was 4.9 (p<0.01) and p value is highly significant.

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

1. Superficial infections patients were 3 (15%) in plating group and 1 (15%) in nailing group.
2. Implant irritation was 3 (15%) in plating group and 1 (15%) in nailing group of patients.
3. Mean shortening of clavicle (in mm) 4.4 (22%) in plating technique and 4.7 (23.5%) in nailing technique.

**Study of comparison of outcome of both techniques**

1. Union rate was 100% in both techniques
2. In Mean union rate

a. Clinical union in plating patients was 7.88 (SD±1.2), 7.52 (SD±1.3) in nailing patients, t test was 0.9 and p>0.36. (It was insignificant p value).

b. Radiological union 14 weeks (SD±0.8) in plating technique patients, 13 weeks (SD±0.2) in nailing technique patients, t test was 5.4 and p value was highly significant (p<0.00).

3. Study of Mean Quick DASH score

a. First month – 22.9 (SD±1.5) in plating patients, 16.3 (SD±0.5) in nailing group, t test value was 18.6 and p value was highly significant.

b. 3rd Month – 13.6 (SD±1.2) in plating vs 7.8 (SD±0.8) in nailing group, t test was 17.9 and p value was highly significant (p<0.01).

c. Six month – 9.2 (SD±1.3) in plating, 6.1 (SD±0.6) in the nailing group, t test was 20.2 and p value was highly significant (p<0.00).

**Discussion**

The comparative study between, Plating and Titanium Elastic Nailing System in Mid-clavicular fractures of Telangana state population in India. In intra operative details - Mean blood loss (mm) 95 ml (SD±1.5) in plating technique, 60 ml (SD±2.0) in Nailing technique t test was 29.4 and p value was highly significant (p<0.00). Mean operative times in minutes - 75 (SD±2.2) in plating, 59 (SD±1.2) in nailing, t test 21.8 and p<0.00. Mean size of wound (in centimetres) 6.90 (SD±1.8) in

plating 4.50 (SD±1.2) in nailing, t test 4.9 and p value was highly significant (p<0.00). Open reduction mean value in plating was 20 (SD±1.3), and in nailing was 11 (SD±1.8), t test 18.1 and p value was highly significant (p<0.01) (Table-1). The duration of hospital stay for plating patients was 6.1 (SD±0.8) days, 5.2 days (SD±0.1) in nailing patients (Table-2). In post-surgical complications 3 (15%) superficial infections were noted in plating, whereas only 1 (5%) in nailing techniques. Implant irritation - mean value was 4.4 in plating and 4.7 in nailing technique (Table-3).

Comparison of outcomes - showed an 100% union rate in both the techniques. In Mean union rates – The clinical union in plating, 7.88 weeks (SD±1.3) vs 7.52 weeks in nailing technique, t test 0.9, p<0.36 (Insignificant). The Radiological union was 14 weeks (SD±0.8) in plating, 13 (SD±0.2) weeks in nailing, t test was 5.4 and p<0.00 (highly significant). Mean Quick DASH square in first month 22.9 (SD±1.5) in plating, 16.3 (SD±0.5) in nailing, t test 18.6 p<0.01 (highly significant). In 3rd month 13.6 (SD±1.2) in plating, 7.8 (SD±0.8) in nailing, t test 17.9 and p<0.01 (highly significant) In 6th month 9.2 (SD±1.30 in plating, 6.1 (SD±0.6) in nailing, t test 20.2 and p<0.00 (highly significant) (Table-4). These findings were more or less in agreement with previous studies [6, 7, 8].

Three types of fixation techniques are available for middle third clavicle fractures: intra medullary devices, plates and external fixators. Intra medullary fixation can be done by smooth or threaded k-wires, Steinman pins, Hagie's pins, Rush pins, TENS nails or Cannulated screws. Biomechanically plate fixation is superior to intramedullary fixation because it resists the bending and torsional forces that occur during elevation of upper extremity above the shoulder better than the nails but it has its own disadvantages like need for wide exposure and soft tissue stripping, increased risk of damage to supraclavicular nerves, slightly higher infection rates and risk of refracture of clavicle following plate removal [9]. In TENS secondary bone healing occurs earlier. After removal of nails there was no incidence of refracture. It was reported that plating provides better rotational stability but nailing proved to be equally effective as plating especially for the treatment of non-unions [10], hence TENS methods are safer than plating techniques Moreover there is no injury to neuro-vascular structures and implant migration in TENS surgical technique [11]. It was noted that implant removal after plating needs another equally invasive surgery under general anaesthesia, whereas removal of TENS can be done as an outpatient procedure under local anaesthesia with a small incision over the tip of the nail. It is considered an advantage of TENS as compared to plating technique. Hence TENS is safer than plating.

## Summary and Conclusion

It can be concluded that both pre countered plating and TENS are equally effective alternatives for surgical fixation of displaced midshaft clavicle fractures. TENS nailing techniques have advantages like less soft tissue injury, shorter duration of operation, shorter hospital stay, less blood loss, more cosmetic satisfaction and need of just a minor surgery to remove the implanted nail. TENS is safe, minimally invasive surgical technique with lower complication rate and faster return to daily activities.

