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A prospective study on clinical outcome following surgically managed displaced clavicle fractures using pre-contoured locking plate and screws

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Abstract

Background: Most acute displaced clavicular fractures conventionally have been treated non-operatively with the expectation of a high probability of fracture union, good functional outcomes, and a high level of patient satisfaction. However, the outcome of non-operative treatment is not as favorable as once thought and there has been a growing trend to treat these fractures surgically. We studied the clinical outcome of displaced clavicle fractures managed surgically by pre-contoured locking plate and screws.

Materials & methods: A prospective study was carried out between October 2015 and June 2017 in SS Institute of Medical Sciences & Research Centre Davanagere, Karnataka where 50 patients with displaced clavicle fractures were treated surgically by pre-contoured locking plate & screws. They were followed up for a minimum period of 2 years by the main author and evaluated for clinical outcome using dash score and constant moreley score.

Results: Out of 50 cases 42 cases had excellent results without complications & 5 patients had good result without complications. 2 cases which were going for delayed union were treated with bone grafting and 1 case, where the plate was exposed on the medial aspect at 2 months follow up, plate was removed and wound was closed in layers.

Conclusion: In our study of displaced clavicle fractures, which were effectively treated surgically with pre-contoured locking plate & screws gave excellent results & to be considered one of the best surgical modality for displaced clavicle fracture management.

Keywords: Displaced clavicle fracture, pre contoured LCP, dash score, constant moreley score

Introduction

Aim of the study

1. To study the fracture union at interval of 3 months 6 months and 12 months follow up.
2. To assess the functional status of the patient following surgery.
3. To assess the subjective status of the patient following surgery.
4. To determine the complications following the surgery.

Materials & methods: A prospective study was carried out between October 2015 and June 2017 in SS Institute Of Medical Sciences & Research Centre, Davanagere, Karnataka where 50 patients with displaced clavicle fractures were treated surgically by pre-contoured locking plate & screws. They were followed up for a minimum period of 2 years by the main author and evaluated for clinic-functional outcome using DASH score and constant moreley score.

A written consent for participation in this prospective study was obtained from all patients. Most of patients were in the age group between 21 and 40 years (63%). The youngest was 18 years and oldest was 59 years with an average age of 32.1 years. There were 38 males and 12 females. 46 of the fractures were sustained following Road Traffic Accident (92%) and 4 cases (8%) following fall from height. Right clavicle was fractured in 28 cases and left in 21 cases and bilateral clavicle fracture in 1 patient. 42 cases had comminution at fracture site. All the cases had displacement more than 2 cm. On an average the timing of surgery was 1 days post injury. 13 cases had associated injuries.

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6 patients had rib fractures, 1 had scapula fracture, 2 cases had tibia fracture, 1 case had patella fracture and 2 cases had facial bone fractures. Patients with isolated clavicle fracture were in hospital for 5 days. Those patients requiring treatment for associated major injuries stayed for long time ranging from 14 days to 44days. All the cases were operated with precontoured locking plate fixed on superior surface with 3.5 mm locking screws. Interfragmentary screw was used in 27 cases.

Demographic details of patients

Age	18-59yrs (32.1)
Sex	38M:12F
Mode of injury	
RTA	46
Fall from height	4
Laterality	
Right	28
Left	21
Bilateral	1
Communion	42
Allman type 1	50
Interval from injury to operation	1-7days

Inclusion criteria

- Age >18yrs.
- Displaced clavicle fractures (Allman group I, II, III)
- A fracture that had occurred less than two weeks previously.
- Bilateral clavicle fractures
- Clavicle fractures associated with neurovascular injury

Exclusion criteria: Haemopneumothorax

- Multiple rib fractures
- Flail chest

Operative technique

Patient in supine position with a sand bag placed behind the ipsilateral scapula. Parts were painted and draped under strict aseptic precaution. An oblique incision (approximately 8–10 cm) was made over the fracture site. Larger branches of the identifiable supraclavicular nerves were identified and protected throughout the procedure; smaller branches were sacrificed at the surgeon's discretion. Precontoured locking plate with 3.5mm locking screws were used. Fixation was performed following a reduction with minimal periosteal stripping. Three screws were used in the medial and lateral areas, whichever case was possible.

