



Original Article

A Prospective Study of Surgical Management of Middle–Lateral 1/3 Junction Clavicle Fracture on General Population By Pre-Contoured Locking Compression Plate

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ABSTRACT

Background: Clavicle fractures are among the most common injuries of the shoulder girdle, with midshaft fractures accounting for the majority of cases. Although conservative treatment has traditionally been the standard approach, displaced fractures are associated with higher rates of non-union, malunion, and functional impairment. Open reduction and internal fixation using pre-contoured locking compression plates has emerged as an effective treatment modality, providing stable fixation, early mobilization, and improved functional outcomes. Therefore, the present study was undertaken to evaluate the clinical and functional outcomes of clavicle fractures treated with pre-contoured locking compression plates.

Aim: This study has been undertaken to study the role of pre-contoured locking compression plate in fixation of mid third clavicle fractures.

Materials and Methods: We reviewed the results in 25 cases of middle 1/3-lateral 1/3 junction clavicle fracture treated with pre-contoured locking compression plate during period from November 2021 and December 2023 in Aralaguppe Mallegowda District Hospital attached to Chikkamagalur Institute of Medical Science.

Results: Out of 25 patients operated with pre-contoured LCP, out of which one patient developed plate prominence, one had superficial skin infection, none of them developed non-union. Union was evaluated clinically and radiographically.

Conclusion: This implant has been provided with compression mechanism to achieve maximum compression, fast fracture healing and early mobilization.

Keywords: Middle 1/3-Lateral 1/3 clavicle fracture, pre-contoured LCP, faster healing.

INTRODUCTION

Clavicle is the horizontally placed collar bone that connects the upper limb to the trunk and plays a very important role in mobility and anatomical stability of upper limb. Its subcutaneous position makes it vulnerable to traumatic injuries.⁽¹⁾ Fractures which involve the clavicle are very common and account for almost 5-10% of all the fractures and up to around 45% of those which involve the shoulder girdle. Fractures of the mid-lateral 1/3 junction of clavicle account for about 60-80% of all the clavicular fractures.⁽²⁾ Most of these fractures occur due to a direct blow to the anterior chest wall or by falling on the outstretched hand. The most common site of clavicle fracture is said to be the mid shaft, which is followed by the lateral ends.^(3, 4) Some of these fractures are usually unstable due to the displacing forces which act on the fractures, an inferior force acting on the lateral fracture and an anterosuperior force acting on the medial clavicle fragment. Historically we were taught, "All clavicle fractures do well with non-operative treatment". Such treatment is usually successful and till recently most of the available literature showed that more than 95% of clavicle fractures achieve union with acceptable cosmetic and functional results.⁽⁵⁾ Recent studies have shown that great number of patients

develop symptomatic malunion, non-union, and poor functional outcomes after conservative management of displaced fractures.⁽⁶⁾ Also, persistent wide separation of fragments with interposition of soft tissue may lead to failure of closed reduction. There is 15% non-union rate in widely displaced fractures of middle-third and lateral third clavicle treated without surgery and all fractures with initial shortening of more than 2cm resulted in non-union.⁽⁵⁾ Surgery is accepted more and more as primary treatment for displaced middle and lateral 1/3 clavicle fractures, mainly because the results of operative treatment is superior and prompts unsurprising and early come back to work.^(7,8)

There are many treatment modalities for middle and lateral 1/3 clavicle fracture like intramedullary K wire, TENS, plating like dynamic compression plate, semi tubular plate, reconstruction plate, locking compression plate.⁽⁹⁾ The shape of the clavicle bone is 'S' shaped and plate pre contoured to the shape of clavicle LCP were used in this study and evaluated the functional outcome of treating clavicular fracture with LCP. In large number of complex clavicles fractures, satisfactory outcome is possible with a low complication rate using a locked compression plate.⁽¹⁰⁾

We have taken this study for the better understanding of functional and clinical outcome of middle and lateral third junction clavicle fracture treated with locking compression plate and to evaluate the complications associated with it.

AIM

This study has been undertaken to study the role of pre-contoured locking compression plate in fixation of middle – lateral third clavicle fractures and the complications associated with it.

Inclusion criteria

- Patients greater than 18 years.
- Displaced clavicle fracture.
- Bilateral clavicle fractures.
- Clavicle fracture associated with neurovascular injuries.
- Failure to maintain reduction of middle-lateral third clavicle with conservative management.
- Patient willing to follow up in our department.
- Written informed consent for recontoured plate.

Exclusion criteria

- Patient age less than 18 years of age.
- Hemopneumothorax.
- Multiple rib fractures.
- Flail chest.
- Medically unfit for surgery.

Time interval of Surgery

24 patients (96%) were operated in first week of incidence. 1 patient was operated after 1 week due to his medical complications.

