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Minimally invasive stabilization of midshaft clavicle fractures using TENS: Impact on functional recovery and early mobilization

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ABSTRACT

Background: Clavicle fractures are commonly seen in young population, notably in those who are more active in sports, on the contrary, in elderly and children they are attributed mostly to falls, accounting for around 2.6% of all the fractures. The most common site of fracture in the clavicle occurs at the middle third and which accounts for almost 80% of all clavicle fractures. To explain the faster pain relief, early return of function and restitution of clavicle length with the help of reduction and internal fixation of clavicle fracture creating an elastic stability at the fracture gap.
Methods: 32 patients presenting with mid shaft clavicle fractures in department of orthopaedics, KLEs Dr. Prabhakar Kore Hospital & Medical Research Centre and Charitable Hospital, were included in this study after taking their consent and fracture was stabilized using TENS nail.
Results: In this study, it was noted that males were predominantly involved, maximum incidence between 20-30 years. Most of the cases had RTA as a mode of injury with right clavicle fracture predominance. Post operatively, patients were followed up and Oxford Shoulder Score (OSS) was calculated at 4, 8, 16 weeks and the improvement in OSS score was found to be statistically significant.
Conclusions: We concluded that intramedullary fixation of displaced mid shaft clavicle fractures is a safe minimally invasive technique and is recommended in view of faster union, lesser morbidity, earlier rehabilitation and fewer complications.

Keywords: Intramedullary fixation, Mid shaft clavicle, TENS nail

INTRODUCTION

Clavicle fractures are commonly seen in young population, notably in those who are more active in sports, on the contrary, in elderly and children they are attributed mostly to falls, accounting for around 2.6% of all the fractures. The most common site of fracture in the clavicle occurs at the middle third and which accounts for almost 80% of all clavicle fractures.[1-3] Previous studies were of the opinion that displaced clavicle shaft fractures were a typically benign injury with an intrinsically good prognosis even on conservative treatment.[4,5] Zlowodzki et al in his meta-analytical study of literature over a period of 30 years from 1975 to 2005, observed 15.1% rate of non-union in conservatively managed patients with displaced fracture of midshaft clavicle.[6] High tricortical union with low uneventful post operative period have been described after using various methods of fixation in displaced fractures, intra-medullary methods being the preferred one.

Intramedullary fixation for clavicle fractures was first described by peronei in 1950.[7] A systematic review showed relative risk reduction of 72% and 57% for non-union when using intramedullary fixation and plate fixation, respectively, when compared with non-operative treatment of midshaft clavicle fractures.[6] Intramedullary devices act as internal splints which maintains alignment without rigid fixation. Thus, the intramedullary device

holds advantages of a smaller incision, less soft tissue dissection, load sharing fixation and relative stability that encourages copious callus formation.[8]

Another advantage of the titanium ESIN is that it can block itself in the bone and provide a three-point fixation within the S-shaped clavicle.[9,10]

In this study, we have analysed the data obtained from 32 patients of midshaft clavicle fractures and the impact on their functional recovery using TENS nail as a minimally invasive surgical procedure.

METHODS

Our study aimed to explain the faster pain relief, early return of function and restitution of clavicle length with the help of reduction and internal fixation of clavicle fracture creating an elastic stability at the fracture gap.

This was a prospective study of functional outcome of TENS intra-medullary nailing in mid shaft clavicle fractures which includes 32 patients, done in KLE's Dr. Prabhakar Kore Charitable Hospital and MRC, at Orthopaedics Department, Belagavi, from June 2022 to June 2023.

Consent was obtained from patients or guardians of patients who underwent the procedure. No patient who underwent internal fixation during the study period was excluded since consent was obtained from them all.

We included patients who had marked displacement of fracture radiographically with shortening of >2 cm, aged between 16-70 years, patients with associated lower limb injuries and floating shoulder injuries and medically fit for anaesthesia.

Pre-operatively chest X-rays with bilateral clavicle were evaluated and studied. Post-operatively, regular follow-ups at 4, 8 and 16 weeks or till roentgenographic and clinical evidence of union was achieved. OSS was used as a clinical subjective parameter for evaluating patient's functional improvement in day-to-day activities.

Data collection and management

A pre-defined data collection tool was used to collect data which included demographics such as age and gender as well as mode of injury, side of injury, associated injuries and time for union. Data analysis was done using SPSS-14.0 and Microsoft excel.

