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Functional outcome of displaced fracture middle third of clavicle managed surgically by titanium elastic nailing

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Abstract

Introduction: In the clavicle fractures, shaft fractures are very common constituting about 70-80% of cases followed by lateral end and medial end fractures of clavicle. Surgical management is better option in displaced midclavicular fractures considering high complication rates in conservative management.

Materials and methods: This was a prospective study conducted between August 2016 to February 2018 approved by ethical committee of our Institute. 28 midclavicular fractures were included in the study and were operated Titanium Elastic Nailing (TENS). All patients were assessed clinoradiologically at 4, 8 12 and 24 weeks. The functional outcome was assessed by Constant and Murley score.

Results: Time taken for radiological union was achieved with an average of 10.89 ± 1.79 weeks. Functional assessment was made with Constant and Murley score at 24 weeks showed excellent score in 20 cases (71.4%), good score in 7 case (25%) and fair score in 1 case (3.6%). Only patient had complication, nail protrusion at posterior cortex of lateral end of clavicle was seen at 20 weeks.

Conclusion: In closed mid-shaft clavicle fractures TENS nailing is good an option considering better functional outcome, faster union and fewer complication in properly selected cases.

Keywords: Stability, fluoroscopy, acromioclavicular, plating, infection

Introduction

The clavicle assumes a gentle S shape medial end convex forward and lateral end concave forward. This shape has been likened to the musical symbol clavicula thus the name ^[1]. The clavicle is an S-shaped bone that acts as a strut between the sternum and the glenohumeral joint. It also has a suspensory function to the shoulder girdle. The shoulder hangs from the clavicle by the coracoclavicular ligament ^[2]. Mid-clavicle fracture is one of the most common injuries of the skeleton, representing 3% to 5% of all fractures and 45% of shoulder injuries. The annual incidence of mid-clavicle fracture is 64 per 100 000 population. In the clavicle fractures, shaft fractures are very common constituting about 70-80% of cases followed by lateral end and medial end fractures of clavicle. Open clavicle fracture is an absolute rarity, found in only 0.1% to 1% of cases. The rate of mid-clavicle fractures is more than twice as high in men as in women. Most of the fractures in clavicle are seen in third decade of life ^[3].

The incidence of nonunion of mid-clavicle fractures is usually quoted as being from 0.1 to 0.8% and the mainstay of treatment has been non-operative. More recent data, based on detailed classification of fractures, suggest that the incidence of nonunion in displaced comminuted mid-shaft clavicle fractures in adults is between 10 and 15% ^[4].

Several studies have examined the safety and efficacy of primary open reduction and internal fixation for completely displaced mid-shaft clavicle fractures and have noted high union rate with a low complication rate ^[5].

Locking compression plate has been recent addition to the modality of clavicular fracture fixation and has been found to be useful device especially in complex clavicular fractures with minimal complications with satisfactory clinoradiological outcome ^[6].

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Primary internal fixation of displaced comminuted mid-shaft clavicle fractures leads to predictable and early return to function [7].

Older studies suggested that a fracture of the shaft of the clavicle, even when significantly displaced, was an essentially benign injury with an inherently good prognosis when treated non operatively [8, 9]. Dynamic compression plates are cheaper and usually used implants for clavicular fracture fixation which are strong as well. However they disadvantages include difficult contouring and more likely to cause soft tissue irritation. On the other hand anatomically pre-contoured plates have better features in terms of lack of need for further bending as well as less likely to cause soft tissue irritation and problems. At the same time they retain mechanical strength. There are fracture patterns in which Titanium Elastic Nailing (TENS) nail were used and comparatively gave a good stability with minimal incision and less soft tissue damage.

In this prospective studied, we studied clinicoradiological outcome of displaced mid-clavicular fractures fixed with Titanium Elastic Nailing (TENS) and complications associated with them.

