Treatment Outcomes of Flexible Intramedullary Nailing in Fracture Shaft of Clavicle

Areeb Ali Siddiqui¹, Avinash Rastogi² Rahul K. Gupta³, Arunim Swarup⁴

¹Junior Resident, Department of Orthopaedics, Chhatrapati Shivaji Subharti Hospital, Meerut, Uttar Pradesh, India
²Professor, Department of Orthopaedics, Chhatrapati Shivaji Subharti Hospital, Meerut, Uttar Pradesh, India
³Assistant Professor, Department of Orthopaedics, Chhatrapati Shivaji Subharti Hospital, Meerut, Uttar Pradesh, India
⁴Professor, Department of Orthopaedics, Chhatrapati Shivaji Subharti Hospital, Meerut, Uttar Pradesh, India

Abstract: Background: Nonsurgical treatment of midshaft clavicular fractures leads to unsatisfactory results such as nonunion, shortening and limited function of the shoulder. Till date, various implants have been developed for open reduction including intramedullary wires, screws, and plates, each of which having various complications such as blood loss, non-union, implant irritation. TENS fixation is rather a newer modality with less complication and good outcome and is a lesser researched topic, thus this study was carried out to further evaluate the outcomes. Materials and Methods: 34 displaced mid shaft clavicular fracture patient were included in this study in which 10 patients were included retrospectively from a period of 2016-2018 and 24 patient were included prospectively from 2019 to 2021. Patients of mid shaft clavicular fracture were managed by TENS nail. Patients were followed up post operatively at 2 week, 6 week, 3 month, 6 month and at 12 month postoperatively. Outcome was measured by the Constant-Murley score, and DASH Score and fracture union. Secondary outcome was measured by operative time, wound size, cosmetic results and complications. Results: In this study, it was seen that mean Constant Murley score at 12 months duration was 94.88, mean DASH score was 7.45, mean union time was 9.5 weeks and mean operative time was 36.32 mins. However, DASH score was only measured after 8 weeks duration as overhead abduction was not advisable in view of rotation of fracture fragment. Conclusion: The use of TENS for fixation of displaced midshaft clavicle fractures is recommended in view of faster fracture union, lesser morbidity, better cosmetic results, easier implant removal and fewer complications.

Keywords: Titanium Elastic Nail, Displaced mid-shaft clavicular fractures, Dash Score, Constant Murley score

1. Introduction

Clavicle derives its name from Latin origin word clavis from which has been derived the word “clavicula” referring to “little key” as when arm is abducted this bone rotates like key. Fracture of the clavicle are common and account for 5–10% of all fractures¹. ²men are more commonly (68%) affected. Although the incidence in our country is not available, the yearly global incidence of clavicle fracture is 71 in 100, 000 males to 30 in 100, 000 females.³ Whereas low energy injuries result in minimally displaced fractures of clavicle, high energy injuries are more likely to be severely displaced, Majority of clavicle fractures (70–80%) are located in the mid-diaphyseal region.

Conventionally, acute mid clavicular fractures which are not severely displaced in an adult are successfully treated non-operatively with ether a sling or a figure-of-eight bandage. with non-union⁴reported in less than 1% fractures. The recent reports of non-union rates of 29%⁵ and mal-union rates of 14-36%,⁶ resulted with displaced clavicle fractures treated non-operatively have made many prefer operative treatment in displaced mid-shaft clavicular fractures (DMCF). Shoulder biomechanics are reported to get significantly altered by mal-union of the clavicle⁷. Operative fixation of displaced clavicular fractures have reported improved patient outcomes, early return to function, decreased non-union and mal-union rates, and better cosmesis⁸,⁹ making the preference move towards surgical fixation of selected clavicle fractures. Mal-union of the clavicle in association with shortening of clavicle results in change in glenoid orientation, and upward angulations of the clavicle at the sternoclavicular joint therefore, it is indicative for surgical fixation of clavicle fractures, especially in the active young group of patients. Both plate fixation and intramedullary fixation theoretically have their own advantages. Plate fixation will give a more rigid stabilization and a stronger construct to allow early rehabilitation. But has some disadvantages like excessive blood loss, risk of injury to supra clavicular nerve, periosteal striping. The intramedullary nailing is a recent and less researched technique and has the advantage of less soft tissue stripping which preserves vascular integrity during fracture healing thereby generating more callus and decreasing risk of infection, thus this study aims at evaluating the functional outcome of DMCF fixed with intramedullary nailing.

2. Material and Method

The study was carried out on patients of displaced mid-shaft fractures of clavicle in Department of Orthopaedics, N. S. C. B Subharti Medical College, Meerut from August 2019 to July 2021.

