

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2019; 5(4): 196-199
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www.orthopaper.com
Received: 18-08-2019
Accepted: 22-09-2019

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Clinical outcome and complications of comminuted midshaft clavicle fractures treated with anatomical locking compression plate-a prospective study

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DOI: <https://doi.org/10.22271/ortho.2019.v5.i4d.1673>

Abstract

Fractures of the clavicle is one of the most common injuries of human skeleton which used to be traditionally treated non-operatively. The present study was undertaken to evaluate the functional outcome in displaced midshaft comminuted clavicle fractures treated with anatomical locking compression plate. 40 patients included in the study between December 2016 to January 2018 with displaced comminuted midshaft clavicle fractures were treated surgically with anatomical locking plate and screws. 34 fractures united at an average of 11.24 weeks, 4 patients had delayed union, 2 patients had plate loosening and 3 patients had implant prominence and irritation. The functional outcome according to Constant and Murleyscore after fracture union in surgically treated midshaft one third clavicle fractures were excellent in 30 patients, good in 6 patients and fair in 2 Patient and poor in 2 patient. This study shows rigid fixation with anatomical locking compression plate and screws for displaced comminuted mid shaft clavicle fractures has excellent to good functional outcome in 90% of the cases and progress to predictable union and has acceptable complications rate.

Keywords: clavicle – injuries, fractures- fixation, anatomical locking compression plate.

Introduction

Midshaft comminuted clavicle fracture is one of the most common injuries of the skeleton, representing 3% to 5% of all fractures and 45% of shoulder injuries. Open clavicular fracture is an absolute rarity, found in only 0.1% to 1% of cases. The rate of midclavicular fractures is more than twice as high in men as in women. The peak incidence occurs in the third decade of life ^[1].

The most commonly used system of classification of clavicular fractures is that of Allman. It is divided into 3 Groups. 2 Group I: Middle-third fractures, Group II: Lateral-third fractures, Group III: Medial- third fractures.

The incidence of nonunion of midclavicular fractures is usually quoted as being from 0.1 to 0.8%, and the mainstay of treatment has long been non operative. These data, however, are based on studies in which clavicle fractures were not adequately classified regarding patient age and fracture displacement. More recent data, based on detailed classification of fractures, suggest that the incidence of nonunion in displaced comminuted midshaft clavicular fractures in adults is between 10 and 15% ^[3].

Also persistent wide separation of fragments with interposition of soft tissue may lead to failure of closed reduction. There is 15% nonunion rate in widely displaced fractures of middle-third of the clavicle treated without surgery. And all fractures with initial shortening of more than 2cm resulted in nonunion ^[4].

Several studies have examined the safety and efficacy of primary open reduction and internal fixation for completely displaced midshaft clavicular fractures and have noted high union rate with a low complication rate.5 In a large number of complex clavicle fractures a satisfactory outcome is possible with a low complication rate using a locked compression plate.6 Primary internal fixation of displaced comminuted mid-shaft clavicular fractures leads to predictable and early return to function ^[7].

While the overwhelming majority of clavicle fractures are benign, associated life- threatening

intrathoracic injuries are possible. Complications vary based on location of fracture⁸. Fracture of the clavicle is associated with delayed union or nonunion⁹, brachial plexus compression resulting from hypertrophic callus formation, compression or laceration of the great vessels, trachea, or esophagus, injuries to the neurovascular bundle and the pleural dome, poor cosmetic appearance, pneumothorax and intrathoracic injury.

There are various methods for treating clavicle midshaft fractures, such as intramedullary K-wires or Steinmann pins fixation and plate fixation. In particular, plate fixation can help obtain firm anatomical reduction in severe displaced or comminuted fracture.

There are various plates including Sherman plates, Dynamic compression plates and Semi tubular plates. Among them, a reconstruction plate and Anatomical locking compression plate (LCP). We have taken up this study to gain a deeper understanding of results and complications associated with this procedure, to evaluate the functional outcome after fixation of displaced clavicular fractures with locking compression plate.

Methodology

The present study was carried out from 1ST DECEMBER 2016 to 31ST JANUARY 2018 at Orthopaedic Department in Shri B.M.Patil Medical College Hospital and Research Center, Vijayapur. During this period 40 patients of middle shaft comminuted clavicle fractures were treated surgically. Adults above 18 years, Robinson’s type 2B1 and 2B2 included for this study. Patients willing for treatment and giving informed and written consent. Patient is below 18 years. Medial third comminuted clavicle fracture, Fracture of lateral third clavicle, Patients not fit for surgery, managed conservatively for other medical reasons, All open fractures of clavicle, Immunocompromised status were excluded from the study. All our cases were operated within 4 days of injury. After obtaining fitness for surgery careful preoperative planning of fixation is done. Patient is placed in beach chair position and operative site painted draped. Transverse skin incision made over the deformity of the fracture and extended on either side aiding the reduction and plate fixation supraclavicular nerves were preserved throughout the procedure k wire fixation used for provisional fixation, minimal soft tissue dissection was done fracture was fixed with pre contoured locking compression plate and lag screws were used wherever necessary for additional fixation. Arm was immobilized for 4 weeks and gradual mobilization and arm exercises were started after 4 weeks. Repeat radiographs were taken at the end of 4 weeks to decide on mobilization and to masses union.