Material and Methods

This was a prospective study carried out from August 2016 to February 2018 in the Department of Orthopedics at our Institute. All closed clavicular mid one-third fractures with age more than 16 years were included in the study. Open fractures, pathological fractures and age less than 16 years were excluded from the study. All medically fit patients were admitted and routine radiographs included standard anteroposterior view of affected shoulder. All patients were posted with valid written consent for surgery and were operated on selective basis. Titanium elastic nailing (TENS)-nailing was used in all patients. All patients were operated under general anesthesia in beach chair position. Surgical Technique for TENS nailing included entire upper limb from base of neck to hand preparation and draped with sand bag between the scapula. A small incision was made approximately 1 cm lateral to the sternoclavicular joint. Titanium elastic intramedullary nail was inserted (the diameter varied from 2 to 3 mm depending on the width of the bone). Since medullary canal is very small in clavicle, for better gliding of nail, it is essential to straighten the nail for smooth and better gliding. Closed reduction was performed under fluoroscopic guidance. It is essential for the tip of the nail to reach just medial to the acromioclavicular joint for better stability. Chances of penetration of dorsal cortex is high and therefore proper maneuvering of the nail tip is quite essential under fluoroscopic control. After reaching acromioclavicular joint, the fracture is manually compressed and the nail was cut close to the entry point to avoid soft tissue irritation and also making sure that some amount of nail is left behind for easy removal later on. Patients were discharged between 3rd to 5th postoperative day with arm sling. Rehabilitation with pendulum exercises was started at the end of 2 weeks. At 4 to 6 wks gentle range of motion of the shoulder was allowed but abduction in limited to 80 to 90

degree. At 6 to 8 weeks postoperatively, active range of movements are started. All patients were assessed clinicoradiologically at 4, 8 12 and 24 weeks. The functional outcome was assessed by Constant and Murley score at 24 weeks.

Results

The present study constituted of 28 patients with fresh middle third fracture of the clavicle underwent titanium elastic intramedullary nail fixation. There were 25 males and 3 females. Mean age group was 29.61 ± 10.73 years. The mode of injury were 60-67% of cases due to road traffic accident, 25% of cases due to fall from height and 6-7% of cases were due to sports related injuries. Fracture pattern were classified according to Robinson classification According to Robinson classification, 96.4% (27) cases were simple (B1) type and 3.6% [1] cases were wedge (B2) type. (Table 1).

Table 1: Distribution of cases according to Robinson classification

| Type of fracture | Number of cases |
|------------------|-----------------|
| Type 2b1 | 27 (96.4%) |
| Type 2b2 | 1 (3.6%) |

Post-operative pain assessment was done with Visual Analogue Score (VAS) at postoperative day 3 and it showed the VAS score of 3 in 15 cases (53.6%).

Time taken for radiological union was achieved with an average of 10.89 ± 1.79 .

Radiological union was achieved with an average of 10.89 ± 1.79 weeks. Most of the union in the study 82.1% of cases, that is 23 cases showed union at 9-12 weeks (Figure 1 and 2) whereas only one case showed union at more than 16 weeks. (Table 2)

Table 2: Distribution of case according to the time taken for the union

| Time for union (Weeks) | TENS group |
|------------------------|------------|
| 9-12 | 23 (82.1%) |
| 13-16 | 4 (14.3%) |
| >16 | 1 (3.6%) |
| Total | 28 (100%) |

The complications encountered in our study were very less. Only patient had, nail protrusion at posterior cortex of lateral end of clavicle was seen at 20 weeks (n=1) (Figure 5).

