Management of unstable lateral end clavicle fracture with suture anchor technique - single centre experience

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Abstract
Fracture of the lateral end clavicle especially displaced fractures like the type II b are difficult to manage. Superior displacement due to deforming forces of trapezius and the small distal lateral fracture fragment cause difficulty in surgical management. Suture anchor technique is an easy and reliable way of fixing these fractures and has a superior functional outcome. This study illustrates the functional outcome following suture anchor fixation of lateral end clavicle fractures.

Materials and Methods: 153 fracture clavicle since 2011 out of which 23 are lateral end clavicle fracture of which are stable and treated conservatively among these 11 patients had type 2 unstable distal end fracture and thus selected to undergo surgical intervention.

Results: A total of 11 patients with type II clavicle fractures were enrolled in our study (9 males, 2 females). Mean patient age was 43.1±8.5 years, and mean follow-up period was 25.3 months (range; 12–56 months). CMS scores for all 11 patients at 3 and 12 months postoperatively were 73.10±5.43 and 91.63±3.72, respectively.

Conclusion: Several methods of fixation with K wire, open reduction and internal fixation (ORIF) with plate and screws spanning the acromioclavicular joint, hook plate, coracoclavicular screw fixation and suture anchor fixation wires have been described in literature. For unstable lateral end clavicle fractures stabilization with suture anchor is a safer, reliable management and less technically demanding mode of management with good results.

Keywords: Unstable lateral end clavicle fracture, suture anchor fixation, novel technique

Introduction
Distal clavicle fracture is caused by trauma with direct force on the bone due a fall in adults. It accounts for 2.6 – 4% of all adult fractures [1]. Though fracture of the shaft is the commonest, lateral end fracture constitutes 21–28% of all clavicle fractures. Of these 10–52% are displaced fractures [2]. Treatment modalities vary from immobilization to operative reduction depending on the stability of the fracture. Several methods of fixation with K wire, open reduction and internal fixation (ORIF) with plate and screws spanning the acromioclavicular joint, hook plate, coracoclavicular screw fixation and suture anchor fixation wires have been described in literature. In this study we have reviewed the technique reliability reproducibility and ease of surgery in fixing the lateral end clavicle fracture with suture anchors.

Materials and Methods
In the Department of Orthopedics at our institute which is a teaching medical college hospital, we have seen 153 fracture clavicles since 2011 out of which 23 are lateral end clavicle fractures. Twelve of these cases had a stable fracture pattern and were treated conservatively. Eleven patients had type 2 unstable distal end fracture and thus selected to undergo surgical intervention. The patients after evaluation for fitness for surgery underwent ORIF with suture anchor.

The patients were selected after they were eligible under our inclusion criteria which included only a) Acute trauma, b) Skeletally mature patients c) Closed fractures
Exclusion criteria included patients with multiple, pathologic or bilateral clavicle fractures and other.
Surgical technique
The patients were put in Beach chair position under General anaesthesia. Superior approach to the Acromioclavicular joint was used. A longitudinal incision was made approximately 5 cm from the distal clavicle to the coracoid process. Before incision thorough infiltration with tumescent solution containing 0.1ml adrenaline (1 in 1000) diluted with 500ml of 0.9% NaCl solution was injected the incision region to reduce the bleeding.

The subcutaneous tissue was undermined in both medial and lateral direction, thus exposing the delto-trapezial fascial interval. The delto-trapezial fascia is split in line and the deltoid muscle is split vertically in line with the coracoid base, where the suture anchor is to be anchored. The fractured fragments are identified.

The base of the coracoids is identified and a 2.7-mm drill was used to create 2 holes in the clavicle. Suture anchor of size 5 mm inserted and correspondingly drill holes were drilled in the medial end of the clavicle 1 cm away from the fracture site. A single suture anchor was inserted in the base of the coracoids, and the arms were pulled through the drill holes and tied over the clavicle in an over reduction position. If a butterfly fragment is there then it is to be held with the cerclage ethibond (number 2) and then the keeping the fracture reduced the suture anchor fibres are secured with knotting. Fixation is stable hemostasis secured and wound closed in layers. Delto-trapezial fascia closed also the deltoid split. Sterile dressing was done. Shoulder immobilizer was applied postoperatively.

Rehabilitation protocol advised to our patients
Dressing change was done in the second Postoperative day. Suture removal done on POD 14. Shoulder immobilisation till 3 weeks. Range of motion activities started from the 4th week onwards. 4th to 5th week - Abduction and rotation, gravity eliminated. 6th week to 9th week - abduction, flexion and rotation against gravity. After 12 weeks repeat x ray were done to confirm the fracture union patient advised for gradual weight lifting. Return to intense activities was possible at the end of the third month. All patients were followed at postoperative months 3, 6, and 12 and underwent clinical and radiographic evaluation after 1 year.
Post-operative assessment of the joint was done at postoperative months 3 and 12 months using the Constant-Murley Shoulder Outcome Score (CMS). The Visual Analog Scale (VAS) questionnaire was used at every follow up to assess. During follow-up, complications including infection and malunion or nonunion (based on Zanca radiographic view) were evaluated. Loss of reduction and clavicular shortness were evaluated in each patient by measuring and comparing the side of fracture with the opposite side on follow-up radiographs.

