

PLATING VERSUS TITANIUM ELASTIC NAIL SYSTEM IN CLAVICLE FRACTURE MANAGEMENT – A COMPARATIVE STUDY

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Abstract

Background: To compare plate fixation and intramedullary nailing with TEN for internal fixation of displaced midshaft clavicle fractures. **Materials and Methods:** Patients were divided into 2 groups of 16 each. First group was TENS group and second group was plating group. Assessment includes standardized clinical evaluation and completion of the Constant Shoulder Score and Disability of the Arm, Shoulder and Hand (DASH) score. **Result:** The mean age in plating group was 33.3 years and in TENS group was 35.5 years. There were 11 males (73.3%) and 4 females (26.7%) each for TENS group and LCP group with a male to female ratio of 2.7:1. Road traffic accident was the most common mode of injury in both the groups which was seen in 9 cases (60%) for TENS group and 7 cases (46.7%) for LCP group. Fall from height was next to RTA in TENS group seen in 4 cases and fall on outstretched hand was next to RTA seen in 3 cases. The dominant limb was predominantly involved in both the groups, 60% in TENS group and 80% in plating group. associated injuries were seen in 3 patients (10%). Type of fracture was 2B1 in 13 and 11, 2B2 in 2 and 4 in plating and TENS group respectively. 10 patients and 3 patients had 2- 4 days from diagnosis till surgery respectively. Duration of surgery >50 minutes was seen in 6 and 13, duration of hospital stay was 2-3 days in 10 and 0, 4-5 days in 5 and 11 and 6-7 days in 0 and 4 patients respectively. 15 patients in plating group had 60-90 ml and 10 in TENS group had 90-120 ml blood loss. Most common complication in plating group was skin irritation in 2 both groups. **Conclusion:** TENS is suitable for treating simple displaced fractures of the mid-shaft clavicle. Fixation of comminuted fractures of mid-shaft fractures of clavicle, open reduction and internal fixation by LCP remains the effective modality.

INTRODUCTION

The clavicle is the most commonly fractured bone, accounting for up to 12% of all adult fractures. The clavicle is an 'S'-shaped long bone placed horizontally. It forms an important stabilizer between the axial and appendicular skeleton. Although the subclavian vessels and brachial plexus are in close proximity to the bone, they are rarely injured in a fracture of the clavicle. The medial end articulates with the sternum, and the lateral end articulates with the acromion process of the scapula. The coracoclavicular (CC) ligaments are attached to the lateral clavicle and provide vertical stability to the acromioclavicular (AC) joint. Patients present with localized pain, swelling and deformity over the

fractured bone. Being a subcutaneous bone, ecchymosis and tenting of the skin are also frequently present.^[1-3]

In fractures of the middle third, the proximal (medial) fragment is often pulled up by the sternocleidomastoid muscle, and the weight of gravity on the upper extremity pulls downward on the lateral fragment, accentuating the deformity. A careful neurovascular examination of the ipsilateral upper limb and auscultation of the chest is necessary, especially in high-energy injuries, because of the presence of vital structures in close proximity.^[4-6]

Various methods of fixation such as Kirschner wires, pins (Rush pin, Knowles pin, Rockwood pin), titanium elastic nail (TEN), plates with screws and external fixation are available for displaced mid-third clavicular fractures. Of these, plate fixation and

intramedullary nailing with TEN are commonly used nowadays for internal fixation of displaced midshaft clavicle fractures. Biomechanically plate fixation is superior to intramedullary fixation because it better resists the bending and torsional forces that occur during elevation of the upper extremity above shoulder level. Considering this, we conducted this study to compare plating versus titanium elastic nail system in management of clavicle fracture.^[7-9]

MATERIALS AND METHODS

The present cross-sectional study was conducted 32 patients having clavicle fracture who attended OPD and emergency Department of Orthopaedics, RIMS during November 2019 to October 2021. Inclusion criteria was age >18 years and <70 years, closed fractures, Robinson Classification 2B1 and 2B2 (displaced fractures) and no medical contradictions to general anaesthesia. Exclusion criteria was pathological fractures, multiple injured patients, associated head injury, neurovascular injury, acromioclavicular joint dislocation, any medical contradiction to surgery or general anaesthesia and those not willing to take part in study.