Functional assessment was made with Constant and Murley score at 24 weeks showed excellent score in 20 cases (71.4%) (Figure 2 and 4), good score in 7 case (25%) and fair score in 1 case (3.6%). (Table 3)

Table 3: Distribution of case according to the Constant and Murley score system

| Constant and Murley score | TENS group |
|---------------------------|------------|
| Excellent | 20 (71.4%) |
| Good | 7 (25%) |
| Fair | 1 (3.6%) |
| Poor | nil |
| Total | 28 (100%) |

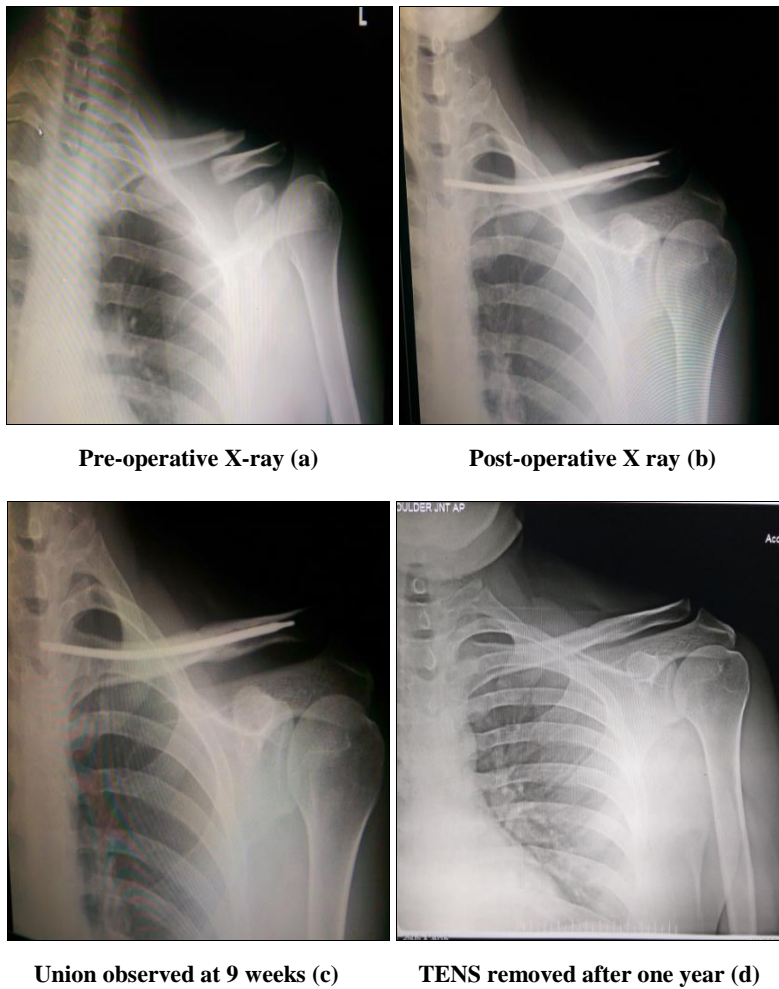


Fig 1: Showing radiography preoperative, post-operative, at 9 weeks and 1 year implant removal



Fig 2: Clinical photographs showing complete shoulder movements at 24 weeks post-operatively

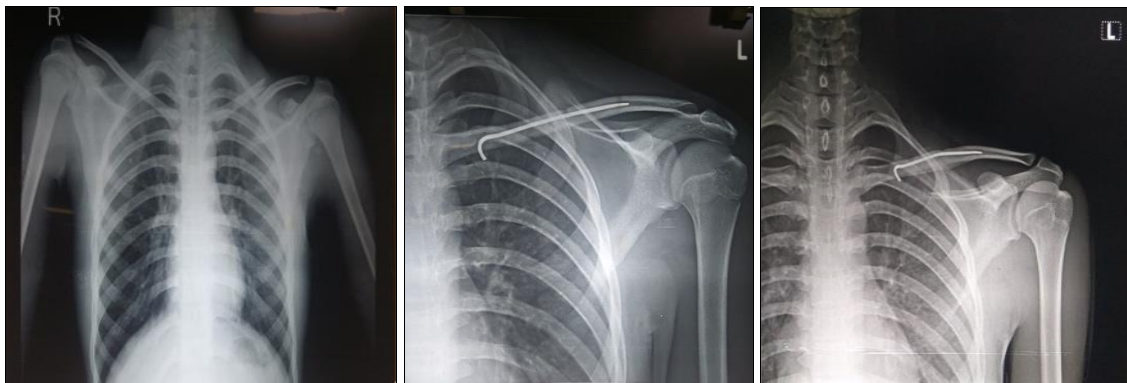


Fig 3: Showing radiography showing preoperative, post-operative and good union at 11 weeks