Results
The age group of the study cohort ranged from 21 to 53 years and male: female ratio 5:1. A total of 11 patients with type II clavicle fractures were enrolled in our study (9 males, 2 females). Mean patient age was 43.1±8.5 years, and mean follow-up period was 25.3 months (range: 12–56 months). CMS scores for all 11 patients at 3 and 12 months postoperatively were 73.10±5.43 and 91.63±3.72, respectively. Mean time interval between injury and surgery was 12.22±5.21 days. No superficial infection was recorded in any patients. According to VAS scores, patient satisfaction was 8.15±1.18 at 3 months and 9.12±0.89 at 12 months. 8 patients were in excellent condition and 3 patients were in good condition at 12 months postoperatively. Mean duration of surgery was 57.25±10.41 min, and there was no significant relationship between CMS scores and duration of surgery (minutes per patient) (p=0.801 and p=0.779 for 3 months and 12 months, respectively). Mean time to union in our patients was 4.76±1.36 months. All the patients are doing extremely well and returned back to their normal level of activity. On radiographic evaluation bony union was observed in all cases.

Discussion
Clavicle is one of the common bones to be traumatically fractured. Most clavicle fractures can be successfully treated by nonsurgical methods. The treatment outcomes of the distal clavicle fractures depend on the bone displacement and injury to the coracoclavicular ligament which makes the fractures unstable. Type 1 injuries generally being stable without any displacement are managed conservatively with a sling to support the weight of the limb. Type 3 injuries are managed similarly which unites as such, but may lead on to AC joint arthrosis which will need surgical resection of the distal fragment. Type 4 is just a periosteal disruption in children and bone fills the periosteal sleeve resulting in union and remodelling. There are no clear management guidelines for type 2 and 5.

Fractures are classified based on those that involve or are distal to the conoid tubercle of the clavicle. The reason for this distinction is that fractures that are medial to the conoid tubercle can generally be treated like middle-third fractures, but those bone fractures lateral to the conoid present different management concerns and treatment requirements based on the intactness of the coracoclavicular ligaments.
Neer\(^1\) type II distal clavicle fractures without Coracoclavicular ligament injuries form a special group which are at high risk of complications such as nonunion or shoulder dysfunction due to conservative management. Nonsurgical treatment results in nonunion in 33.3% of cases and surgical treatment results in nonunion in 1.6% of cases as shown by Oh et al\(^5\). If the conoid part of coracoclavicular ligament is torn with fracture lateral to the conoid tubercle; then the distal part sags down with the medial end of the clavicle going up this id compounded by the pull of the trapezius, causing the coracoclavicular distance (CCD) to increase. Due to these issues there is a high risk of non-union if the fracture is managed conservatively\(^5\).

| Method of fixation          | Challenges                                                                 | Comments (6)                                                                 |
|-----------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------|
| 1. Distal clavicle plating  | Small lateral or distal end may not get adequate hold in the small fragment. | Less stability- may lead to nonunion or delayed union or may need longer period of immobilisation |
| 2. Plating that includes acromion | Acromioclavicular joint is spanned                                            | Excessive soft tissue dissection. Implant induced bursitis                   |
| 3. K-wires                  | Easy to finish the surgery                                                   | Very less stability.                                                         |
|                             |                                                                             | Force so great and large in this area – may lead to break down of k-wire.    |
|                             |                                                                             | No accurate reduction possible.                                              |
|                             |                                                                             | Loss of fixation and shoulder stiffness.                                     |
|                             |                                                                             | Implant migration.                                                          |
| 4. Hook plate               | Very good stability for very early mobilisation                            | Sometimes may slip from underneath the acromion and also acromion lysis (4) forcing for implant exit (7) |
| 5. Coracoclavicular screw   | Less dissection.                                                            | Needs C arm.                                                                 |

Fig 6: Anatomy of lateral end of clavicle

Fig 8: Type 2b fracture of lateral end of clavicle

Table 3: Fixation technique as advised by various authors and orthopaedic surgeons
Various treatment modalities have been described to treat these type 2 Neer fractures. Intramedullary Kwire fixation is a simple procedure. But K wire fixation has complications which include pin migration, infections and failure of fixation. Threaded pins is safer than with smooth pins for transacromial fixation, as the threading prevents pin movement. However, delayed complications of the acromioclavicular joint, such as arthrosis, still remain a concern. Scadden and Richards obtained good results from fixation using malleolar screws though their use for comminuted fractures or small distal fragments is limited. Hook plate fixation has been more effectively used in recent years, but due to subacromial impingement and rotator cuff tears a second surgery to remove the hardware is essential. Mersilene tapes were used to treat distal clavicle fracture by Chen et al. They reported anatomic locking plate combined with suture-endobutton for CC ligament reinforcement to be a reliable method to achieve osteosynthesis and stabilization in Neer type IIB distal clavicle fractures without compromising the physiology of the shoulder. Suture anchor fixation of distal clavicle fracture by closed reduction method or mini open method helps to preserve the biological process of fracture union and healing. This method has helped to achieve successful bony union with no surgical complications and there is no additional cost or re-surgery for implant removal or implant failure thereby preventing additional costs. The technique used in this study can provide favorable results in treatment of patients with distal clavicle fractures.

Conclusion
For unstable lateral end clavicle fractures stabilization with suture anchor is a safe, reliable management and less technically demanding mode of management with good results.

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