RESULTS

Among 32 patients, the minimum age of the patients included in the study was 20 while maximum being 63 years with 27 of them being males and remaining 5 being females. Patients included in this study were taken for surgery in less than 10 days of injury, out of which maximum of them were operated within 48 hours.

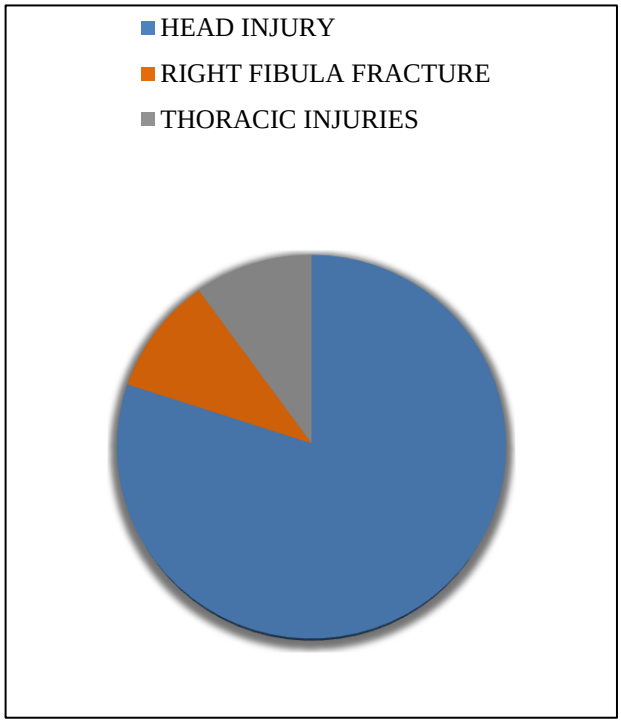

Figure 1: Associated injury- Out of 32 patients,10 patients (31.2%) had associated injury out of which 8 patients (25%) had head injury while 1 patient (3.1%) had right fibula fracture and 1 patient (3.1%) had thoracic injury.

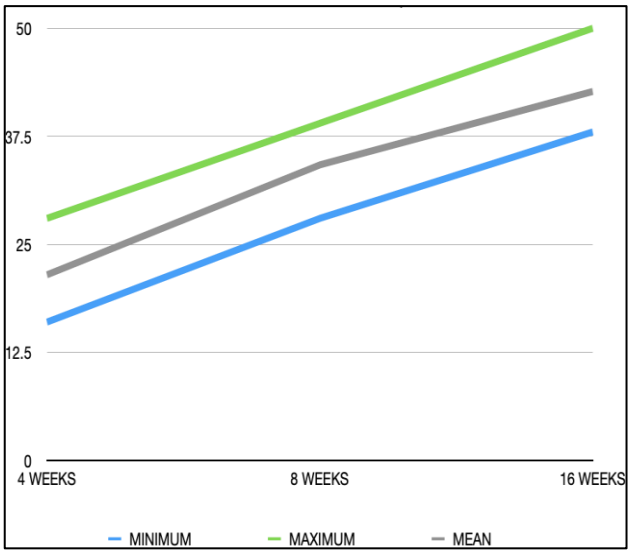

Figure 2: OSS at follow ups-Patients were followed up post-operatively and OSS score was calculated at 4, 8 and 16 weeks. Mean OSS score at 4, 8 and 16 weeks of the study participants was found to be, 21.47+3.048, 34.19+3.095 and 42.69+3.095 respectively (Table 2) and the improvement in OSS score was statistically significant in this study (p=0.002).