Fig 4: Showing shoulder range of movements at 24 weeks post-surgery



Fig 5: Showing TENS nail protrusion at 20 weeks post operatively

Discussion

Clavicular fractures managed conservatively have complications rates from 10-15% in the form of malunion, non-union, decrease in shoulder power, shoulder stiffness and cosmetic unacceptability [11-13]. Therefore surgical treatment seems more suitable to overcome such complications and considered superior to conservative treatment [14]. Open reduction and internal fixation with the plate is routinely performed surgeries plating has been standard surgical procedure for clavicular fractures which can be applied anteriorly or superiorly. However intramedullary nailing in the form of TENS has been latest addition in the fracture fixation of clavicle which have given good results functionally mainly due to smaller invasive technique and cosmetically better [12]. In this study we compared the clinic radiological outcome of clavicle fractures fixed with open reduction and internal fixation with anatomical clavicular plate and TENS nailing by closed reduction under fluoroscopic guidance.

In our study, the average union time was 10.89 ± 1.79 weeks with majority being 23 patients (82.1%) between 9 to 12 week. In Saha *et al.* study [16]. The average time to achieve union in plate group was 22 ± 6 weeks and In TENS group it was 18.77 ± 5.96 weeks. ($P=0.025$). In Anil *et al.* study, the TENS group were united with an average time of 11.4 ± 2.12 weeks and in plate group one case non united but rest cases united with an average time of 13.4 ± 3.46 weeks and the difference was significant ($p=0.016$).

In our study, one patient (3.6%) had nail protrusion from the posterior cortex of lateral end of clavicle after 5 months of surgery, union was achieved by 11 week and patient was able to do all the movement pain free. Three fourth of the TENS nail was protruded outside which was later removed under aseptic precautions.

In Saha *et al.* study [16], which was a comparative study involving mid clavicular fractures operated with TENS

nailing and plating showed major complications were noted in 5 patients, infection in four patient and non-union in one patient belonging to the plate group, while none in the TENS group. Such infections were managed by debridement followed by intravenous antibiotics without removing the implants as fixation was stable. The non-union case required revision surgery with bone grafting and healed thereafter uneventfully.

In Anil *et al.* study [17], which was comparative study again with mid clavicular patients operated with TENS nailing and plating showed TENS group the complications are delayed union in one patient (4%), infection in one patient (4%). In plate one patient (4%) having non-union, one patient (4%) having delayed union and one patient (4%) having mal-union. In addition to it in plate group, hypertrophic scar was found in three patients (12%) cases, plates loosening due to infection in two patient (8%) cases, two patients (8%) showed infection.

In the present study the functional outcome was measured by Constant and Murley scoring system showed 20 patients (71.4%) had excellent result, good result in 7 patient (25%) and fair result in 1 patient (3.6%).

In Anil *et al.* study [17], Patients treated by plating showed excellent outcome in 60% cases while 84% in TENS group. The mean DASH score was found to be 1.87 ± 3.4 in TENS group and 4.8 ± 5.9 in plate group. Both the scoring system suggested TENS nailing was better the plate fixation.

Conclusion

Titanium Elastic Nailing is excellent modality of fracture fixation in closed displaced mid clavicular fractures with minimal complications and excellent clinicoradiological outcome. Other advantages include less hospital stay, better patient comfort in terms of reduced post-operative pain. Limitation of the study, however was small sample size for comparison.

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