BLDE University SHRI B.M. Patil Medical College Hospital and Research Centre, Bijapur. All the patients were available for follow-up and they were followed at 4 weeks, 3 months, 6 months. Results were analyzed both clinically and radiological for union.



Preoperative comminuted midshaft clavicle fracture



Immediate post-Operative radiograph



6 weeks post operative xray



Final fixation

Results

The present study consists of 40 patients of fresh fracture of the clavicle which were treated surgically with Anatomical locking compression plate & screws for middle third clavicle fracture between 1st December 2016 to 31st January 2018 in

Duration of union

The fracture was considered to be united when clinically there was no tenderness, radiologically the fracture line was not visible and full unprotected function of the limb.

Table 1: Time of Union (Wks) among patients

Time of Union (WKS)	N	Percent
8-12	37	93
>12	3	7.5
Total	40	100

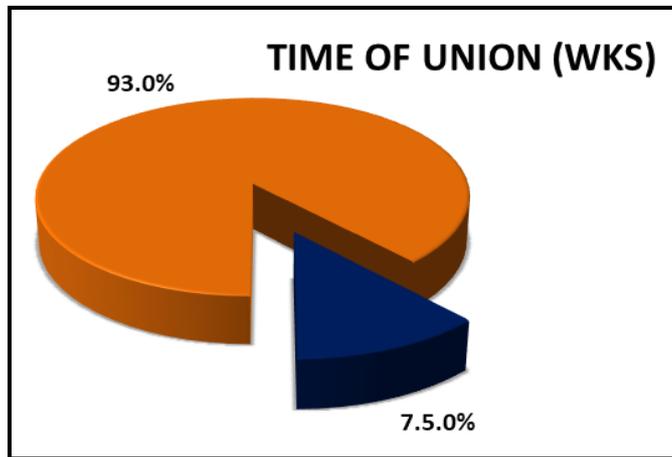


Fig 1: Time of Union (Wks) among patients

In our study 37 patients (> 90%) united at the end of 12 weeks. Delayed union occurred in 3 (7.5%) patients. All eventually progressed to union at the end of 20 weeks. None of the cases required revision and bone grafting.

Functional Outcome

The functional outcome is assessed by Constant and Murley score.

Table 2: Results after surgery among patients

Results	N	Percent
Excellent	30	75
fair	2	5
Good	6	15
Poor	2	5
total	40	100

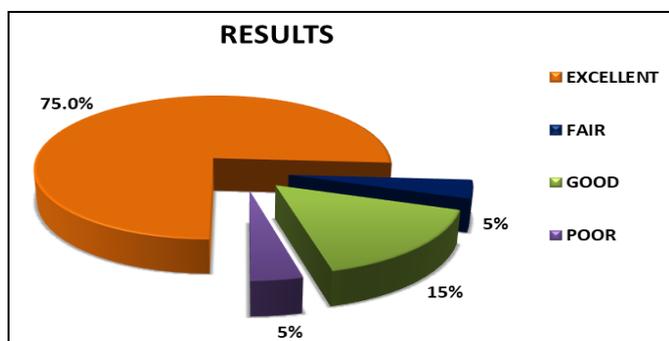


Fig 2: Results after surgery among patients

In this study 30 patients (75%) had excellent functional outcome, 6 patients (15%) good outcome, 2 patients (5%) fair outcomes 2 patients (4%) poor outcomes.

Complications

12.5% of our cases had complications out of which 7.5% had plate prominence and irritation for which no intervention was done and were advised implant removal after the union. 5% of cases had plate loosening which were kept under observation and extended immobilization protocol. eventually they progressed to union and no further complications. Both these patients were non compliant and did not followed the immobilization for 4 weeks.

Discussion

Clavicle fractures are usually treated conservatively. In a study conducted to analyze the results of conservative

treatment by Hill *et al.* [10] in 1997, Nordqvist *et al.* [11] in 1998 and Robinson *et al.* [12] in 2004 found poor results following conservative treatment of displaced middle third clavicle fracture. There are specific indications like displacement, with or without comminuted middle third clavicle fracture (Robinson Type-2B1, 2B2).