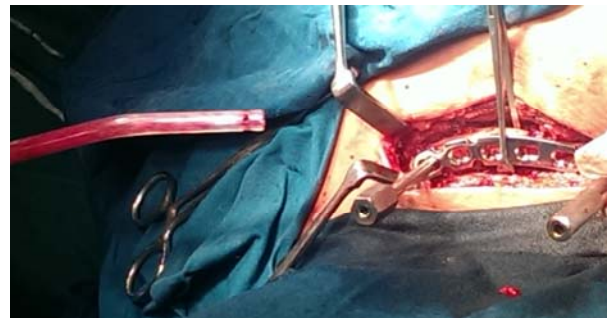
Postoperatively, the patients were given a simple sling for approximately 2 weeks, and pendulum exercise and active range of motion exercise were then started.



Incision



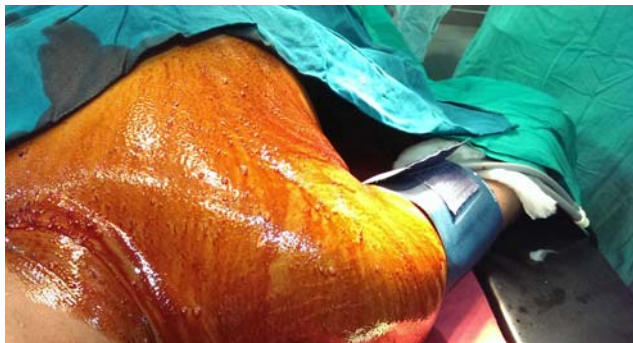
Soft tissue dissection and bone exposure



Fracture fragments reduced and plate placed with drill sleeve



Fracture fixed with precontoured LCP & screws.

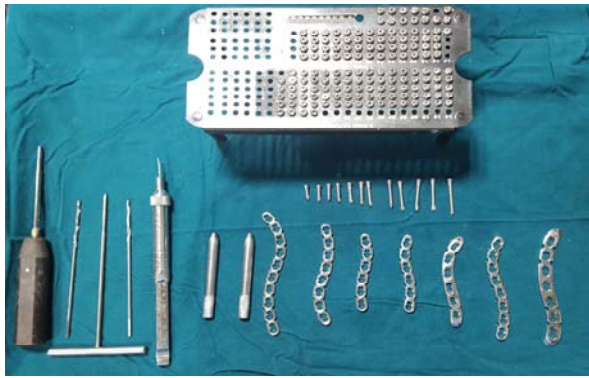


Patient in supine position, parts painted & draped.



Wound closed in layers.

Operative Instruments



- Screw driver
- 3.0 Drill bits
- Depth Gauge
- Sleeves
- 3.5mm Pre-contoured locking compression plates
- 3.5mm Screws and screw box