Demographic data was recorded. Patients were divided into 2 groups of 16 each. First group was TENS group and second group was plating group. After surgical procedures as per standardized protocol, a sling was given to all patients for comfort. Wound was inspected on the 3rd post operative day, and the stitches removed on 10th day after operation and patient discharged with sling and advised elbow, wrist and finger range of movement exercises. Assessment includes standardized clinical evaluation and completion of the Constant Shoulder Score and Disability of the Arm, Shoulder and Hand (DASH) score. Both an antero-posterior and a 200 cephalad radiograph was done for each patient. Patients are followed up for a period of 1 year at regular intervals of 3 weeks, 6 weeks, 3 months, 6

months and finally 12 completed months. Results were tabulated and assessed statistically. P value less than 0.05 was considered significant.

RESULTS

[Table 1] shows that mean age in plating group was 33.3 years and in TENS group was 35.5 years.

[Table 2] shows that there were 11 males (73.3%) and 4 females (26.7%) each for TENS group and LCP group with a male to female ratio of 2.7:1 for both the groups in our study.

[Table 3] shows that road traffic accident was the most common mode of injury in both the groups which was seen in 9 cases (60%) for TENS group and 7 cases (46.7%) for LCP group. Fall from height was next to RTA in TENS group seen in 4 cases and fall on outstretched hand was next to RTA seen in 3 cases.

[Table 4] shows that the dominant limb was predominantly involved in both the groups, 60% in TENS group and 80% in plating group.

[Table 5] shows that associated injuries were seen in 3 patients (10%). All associated injuries were managed by appropriate treatment modality with resultant favorable outcome

[Table 6] shows that type of fracture was 2B1 in 13 and 11, 2B2 in 2 and 4 in plating and TENS group respectively. 10 patients and 3 patients had 2- 4 days from diagnosis till surgery respectively. Duration of surgery >50 minutes was seen in 6 and 13, duration of hospital stay was 2-3 days in 10 and 0, 4-5 days in 5 and 11 and 6-7 days in 0 and 4 patients respectively in TENS and plating groups. 15 patients in TENS had 60-90 ml and 10 in plating group had 90-120 ml blood loss. Most common complication in plating group was skin irritation i.e 2 patients in both groups. DASH at 6 months >15 was seen in 1 each and Constant Murley Score >15 was seen in 2 and 1 in plating group and TENS group respectively.

Table 1: Distribution of patients

Age in Years	TENS GROUP	PLATING GROUP	Total
20-30	6(40%)	5(33.3%)	11(36.7%)
31-40	6(40%)	6(40%)	12(40%)
41-50	1(6.7%)	4(26.7%)	5(16.7%)
51-60	2(13.3%)	0(0%)	2(6.7%)
Total	15(100%)	15(100%)	30(100%)
Mean ± SD	33.33±11.43	35.53±8.55	34.43±9.98

Table 2: Gender distribution

Gender	TENS GROUP	PLATING GROUP	Total
Female	4(26.7%)	4(26.7%)	8(26.7%)
Male	11(73.3%)	11(73.3%)	22(73.3%)
Total	15(100%)	15(100%)	30(100%)

Table 3: Mode of Injury- frequency distribution in two groups

Mode of Injury	TENS GROUP	PLATING GROUP	Total
ASSULT	1(6.7%)	1(6.7%)	2(6.7%)
FALL FROM HEIGHT	4(26.7%)	2(13.3%)	6(20%)
FOOSH	0(0%)	3(20%)	3(10%)
RTA	9(60%)	7(46.7%)	16(53.3%)
SPORTS	1(6.7%)	2(13.3%)	3(10%)
Total	15(100%)	15(100%)	30(100%)

Table 4: Side of Injury- frequency distribution in two groups

Side of Injury	TENS GROUP	PLATING GROUP	Total
Dominant	9(60%)	12(80%)	21(70%)
Non dominant	6(40%)	3(20%)	9(30%)
Total	15(100%)	15(100%)	30(100%)

Table 5: Associated Injury- frequency distribution in two groups

Associated Injury	PLATING GROUP	TENS GROUP	Total
Nil	13(86.7%)	14(93.3%)	27(90%)
Yes	2(13.3%)	1(6.7%)	3(10%)
Colles' fracture right	1(6.7%)	0(0%)	1(3.3%)
Fracture both bone right leg	0(0%)	1(6.7%)	1(3.3%)
Jones fracture left foot	1(6.7%)	0(0%)	1(3.3%)
Total	15(100%)	15(100%)	30(100%)