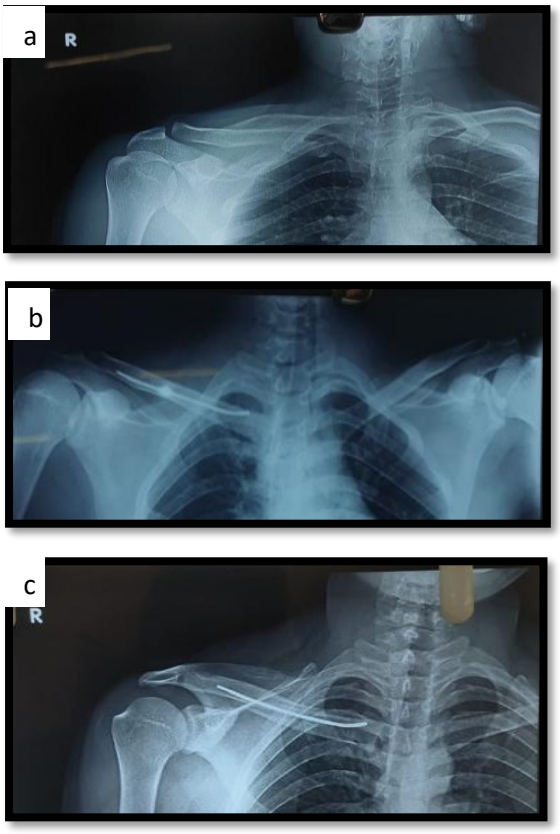

Figure 3 (a-c): Pre-operative X-ray of a 39-year-old male with right sided mid shaft clavicle fracture following road traffic accident. Post-operative X-ray showing fracture fixation done with TENS nail. 16 weeks post-operative X-ray showing satisfactory union with nail in situ.

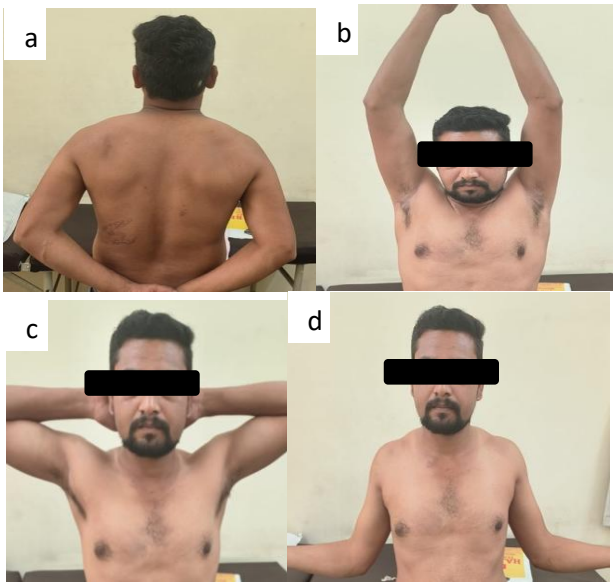

Figure 4 (a-d): Satisfactory range of motion seen in the same patient at 16 weeks post-operatively showing, internal rotation, flexion, abduction, external rotation. OSS in this patient improved from 21 at 4 weeks to 44 at 16 weeks post-operatively.

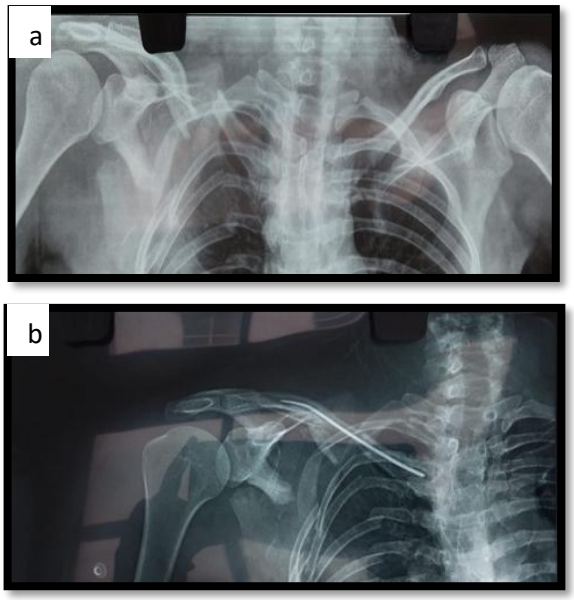

Figure 5 (a, b): Pre-operative X-ray of a 32-year-old female with right sided mid shaft clavicle fracture following road traffic accident. Post-operative X-ray showing fracture fixation done with TENS nail.

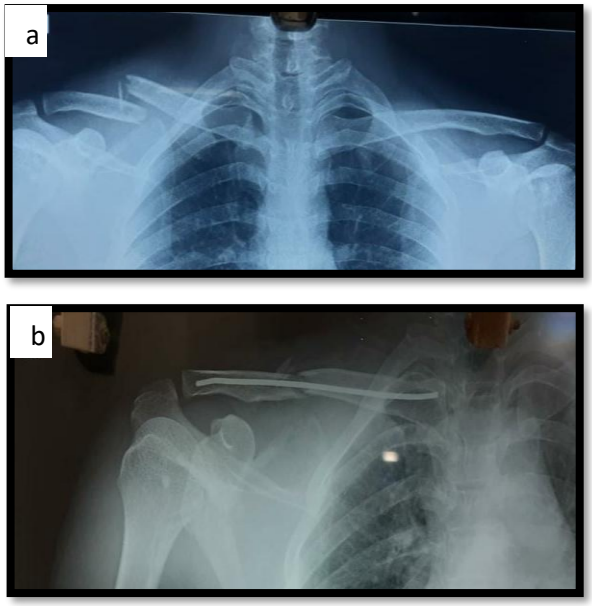

Figure 6 (a, b): Pre-operative X-ray of a 46-year-old male with right sided mid shaft clavicle fracture following fall on outstretched hand. Post-operative X-ray showing fracture fixation done with TENS nail.