Study Design

This is a retrospective and prospective interventional study

Sample Population

A total of 40 patients were enrolled for the study out of which 6 were lost in follow-up 10 patients were taken from
previous study conducted in 2016-2018 by Dr Jatin Bansal 
after due consent. The rest 24 patients were followed up post 
operatively at 2 week, 6 week, 3 month, 6 month and at 12 
month.

**Inclusion criteria:** Adult patients with displaced mid-shaft 
of clavicle fractures, Comminuted mid-shaft clavicle 
fractures (Robinson displaced fracture type 2A2, 2B1) 
Age between 18-60 years, Fractures causing tenting of skin.

**Exclusion criteria:** Old fracture of clavicle (3 weeks or 
more), Age: less than 18 and more than 60 years of age, 
Robinson classification – Type 2-B2, Type 3-A1, A2, B1, 
B2, Compound fracture. Floating shoulder, Un-displaced 
fracture clavicle, Moderate to severe head injury. 
Pathological fractures, Bilateral Clavicular fracture, Fracture 
associated with neuro-vascular injury, Prior surgery of the 
shoulder or clavicle, Prior chronic illness of the shoulder 

**Preoperative evaluation**

Preoperative evaluation was done by assessing the patient 
according to Robinson classification, measurement of 
length, radiological evaluation (Anteroposterior (AP) view 
and Cephalic tilt view), Patient were be evaluated for all the 
necessary investigation required for preanaesthetic fitness.

**Technique**

After administration of general anaesthesia, the patient was 
placed in supine position on radiolucent table with a sandbag 
under the midline between both the scapulae. Preoperatively 
on the operating table the shoulder region was screened 
using image intensifier to confirm its access to 
 sternoclavicular joint. The injured extremity prepared and 
draped from the whole clavicular region to the upper arm. 
Care was taken to make sure that the sternoclavicular joint 
was accessible for the entry point. Small incision was made 
approximately 1 cm lateral to the sterno-clavicular joint and 
entry point was made in the anterior cortex of medial 
clavicle 1cm lateral to sternoclavicular joint using Bone 
Awl. EIN loaded on T-Handle (the diameter from 2-3 mm 
depending on width of the bone) and inserted from the entry 
point. Closed reduction was performed under fluoroscopy 
and held using 2 percutaneously introduced pointed 
reduction clamps. If closed reduction could not be achieved 
an additional incision was made above the fracture site for 
direct manipulation of the main fragments, the nail then 
was advanced manually until just medial to the acromion-
clavicular joint. Accurate maneuvering of the nail tip is 
necessary under fluoroscopic control to avoid penetration of 
the thin posterior cortex. After reaching the end point the 
fracture was compressed and the nail was cut close to the 
entry point with Jumbo Cutter to minimize soft tissue 
irritation, at the same time leaving sufficient length behind 
for easy extraction later on. Surgical wound was then 
washed with Normal Saline and skin closed using 2-0 
polyamide suture. The mentioned nails were procured from 
both locally available vendors as well as AO (synthes, 
Switzerland).

**Postoperative protocol:**

Operated patients were given an arm pouch sling for 3 
weeks, IV antibiotics given for 5-6 days and then oral broad 
spectrum antibiotics for next 5-6 days. Stitches were 
removed in 10 to 12 days after surgery and mobilization of 
the shoulder started as pain permits. The mobilization 
protocol followed was pendulum motion exercises during 
the first 3 weeks, followed by active abduction and flexion 
up to the horizontal plane from 3-10 weeks to avoid rotation 
at fracture site. The full ranges of active motion were 
permitted after 10 weeks and return to full activity to was 
permitted after 3 months.

**Follow up protocol:**

All patients were reviewed in the outpatient department at 2 
week and 6 week, 3 month, 6 month and 12 month after 
surgery. Functional Outcome was measured by the Constant-
Murley score, and DASH Score and fracture union.

3. **Results**

The present study was carried out with an aim to evaluate 
the functional results of fractures of mid shaft clavicle 
treated from August 2019 to July 2021 by intramedullary 
nailing. The study sample comprised of the retrospective 
group-(from 2016 to 2019) of DMCF of Robinson type 2-A2 
and B1 and a prospective follow up group-of those DMCF 
treated by closed/open reduction and intramedullary nailing 
both comprising a total of 40 unilateral DMCF and 6 
patients were lost in follow up. To homogenize the sample, 
the retrospective sample of patients were selected on the 
basis of the age matched groups of prospective cases 
selected for closed/open reduction and internal fixation with 
intramedullary nails. All the patients who consented for the 
study conducted in the Department of Orthopaedic Surgery 
were included in this study and called for follow-up for 
observing their outcome periodically for the next 1 year or 
more. All cases were assessed radiologically pre-operatively 
and were classified using Robinson classification of 
clavicular fractures.