Table 6: Comparison of parameters

Parameters	Variables	TENS GROUP	PLATING GROUP
Type of Fracture	2B1	13(86.7%)	11(73.3%)
	2B2	2(13.3%)	4(26.7%)
Time to Surgery (days)	2-4	10(66.7%)	3(20%)
	5-7	2(13.3%)	9(60%)
	8-10	3(20%)	3(20%)
Duration of surgery (minutes)	<50	9(60%)	2(13.3%)
	>50	6(40%)	13(86.7%)
Duration of Hospital Stay	2-3	10(66.7%)	0(0%)
	4-5	5(33.3%)	11(73.3%)
	6-7	0(0%)	4(26.7%)
Blood loss (ml)	60-90	15(100%)	0(0%)
	91-120	0(0%)	5(33.3%)
	120-150	0(0%)	10(66.7%)
Complication	Hardware migration	1(6.7%)	0(0%)
	Infection	0(0%)	1(6.7%)
	Mal union	0(0%)	1(6.7%)
	Non union	1(6.7%)	0(0%)
	Skin Infection	1(6.7%)	0(0%)
	Skin Irritation	2(13.3%)	2(13.3%)
DASH at 6 months	<10	10(66.7%)	9(60%)
	10-15	4(26.7%)	5(33.3%)
	>15	1(6.7%)	1(6.7%)
Constant Murley Score	<10	10(66.7%)	4(26.7%)
	10-15	3(20%)	10(66.7%)
	>15	2(13.3%)	1(6.7%)

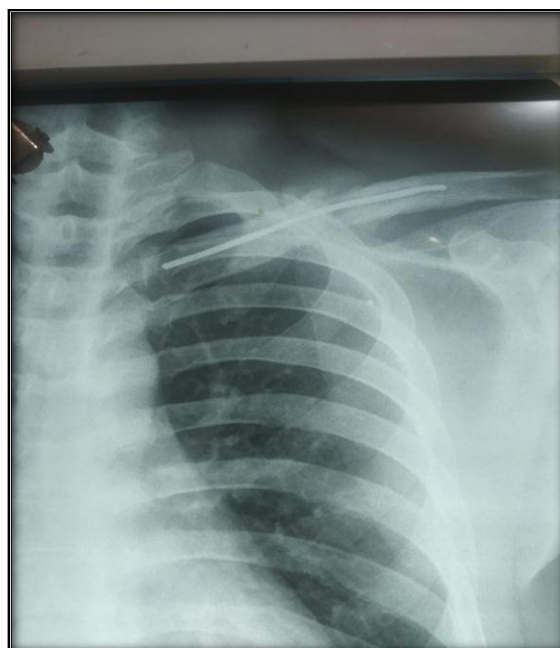
**Figure 1: Pre-operative X-Ray of patient planned for TENS nailing****Figure 2: Post-operative X-Ray**



Figure 3: Pre-operative X-Ray of patient planned for plating

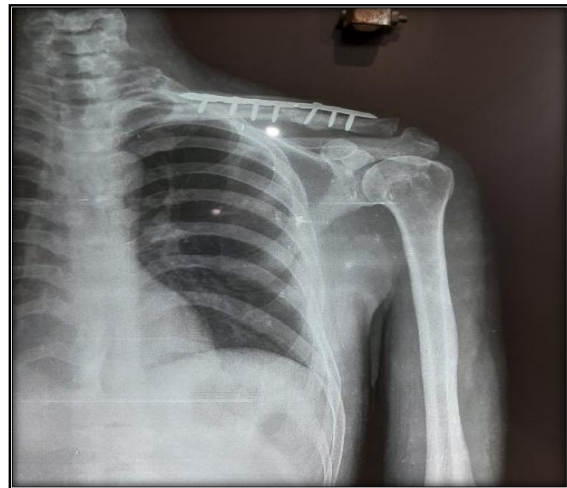


Figure 4: Post-operative X-Ray

DISCUSSION

The present study was conducted on patients with displaced midshaft clavicle fractures in the Department of Orthopaedics, RIMS Imphal from November 2019 to October 2021. Patients were divided into two groups randomly, Group 1 and Group 2 respectively. Group 1 patients were treated by TENS whereas Group 2 patients were treated by Locking Compression Plate. The results were studied by comparing the 2 groups. During the subsequent follow-up, clinical and functional outcome was assessed by parameters like union time, DASH score and Constant Murley score. We also tried to assess the post-operative complication like skin irritation, malunion, non-union, hardware migration and infection.

In our present study, the age of the patients for TENS group ranged from 20 years to 60 years with a mean of 33.33 ± 11.43 and in LCP group ranged from 20 years to 50 years with a mean of 35.53 ± 8.55 . This was comparable to the study of Narsaria N et al⁹ where mean age was 40 ± 11.2 years for LCP group and 38.9 ± 9.1 for TENS group.