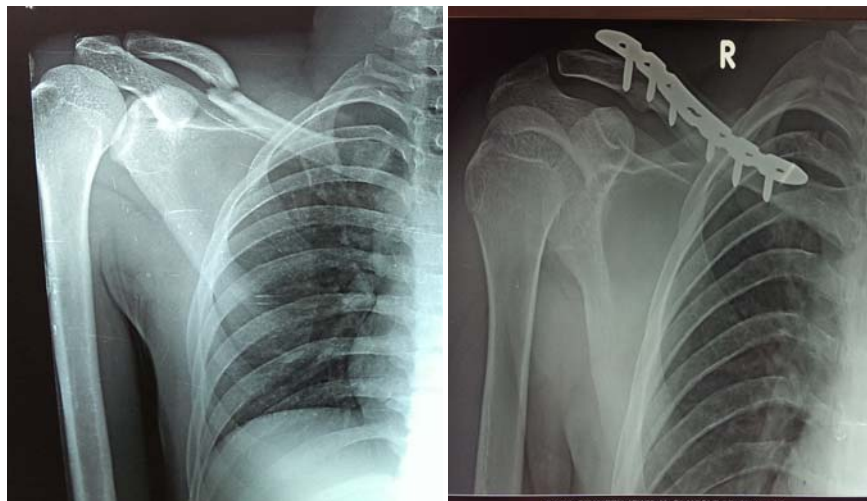
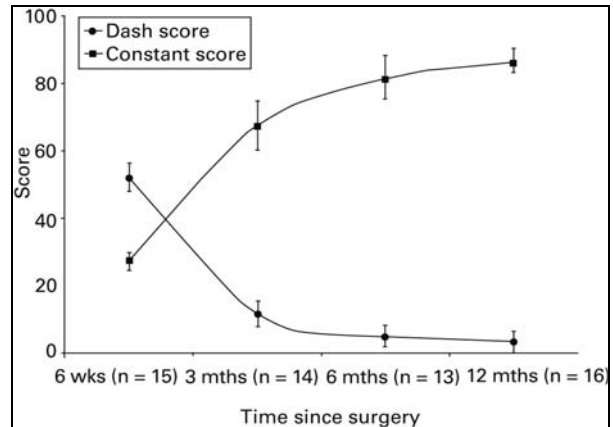
Result

Fifty patients volunteered to participate and signed the written informed consent. All of them completed the study. Demographic data are shown in table 1. The mean operative time was 48 min (range, 30 to 66 min). Bony union was achieved in 48 cases after surgery at an average of 12 weeks (range, 8 to 24 weeks). These Patients returned to their daily routine activities from the time of injury on an average of 14 weeks (range, 8 to 20 weeks). 2 cases presented with signs of delayed union at 8 weeks, which were augmented with iliac bone graft and these fractures united by 24 weeks. 1 patient had plate exposed on the medial side (wound dehiscence) with signs of infection when presented at 8 weeks of follow up. The plate was removed. On table, the fracture was already uniting, adequate wound debridement was done and the infected granulation tissue was sent for culture and sensitivity.

Culture reports showed positive for Staphylococcus aureus & specific iv antibiotics was started. Secondary wound suturing was done once the culture sent came as negative.

Postoperative complications were noted in the follow up. The complications were dysesthesia in the area of the incision in two cases, painful shoulder in three cases. Patients were specifically questioned about their satisfaction or dissatisfaction regarding the appearance of the healed surgical scar, appearance of shoulder. 9 patients had dissatisfaction regarding the healed surgical scar. None of the patients were dissatisfied by the appearance of shoulder in the follow up.

Operation time	30-66min (48)
Bone union	8-24 weeks(12)
Return to activity	8-20weeks(14)
Complications	
Dyesthesia	2
Wound dehiscence	1
Hypertrophic scar	0
Painfull shoulder	3
Motion limitation	0
Satisfaction with appearance	41
Dash score	3.1-5.3 (4.2)
Constant morely score	85-90 (87.5)



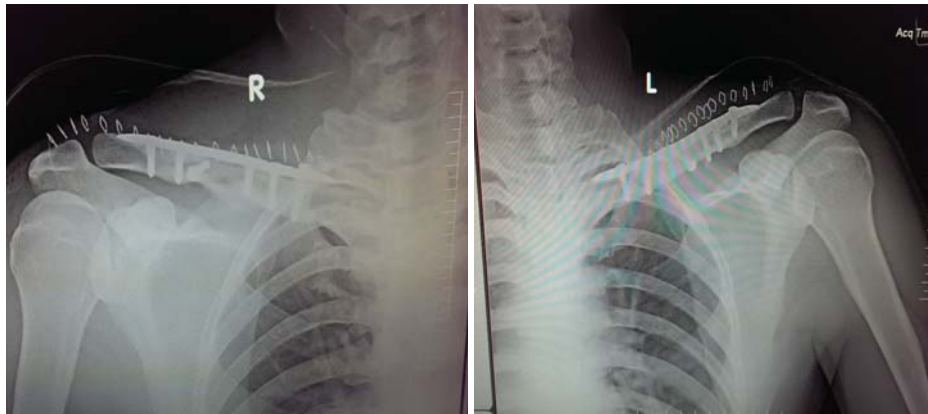
19yr male with closed displaced middle 1/3rd clavicle fracture with post op check xray with pre-contoured lcp & screws