The present study of patients with comminuted midshaft clavicle fractures is compared with Bostman *et al* [13] study which treated middle third clavicle fractures. In that study totally 103 patients were treated by early open reduction and internal fixation with plate and screws. It was also compared with Cho *et al.* [14] study where 41 patients with a clavicle midshaft fracture were treated by internal fixation with a reconstruction plate (19 patients) or reconstruction LCP (22patients).

Sex Incidence

In this study 35 patients (86%) male and 5 patients (14%) female. In Bostman *et al* 13 series also commonly males are affected 76 Patients (73.79%) compared to females 27 Patients (26.21%). In Cho *et al* 14 study, the reconstruction plate group that 12 male and 7 female Patients and in the locking compression plate group it was 17 male and 5Patients. Male predominance can be drawn from this inference.

Type of fracture

In this study all Patients with midshaft clavicle fractures were of closed type. This is comparable to Bostman *et al.* [13] and Cho *et al.* [14] study which also showed all their patients were closed fractures.

Fracture classification:

In this present study, Robinson Type-2 B1 (Displaced with simple or butterfly fragment) were more common and there were 18 Patients (36%). Type-2 B2 (displaced with comminution) occurred in only 32 Patients (64%).

In Bostman *et al.* [13] study also Robinson type-2B1 was common in 81 patients (78.64%). Robinson type-2 B2 occurred only in 22 patients (21.36%).

In Cho *et al.* [14] study, in reconstruction plate group there were 7 Patients with B1 type and 12 Patients with B2 type and that of the locking compression group had 9 B1 type and 13 B2type.

Time interval for surgery

All our patients were operated within 4 days of admission. In Bostman *et al.* [13] study all the patients were operated within 3 days of injury. In Cho *et al.* [14] study, the reconstruction plate group was operated by 4 days and that of locking compression plate was 9days.

Duration of union

In this study majority of the comminuted midshaft clavicle fracture cases united between 8 to 12 weeks (>90%). In 3 Patients (7.5%) delayed union occurred as there was a displaced butterfly fragment which united with the main fragment at the end of 16 weeks. There were no non-union. Lazarus MD [15] stated radiological union occurred approximately between 6 to 12weeks.

In Cho 14 *et al.* study, bony union for reconstruction plate was 14.6 weeks and that of locking compression plate was 13.2weeks.

Complications

There were no major complications in this study. Both

Bostman *et al.* and Cho *et al.* [13 14] didn't have any major complications either.

Plate loosening

Plate loosening occurred in 3 Patient (7.5%) at the end of 4 weeks postoperatively. The cause in this patient was also due to non compliance with the post operative protocol. The patient went for farming in the field before the fracture union. With further advise of not to lift heavy weights in the affected limb clavicle fracture went to unite in mal position at end of 12 weeks and no reoperation was performed for this.

In Bostman *et al.* [13] study 7 patients (6.80%) had implant loosening. In all the patients loosening occurred at 6 postoperative weeks. Malunion of varying degree followed in all of these patients and no reoperations were performed.

In Cho *et al* study [14], only there construction group that plate loosening in 3 Patients (15.8%)

Delayed union

Delayed union occurred in 2 Patients (5%) due to a large butterfly fragment in the inferior aspect of clavicle which went on to unite with the main fragments at the end of 16 weeks. In Bostman *et al.* [13] study delayed union occurred in 3 Patients (2.91%).

Skin complications

There was no skin complication. The total complication in this study were 15% excluding skin related minor complications. The total complication rate of Bostman *et al.* [13] study was 23%.

Functional outcome

The functional outcome according to Constant and Murley 16 in this study of total 40 Patients of fresh middle third clavicle fracture fixed with locking compression plate and screws showed excellent results in 30 Patients (75%) and good functional outcome in patients 6 Patients (15%). Fair functional outcome in 2 Patient (5%) & poor results in 2 patients (5%) The advantage of rigid internal fixation and early mobilization of fresh displaced clavicle fracture is that it (displaced comminuted middle third) gives immediate pain relief and prevents the development of shoulder stiffness and non-union.

Conclusion

Operative treatment of clavicle fractures generally have good functional outcome. The advantages of Anatomical locking compression plate include strong fixation due to locking between the screw and plate, and blood supply preservation due to minimal contact between plate and cortical bone. Surgery time can be reduced using anatomical locking compression plate because accurate plate contouring is not necessary and periosteal stripping could be minimized using self-tapping screws. Surgical scars are currently considered major complications due to the increasing demand for aesthetics. In conclusion, bony union could be achieved with anatomical locking compression plate clavicle and the clinical outcomes were satisfactory and complications were minor and rates were predictable and comparable to other studies. All the fractures united and there was no non union. More than 90% have excellent outcome

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