Surgical technique

- Under general or regional anaesthesia patient is put in supine position on to table in beach chair position with towel in between the scapula. Entire limb from neck to hand were prepared and draped. About 8-10cm incision made over anterior aspect of clavicle with centring the fracture site. The skin subcutaneous tissue and platysma were divided without undermining the edges. The overlying fascia and periosteum were next divided. The bony ends were freed from surrounding tissue. Fracture fragments were reduced and pre-contoured plate was applied over superior aspect of the clavicle. At the junction of medial and middle third of the clavicle, the inferior surface is exposed and protective instrument can be inserted during drilling to prevent injury to neurovascular structures. The pre-contoured locking compression plate was fixed to medial and lateral fragment with at least three 3.5mm locking screws for each fragment. Wound sutured in layers and sterile dressing was done.

Post-op Protocol

- Regular dressing of wound done on post op day 2 and 5, IV antibiotics given and sutures removed on post op day 10.
- Arm pouch is used for 3 weeks and gentle pendulum exercises to the shoulder in arm pouch were started.
- At 4-6 weeks gentle active range of motion of shoulder was allowed but abduction is limited to 80 degrees.
- At 6-8 weeks full range of motion of shoulder in all directions were allowed.
- Regular follow up done at 4, 8, 12 weeks 6months and one year.
- Local examination of clavicle for tenderness, shoulder movements assessed and fracture union was assessed radiographically by taking serial radiographs.

- Functional outcome assessed by Constant and Murley Score.

RESULTS

All 25 patients were available for follow-up and were evaluated at regular intervals of 4 weeks, 8 weeks, 12 weeks, 6 months, and 1 year postoperatively. Clinical and radiological assessments were performed at each follow-up visit. The study population comprised 22 males (88%) and 3 females (12%), with the majority of patients belonging to the 35–50 years age group. Road traffic accidents were the most common mechanism of injury, accounting for 20 cases (80%), while the remaining 5 cases (20%) resulted from a simple fall onto the shoulder.

Table 1. Demographic Characteristics of the Study Population

Variable	Number of Patients (n=25)	Percentage (%)
Gender		
Male	22	88
Female	3	12
Mode of Injury		
Road Traffic Accident	20	80
Fall on Shoulder	5	20

All patients had fresh middle-third or lateral-third clavicle fractures were treated surgically using pre-contoured locking compression plates. Fracture union was defined clinically by the absence of tenderness at the fracture site and radiologically by complete bridging of the fracture with evidence of healing on plain radiographs. In the present study, 23 patients (92%) achieved complete fracture union within 10 weeks of surgery, while 2 patients (8%) experienced delayed union. No cases of non-union or implant failure were observed.

Table 2. Fracture Union Outcomes

Outcome	Number of Patients (n=25)	Percentage (%)
Union within 10 weeks	23	92
Delayed Union	2	8
Non-union	0	0
Implant Failure	0	0

Postoperative complications were minimal. One patient (4%) developed a superficial surgical site infection, which resolved with appropriate antibiotic therapy and local wound care. Hypertrophic scar formation was noted in one patient (4%), and plate prominence was observed in two patients (8%). No neurovascular complications, deep infections, or re-fractures were encountered during the follow-up period.

Table 3. Postoperative Complications

Complication	Number of Patients (n=25)	Percentage (%)
Superficial Surgical Site Infection	1	4
Hypertrophic Scar	1	4
Deep Infection	0	0
Neurovascular Complication	0	0
Re-fracture	0	0

Functional outcomes were assessed using the Constant–Murley Shoulder Score at the final follow-up. Excellent results were achieved in 20 patients (80%), good results in 4 patients (16%), and fair results in 1 patient (4%). No patient had a poor outcome. These findings demonstrate that surgical fixation of clavicle fractures using pre-contoured locking compression plates provides excellent union rates, favourable functional outcomes, and a low complication rate.

Table 4. Functional Outcome According to Constant–Murley Shoulder Score

Functional Outcome	Number of Patients (n=25)	Percentage (%)
Excellent	20	80
Good	4	16
Fair	1	4
Poor	0	0



PRE-OP XRAY



IMMEDIATE POST OP



2 MONTHS POST OP



6 MONTHS POST OP



RANGE OF MOVEMENTS

DISCUSSION

Most clavicle fractures have traditionally been managed conservatively. In a landmark study published in 1960, Neer¹¹ reported an exceptionally low non-union rate, with only 3 cases of non-union among 2,235 patients with midshaft clavicle fractures treated non-operatively. Based on these findings, conservative management became the preferred treatment modality for many surgeons. However, subsequent studies have demonstrated higher rates of non-union, particularly in displaced fractures. Zlowodzki et al.¹², in a systematic review published in 2005, reported a non-union rate of 6% among 1,145 clavicle fractures treated non-operatively, which increased to 15–20% in severely displaced fractures. In contrast, patients treated with open reduction and internal fixation (ORIF) had a significantly lower non-union rate of approximately 2%. These findings suggest that while conservative treatment remains effective for many clavicle fractures, surgical fixation may provide superior union rates in selected patients with displaced midshaft fractures.