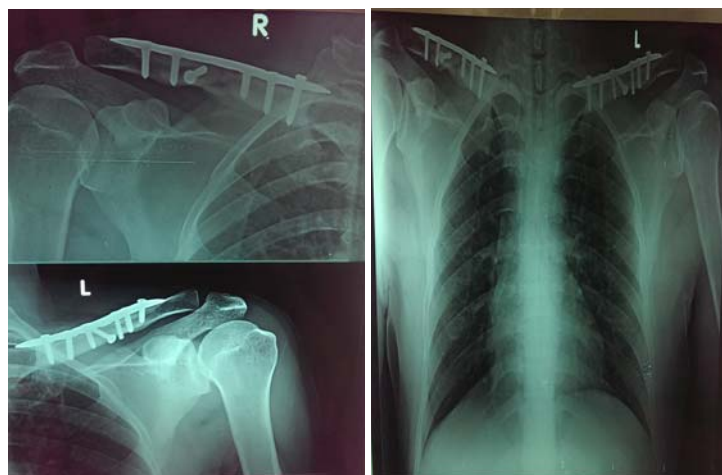
Clinical picture depicting full range of movements



32yr male with b/l closed comminuted middle 1/3rd clavicle fracture



Post operative check xray with precontoured LCP & lag screw fixation

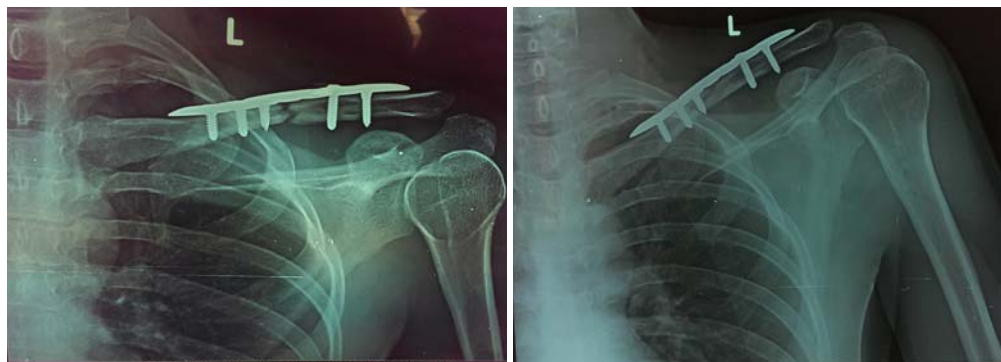


Follow up check xrays at 1 month & 3 months



Clinical picture showing full ROM of both shoulder joints at follow up

22 yr male with closed comminuted middle 1/3RD left clavicle fracture treated with pre-contoured lcp & screw. immediate post op xray



Follow up at 8 weeks showing gap in fracture site going for delayed union. Xray of patient after bone grafting was done on follow up.



Clinical picture of the same patient showing overhead abduction



27yr male who was treated with precontoured locking plate and screws for closed right clavicle fracture. The patient didn't turn up for routine follow up. The patient presented to opd with plate exposed medially at 8 weeks post op with signs of infection.