- This research paper was approved by the Ethical Committee of Surabhi Institute of Medical Sciences, Siddipet, Telangana-502375.
- No Conflict of Interest
- No Funding

**Table 1:** Comparison of intraoperative details in both techniques

| Sl. No | Parameter | Plating mean value | Nailing Mean value | 't' test value | P value |
|---|---|---|---|---|---|
| 1 | Mean loss of Blood (ml) | 95 (SD± 1.5) | 60 (SD±2.0) | 29.4 | P<0.00 |
| 2 | Mean operative time (mins) | 75 (SD±2.2) | 59 (SD±1.2) | 21.8 | P<0.00 |
| 3 | Mean size of wound (cms) | 6.90 (SD±1.8) | 4.50 (SD±1.2) | 4.9 | P<0.00 |
| 4 | Closed reduction | -- | 5 (SD±0.5) | -- | -- |
| 5 | Open mean reduction | 20 (SD±1.3) | 11 (SD±1.8) | 18.1 | P<0.01 |

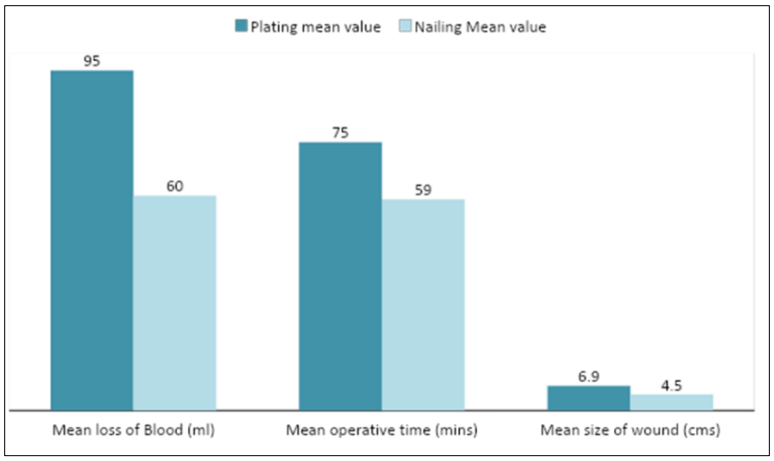


**Fig 1:** Comparison of intraoperative details in both techniques

**Table 2:** Duration of hospital stay

| Sl No | Parameter | Plating mean value | Nailing Mean value | 't' test value | P value |
|---|---|---|---|---|---|
| 1 | Hospital stay | 6.1 (SD±0.8) | 5.2 (SD±0.1) | 4.9 | P<0.01 |

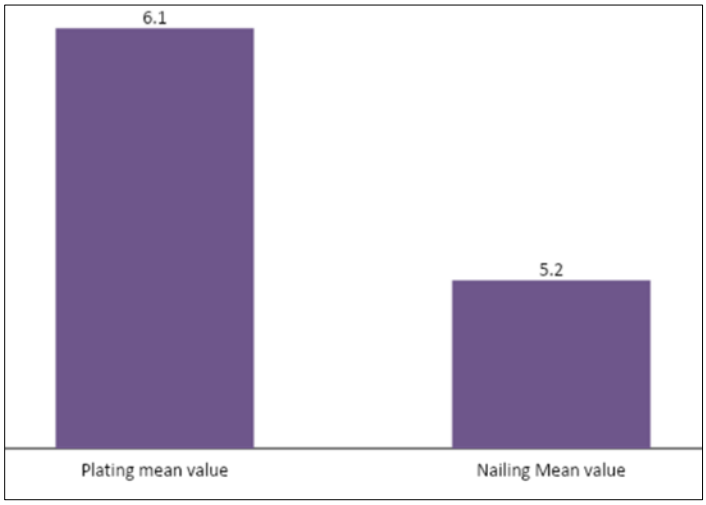


**Fig 2:** Duration of hospital stay

**Table 3:** Study of Post-surgical complications

| Sl No | Complications | Plating 20 | % percentage | Nailing 20 | % Percentage |
|---|---|---|---|---|---|
| 1 | Superficial Infection | 3 | 15% | 1 | 5% |
| 2 | Implant irritation | 3 | 15% | 1 | 5% |
| 3 | Mean shorting | 4.4 | 22% | 4.7 | 23.5% |

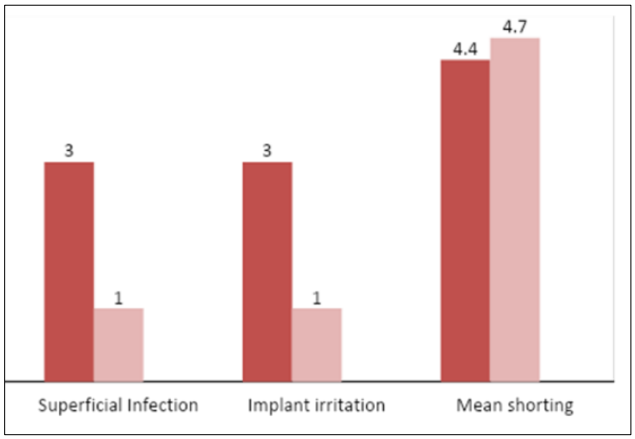


**Fig 3:** Study of Post-surgical complications

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

| Sl. No | Parameter | Plating technique | Nailing technique | 't' test | P value |
|---|---|---|---|---|---|
| 1 | Union rate | 100% | 100% | -- | -- |
| 2 | Mean Union rate a-Clinical union | 7.88 weeks (SD±1.2) | 7.52 (SD±0.2) | 0.9 | p>0.36 |
| | b-Radiological union | 14 weeks (SD±0.8) | 13 (SD±0.2) | 5.4 | P<0.00 |
| 3 a | Mean Quick DASH Score 1 month | $22.9^0$ (SD±1.5) | 16.30 (SD±0.5) | 18.6 | P<0.01 |
| b | 3 months | 13.60 (SD±1.2) | 7.80 (SD±0.8) | 17.9 | P<0.01 |
| c | 6 months | 9.20 (SD±1.3) | 6.10 (SD±0.6) | 20.2 | P<0.00 |

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