Time taken for union was minimum of 6 weeks and maximum being 12 weeks in the patients studied. Minimum flexion achieved was 130 degrees while the maximum being 180 degrees with minimum abduction achieved was 135 with maximum being 180. The minimum and maximum external rotation achieved was 30 and 70 respectively whereas minimum and maximum internal rotation achieved was 30 and 70 respectively.

Table 1: Mode of injury- 75% of the cases had RTA as the mode of injury while other mode of injuries were FOOSH (15.6%) and FFH (9.4%).

Mode of injury	Frequency	(%)
RTA	24	75
FOOSH	5	15.6
FFH	3	9.4
TOTAL	32	100

Table 2: Improvement in OSS.

OSS	Mean	SD	Correlation	P value
4 weeks	21.47	3.048	0.526	0.002
16 weeks	42.69	3.095		

DISCUSSION

The gold standard method of fixation is open reduction and internal fixation with plating. Plating offers the added advantage of absolute stability with good inter-fragmentary compression at the fracture site. Though plating has certain disadvantages, in a study conducted between 2 groups of patients with clavicle fractures, plating had better result as compared to non-surgical intervention as evidenced by increased union rates and better functional recovery.[11]

Another method of fracture fixation is through intra-medullary implants as they offer better biomechanical stability in relation to movements and loading at the shoulder joint.[7,10] Small scar, lesser soft tissue disruption and good amount of callus formation makes intra-medullary nail a better implant of choice than a plate.[8] With certain advantages, nail offers some specific disadvantages as well, namely, soft tissue irritation on the sternal end, implant prominence which often leads to implant removal before complete remodeling of the bone.[12]

Age and sex distribution

Out of 32 cases, maximum number of cases i.e., 12 cases (37.5%) belonged to 20-30 years of age group. Youngest patient was 20 years old and eldest being 63 years old. There were 27 males (84.4%) and 5 females (15.6%) in this study.

Mode of injury

75% of the cases had RTA as the mode of injury while other mode of injuries was FOOSH (15.6%) and FFH (9.4%).

Side of injury

In the study, 21 patients (65.6%) had right side involvement whereas 11 patients (34.4%) presented with left clavicular fracture.

Associated injury

Out of 32 patients,10 patients (31.2%) had associated injury out of which 8 patients (25%) had head injury while 1 patient (3.1%) had right fibula fracture and 1 patient (3.1%) had thoracic injury.

Time for union

The mean time of union after injury of the study participants was found to be 9.13+1.963 with 6 weeks as minimum time duration and 12 weeks being maximum.

Oxford shoulder score

Patients were followed up post-operatively and OSS score was calculated at 4, 8 and 16 weeks (Figure 2). Mean OSS score at 4, 8 and 16 weeks of the study participants was found to be, 21.47+3.048, 34.19+3.095 and 42.69+3.095 respectively (Table 2) and the improvement in OSS score was statistically significant in this study (p=0.002).

Attaining a good intra-operative closed reduction was challenging in certain patients who had AO B2 type of fracture pattern and in some over-weight patients. Percutaneous clamps had to be used to aid in reduction, but this method also failed in some patients. To counter this difficulty, small incision had to be taken over the fracture site so as to directly manipulate the fragments under vision. Minor complications like- medial protrusion of the nail in 2 patients, lateral protrusion in 1 patient and local skin irritation in 1 patient was seen.

Limitation of the study was that other methods of osteosynthesis like external fixation/ plating were not compared.

CONCLUSION

In conclusion, TENS nailing is found to be a safe alternative for fixing middle 1/3rd clavicle fractures and a lesser invasive technique with less soft tissue injury. It is found to be a better approach for osteosynthesis as evidenced by faster union rates, early post-operative return of shoulder movements and lesser intra, peri and post-operative complications. Nevertheless, plating stays the gold standard treatment in cases with comminuted clavicle fractures.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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