The extent of fragment displacement is closely associated with fracture union^(13,14) and anatomical reduction is essential for rapid recovery. Due to increasing instances of severely displaced and comminuted fractures caused by high energy injuries in motor vehicle accidents, industrial accidents and sports injuries now there is increased interest in treatment by ORIF.⁽¹⁵⁾

The clavicle fractures treated with intramedullary K-wire fixation or Steinmann pin result in low resistance to torque, with increased risk of pin loosening and infection, and require a long-term fixation period. Intramedullary nailing with TENS leads to good cosmetic and functional results. It results in significant postoperative pain reduction and faster ROM of shoulder joint. However, multi-fragmentary fractures or oblique fractures can lead to a telescoping of the fracture site causing length reduction.⁽¹⁶⁾ Open reduction and internal fixation with plates, such as Sherman plates, dynamic compression plates, and semi tubular plates, can be effective in obtaining anatomical reduction, applying direct compression to the fracture site, and producing resistance to torque. However, it is difficult to hold the plates to the clavicle in severely comminuted fracture. In contrast, reconstruction plates can be manipulated to fit the contour of the clavicle and fracture pattern to obtain firm fixation, are lighter and thinner than DCP and are durable to multidirectional mechanical stress imposed on the fracture site.^(17,18) But, penetration of both cortices for screw fixation may cause damage to the subclavian artery and firm fixation can be difficult to maintain in osteoporotic patients over 50 years of age.⁽¹⁶⁾ In our study only precontoured LCP were used. Its advantages include strong fixation due to locking between the

screw and plate, providing minimal contact between plate and cortical bone. With other conventional screws and plates, fracture site stability is provided by friction between the plate and bone cortex. In contrast, for LCP uni-cortical screw placement gives good stability because the screw head is locked firmly in the threaded plate hole. It is also helpful in preventing screw loosening or instability. ^(19,20) The risks of injury to the sub clavicular artery or brachial plexus is reduced. The surgery time can be reduced using LCPs because accurate plate contouring is not necessary. In our study we have included patients ranging from 20–50 years of age, amongst them we had the highest number of patients in the age group between 35–50 years and mean age was 36 years, which is similar to a study conducted by Ramkumar et al, ⁽²¹⁾ were in the age group between 19–39 years with an average age was 33.8 years. In this present study among 25 patients, 22 (88%) were males and 3 (12%) were females and were operated with in less than 5 days In a study conducted by Ramkumar et al, ⁽²¹⁾ almost of the patients were Males and were operated with in a week. In our study the most common mode of injury was RTA which was similar to Bostman et al ⁽²²⁾ and Ramkumar et al, ⁽²¹⁾ and Ramesh et al ⁽²³⁾ In our study most of patients i.e., 23 (92%) of them achieved radiological union in 10-12 weeks and 2 patients (8%) achieved union in 14–18 weeks. With the mean interval for duration being 10 weeks with none of patient had non-union. In study conducted by Ramesh et al, ⁽²³⁾ the union was achieved in a mean interval of 9 weeks, Cho et al ⁽²⁴⁾ union achieved in mean interval of 13.2 weeks, time for reunion of clavicle after surgery was less than 14 weeks in Agarwal T et al ⁽²⁵⁾ and 12 to 16 weeks in Aditya et al. ⁽²⁶⁾

In our study 1 patient (4%) developed superficial infection and 2 patient (8%) had plate prominence and 1 patient (4%) had hypertrophic scar and 2 patients had delayed union. Similary in a study Bostman et al⁽²²⁾ had 7 % infection. Aditya et al had 10% hypertrophic scar, 5% had plate prominence and delayed union.

In our study as per Constant and Murley scoring system 20 (80%) of the patients showed Excellent, 4(16%) of them showed Good, 1 patient (4%) had Fair (13%) outcome. Ramkumar et al, ⁽²¹⁾ observed that functional outcome according to Constant and Murley score is excellent in 19 patients (63.3%), Aditya et al⁽²⁶⁾ had 16 patients (80%) excellent outcome and Venkatreddy et al had 77% excellent, 13% had good results. Functional outcome obtained in our study is similar to the above studies and further justify that operative management provides excellent results.

CONCLUSION

The functional outcome as assessed by Constant and Murley, scoring of middle and lateral 1/3 fractured treated in our study with open reduction and internal fixation with LCP showed 80% of the study subjects having excellent outcome and radiological union in 92% patient with in 10-12 weeks. Though clavicle fractures are usually treated conservatively, the anatomical reduction with clavicular length maintenance and alignment of shoulder girdle which is the goal of surgical treatment can be attained with LCP osteosynthesis of the clavicle. It is a safe, superior procedure and gives excellent functional outcome.

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