There were 11 males (73.3%) and 4 females (26.7%) each for TENS group and LCP group with a male to female ratio of 2.7:1 for both the groups in our study. Males were predominantly involved in both the groups which were comparable to study made by Zehir S et al,^[10] where males affected were 58.3% and females affected were 41.7% for TENS group and 57.1% males and 42.9% females for LCP group.

In our study, Road Traffic Accident was the most common mode of injury in both the groups which was seen in 9 cases (60%) for TENS group and 7 cases (46.7%) for LCP group. Fall from height was next to RTA in TENS group seen in 4 cases and fall on outstretched hand was next to RTA seen in 3 cases. This was comparable to the study by Sahu AK et al¹¹ where RTA was the most common mode of injury for both the groups with 48% patients for TENS group and 64% for LCP group.

In our study, clavicle of dominant limb was found to be commonly involved with incidence of 60% in TENS group and 80% in LCP group which was comparable to that of Sahu AK et al,^[11] whose study also had predominantly dominant side involvement of 76% for TENS group and 52% for LCP group.

In the present study, maximum patients in both the groups had no injuries associated with the clavicle fracture. In our study, maximum patients belonged to type 2B1 group of Robinson classification where 13 patients (86.7%) were operated by TENS and 11 patients (73.3%) were operated by LCP which was comparable to the study by Kumar M et al,^[12] where 78.3% patients operated by plating were of AO type 2B1 whereas 89.47% patients operated by TENS.

In our study, maximum patients were operated within 2 to 4 days of injury in TENS group which accounted for 10 patients (66.7%) whereas maximum patients were operated within 5 to 7 days of injury in LCP group which accounted for 9 patients (60%) with a range of 2-10 days. This was comparable to the study by Zehir S et al,^[10] where mean time to surgery for TENS group was 5.7 days while mean time to surgery for LCP group was 6.2 days.

In our study, we found that the operative time was less than 50 minutes for patients operated by TENS which accounted for 9 patients (60%) while the operative time was more than 50 minutes for patients operated by LCP which accounted for 13 patients (86.7%). This was comparable to the study by Chen YF et al,^[13] where the mean operative time for TENS was 48.25 ± 19.76 minutes and that of plating was 66.49 ± 22.47 minutes.

We found that all the patients operated by TENS had the blood loss during the surgery within 60-90 ml as compared to LCP group where the maximum patients had blood loss within 120-150 ml. This was comparable to the study by Liu HH et al,^[14] where blood loss in TENS was 67 ± 37 ml and LCP was 128 ± 49 ml. In the present study, maximum patients of both the TENS and LCP group had union within 10-15 weeks but 2(13.3%) patients of LCP group had union in <10 weeks. This was comparable to the

study by Sahu AK et al,^[11] where union time for TENS group was 11.4±2.12 weeks and 13.4±3.46 weeks for LCP group.

DASH score at 6 months was less than 10 for 10(66.7%) patients in TENS group and less than 10 for 9(60%) patients in the LCP group. In the present study, maximum patients in TENS group (66.7%) had Constant Murley Score of less than 10 with a mean of 11.13±8.46 as compared to LCP group where maximum patients (66.7%) had Constant Murley Score within the range of 10 to 15 with a mean of 11.07±2.37 for TENS group.

In the present study, after comparing both the groups we had 1 case of hardware migration, 1 case of non-union and 1 case of skin infection in TENS group as compared to LCP group where there was 1 case of infection, 1 case of malunion and 2 case of skin irritation. This was comparable to the study by Chen YF et al¹³ where in TENS group, 1 case had infection, 4 case had skin irritation and 17 cases had hardware migration and LCP group 3 cases had infection and 7 cases had skin irritation.

CONCLUSION

Authors found that both methods of internal fixation by TENS and plating have their own advantages and disadvantages, though the final functional outcomes in terms of DASH and Constant Murley score are not influenced by the method of surgical treatment of displaced mid-shaft clavicle fractures. TENS is suitable for treating simple displaced fractures of the mid-shaft clavicle because it showed a stress distribution similar to intact clavicle with a minimally invasive technique, minimal blood loss, no/very less periosteal stripping and a better cosmetic outcome. TENS provides less stability compared with plate fixation, and therefore excessive exercise and weight bearing should be avoided in the early post-operative period. On the other hand, fixation of comminuted fractures of mid-shaft fractures of clavicle, open reduction and internal fixation by LCP remains the effective modality. Plating for mid-shaft clavicular fractures showed greater stability, but had obvious stress shielding. Therefore, for patients with a demand for early return to activity, plating may be preferred.

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