The Robinson type 2 B1 fractures were observed in 15 
subjects, while type 2 B2 fractures were present 19 cases. 
Skin compromise in the form of stretching, puckering, in 
drawing, or color change was present in 13 cases., mean age 
of the patient at the time of presentation in this study was 
35.84 years. Maximum percentage of patient were between 
the age group of 26-45 years (47%) Majority of the patient 
were males 62%. Injury due to road traffic accident predominated 
the series by 69% followed by fall from height 31%. 
patients out of 34 had implant irritation over medial aspect 
which was managed by trimming of implant. The study 
observed that 14 patients out of 34 had open reduction of 
the intramedullary nailing although closed reduction shall have 
distinct advantages of intramedullary nailing.

It was imperative that the blood loss, though not measured in 
this study, was less in those fractures which could be 
reduced closed percutaneously. The length of incision in the 
intramedullary nailing was lesser as the incision was aimed to 
achieve optimum reduction and for insertion of TENS 
under fluoroscopy.

The average union time in this study was 9.5 weeks 
minimum being 9 weeks and maximum being 10 weeks. The 
average operative time in this study was 36.32 minutes while 
maximum being 60 minutes and minimum being 25 minutes.
4. Discussion

Clavicular fractures have traditionally been treated non-operatively with either a sling or figure of “8” bandage with less than 1% rate of non-union. Many studies stated that almost all simple DMCF can be treated non-operatively and healed with little or no complications. However, in most of these publications, the functional outcome was not taken into account.3 More recent studies have shown significantly higher non-union rates in conservatively treated patients. Hence the current recommendation for treatment of displaced mid-shaft clavicular fracture is operative fixation.

Open reduction and internal fixation with plate or open/closed reduction and intramedullary nail are two of the most commonly used surgical techniques for treating DMCF. Plate fixation is the standard operative technique for DMCF which can be applied antero-superior or antero-inferior surfaces. Another emerging mode of fixation is intramedullary fixation, in clavicles with well-developed medullary cavity, by EIN which is shown in this present study. Despite proposed benefits, plating and intramedullary nailing method both have their own limitations. Although plate fixation gives a more rigid stabilization and stronger construct to allow early rehabilitation the disadvantages include the increased exposure and soft tissue stripping, increased risk of damage to supraclavicular nerve, slightly higher infection rates, hypertrophic scars and re-fracture after plate removal. On the other hand intramedullary nailing has advantages of being less invasive requiring less soft tissue stripping, lesser risk of damage to supraclavicular nerve, and lesser infection rates. The subjective disadvantages include skin irritation, implant migration and need for implant removal.

A total of 40 patients were enrolled for the study out of which 6 were lost in follow-up 10 patients were taken from previous study conducted in 2016-2018 by Dr Jatin Bansal after due consent.

DASH score was not recorded in initial 6-8 week follow up as >90 degree (overhead) movement was permitted only after union. There was no major implant related problem like breakage or failure in this study. There were no complications related to infection or neurovascular injury.

It was necessary to perform open reduction in 10 patients in intramedullary nailing. The widely displaced DMCF theoretically have soft tissue interposition which can make closed reduction difficult in such cases. The study observed that 14 patients out of 34 had open reduction of the intramedullary nailing although closed reduction shall have distinct advantages of intramedullary nailing.6 patients out of 34 had implant irritation over medial aspect which was managed by trimming of implant and followed by removal of implant after 10 weeks.

In this study it was observed that average skin incision size was of 4.2 cm and average union time was 9.5 weeks and the constant Murley score of 94.88 this was comparable to study conducted by Narsaria N and co-workers (2014) which observed the length of incision in the nailing group (mean 6.87cm) Constant-Murley score of 94 and mean union time of 8 weeks.

It was observed in this study that average operative time was 36.32 min which was comparable to study conducted by Zeng L and co-workers (2015) which observed the mean operative time of 35.20 minutes thus concluding that DMCF fixation is less traumatic to patient and has good functional outcome.

It was imperative that the blood loss, though not measured in this study, was less in those fractures which could be reduced closed percutaneously.

5. Conclusion

Clavicle fractures occur frequently and account for 5-10% of all fractures. Around 70-80% fractures of clavicle occur in the mid-shaft out of which 50% are displaced (DMCF). It is likely that high energy injuries can displace fractures of clavicle severely. Operative fixation of displaced mid-shaft clavicular fractures with nail as compared to plating have reported improved patient outcomes, earlier return to function, decreased nonunion and mal-union rates and better
cosmesis making the preference to move towards intramedullary fixation of DMCF.

6. Financial support and sponsorship
Nil

7. Conflicts of Interest
There are no conflicts of interest.

References