2nd picture depicting uniting clavicle fracture, where plate and screws were removed and wound debridement was done

Discussion

The clavicle acts as a strut, which transfers power from the trunk to the arm. The clavicle is S-shaped with a medial convexity and a lateral concavity. The middle third is the thinnest part of the clavicle and is located directly under the skin with no soft tissue or muscle attachment. Thus, it is vulnerable to direct and indirect trauma. This explains the high frequency of fractures in the middle third.

Fractures of the clavicular shaft were considered to be a domain of non-operative treatment for a long time. This dogma was based on the studies conducted by NEER CS and Rowe CR in the 1960s. However, recent studies have shown that the rate of malunion and non-union after non-operative treatment might well be much higher than previously shown. Subjective contentment with the results of non-operative treatment is not uniformly high. In 2007, the Canadian Orthopaedic Trauma Society reported that internal fixation with plates resulted in more rapid union, excellent clinical outcomes, and lower complication rates in 132 patients with displaced clavicle fractures than non-operative treatments. Hence, there has been increasing interest in surgical treatments with open reduction and internal fixation.

The operative methods for the treatment of clavicle midshaft fractures involve intramedullary K-wire fixation or Steinmann pin fixation or elastic stable intramedullary nailing and plate fixation. The procedures using the former two materials result in low resistance to torque, carry risks of pin loosening and infection, and require a long-term fixation period. In addition, Elastic stable intramedullary nailing leads to good cosmetic and functional results. Patients profit from marked postoperative pain reduction and a rapid recovery of range of motion in the shoulder joint. However, multifragmentary fractures or oblique fractures can lead to a telescoping of the fracture site. This leads to a postoperative length reduction. To prevent this complication, Elastic stable intramedullary nailing is only recommended for simple or displaced wedge fractures.

Open reduction and internal fixation with plates (plate osteosynthesis) is still the standard method for the surgical treatment of clavicular shaft fractures. The goal of surgical treatment is the anatomic reduction with reconstruction of

clavicular length and alignment of the shoulder girdle. To prevent early stress fracture of the implant, a fairly strong implant in comparison to the bone strength should be chosen. Pre-contoured LCP have been preferred for plate osteosynthesis of the clavicle. The advantages of Pre-contoured LCP include strong fixation due to locking between the screw and plate, and blood supply preservation due to minimal contact between plate and cortical bone. When LCP are used to treat clavicle midshaft fractures, the risks of injury to the subclavicular artery or brachial plexus could potentially be reduced because fixation can be achieved without the tip of the screw reaching the opposite bone cortex and periosteal stripping can be minimized to promote rapid union. It is believed that the surgery time can be reduced using LCP because accurate plate contouring is not necessary and periosteal stripping could be minimized using self-tapping screws. Surgical treatment of displaced midclavicular fractures with pre-contoured locking compression plate and screws, which can be shaped to match the shape of the clavicle, can be effective in the treatment of clavicle midshaft fractures. However, there remains some problem such as increased soft tissue stripping, infections, extensive scars, supraclavicular nerve injury.

Conclusion

In our study of 50 cases of displaced clavicle fractures, we conclude that 47 patients had excellent outcome as deduced by dash score & constant morely score. 2 patients had complication of delayed union and 1 patient had plate exposure medially with signs of infection.

The surgical procedure is easy, less time consuming, less amount of intraoperative bleeding, with no requirement of fluorooscopic usage and surgeon friendly. The pre-contoured LCP helps to achieve anatomical reduction with an excellent end result of bony union by retaining the normal 'S' shape of the clavicle. The patients have no limitation of motion of the shoulder joint and can return to their full daily routine activities as soon as 8 weeks. Majority of the patients have no subjective complaints.

Though there are various surgical methods for fracture clavicle fixation, our study and other published series has shown that open reduction internal fixation with minimal periosteal stripping using pre-contoured locking plate & screws is far superior compared to other surgical modalities. So clavicle fracture fixation with precontoured lcp and screws can be considered the best modality and this is going to stay for a long period in orthopaedic practice.

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