

## Surgical Management of Lateral End Clavicle Fracture

Dr. P. Ramesh Vyraavan - *M.S. Ortho, FAOI (Swiss), Registrar*

Dr. M. Mohan Kumar - *M.S.Ortho, FIGOF, Professor*  
*Sri Ramachandra Medical College, Porur, Chennai*

### I. Introduction:

Clavicle derives its name from Latin word Clavicula referring to the musical symbol of similar shape. Clavicle is called collar bone. It gives the curvature at the base of the neck without which cosmetically it is not better. Clavicle fractures are the most common in children. It is estimated that one in every twenty fracture is clavicle fracture. In fact 35 - 44% of shoulder girdle fractures are clavicle fractures. The importance of proximity to the vital structures in neck, thorax necessitates the early and proper treatment of these fractures. Clavicle forms diarthrodial joint with acromion in the lateral side as the medial side also. Has one primary centre for lateral end appearing usually on 45<sup>th</sup> day. Occasionally has a secondary centre at the lateral end appearing at 18 – 20 years but it rapidly fuses with the shaft. Lateral end of clavicle is usually more prominent than the medial end normally. Lateral end contribution to the growth is less when compared to the medial end. Lateral end has no physal plate at all.

Clavicle is almost a straight bone when looked from anteriorly. Bone mass of clavicle is defined as THICK COMPACTA. In transverse plane it resembles italic *S*. Lateral end has small curve compared to the medial side and also the lateral end is convex posteriorly. In cross section it is flat laterally. Lateral end has conoid tubercle on the posterior portion. Trapezoid line lies in an antero posterior direction just lateral to conoid tubercle.

Upper third of the trapezius inserts on to the superior surface in the outer third. Clavicular head of deltoid arises along anterior ridge in the superior surface of lateral third clavicle. Main nutrient artery enters the clavicle just medial to the coraco – clavicular ligament attachment in the distal third. The orientation is antero posterior orientation at the lateral end.

Lateral end clavicle fractures form around 4 – 15%<sup>1,2</sup> of all fractures, 21 – 25% of all clavicle fractures<sup>1,2,4,5,6,8</sup>. One of the most commonly used classification of lateral third clavicle fracture is Neer’s classification<sup>2</sup>(Table1). The muscle attachments play a major role in displacement. The weight of affected side upper limb and pull of the latissimus dorsi, pectoralis muscles and scapular rotations pull the distal fragments downward and the trapezius pulls the proximal fragment superiorly<sup>7, 8, 9</sup>. As distal third fractures are prone for displacement they usually result in malunion or nonunion<sup>9</sup> hence surgical stabilization is always the best to treat these types of fractures<sup>9</sup>.

Generally there is an opinion that clavicle fractures will heal without any surgical treatment. But now a days there are more complications like non union<sup>4</sup>, shoulder morbidity, late development of shoulder arthritis etc. This might be due to more publishing of articles about clavicle fractures including its surgical outcome. Hence clavicle fractures generally should be treated operatively for better outcome and better result for the patients<sup>4</sup>.

Also in distal third fractures we should consider the integrity of the coraco clavicular ligament which forms a major part in treatment planning. If coraco clavicular ligament is injured the displacement is more. It necessitates fracture fixation rather than non operative treatment.

Table 1 - Neer Classification of Lateral third

Type I	1)Fracture occurs lateral to coracoclavicular ligaments (trapezoid, conoid) or interligamentous 2)Usually minimally displaced 3)Stable because conoid and trapezoid ligaments remain intact
Type IIA	1)Fracture occurs medial to intact conoid and trapezoid ligament 2)Medial clavicle unstable 3)Up to 56% nonunion rate with nonoperative management
Type IIB	1)Fracture occurs either between ruptured conoid and intact trapezoid ligament or lateral to both ligaments torn 2)Medial clavicle unstable 3)Up to 30-45% nonunion rate with nonoperative management
Type III	1)Intraarticular fracture extending into AC joint 2)Conoid and trapezoid intact therefore stable injury 3)Patients may develop posttraumatic AC arthritis
Type IV	1)A physal fracture that occurs in the skeletally immature 2)Displacement of lateral clavicle occurs superiorly through a tear in the thick periosteum

	3)Clavicle pulls out of periosteal sleeve 4)Conoid and trapezoid ligaments remain attached to periosteum and overall the fracture pattern is stable
Type V	1)Comminuted fracture 2)Conoid and trapezoid ligaments remain attached to comminuted fragment 3)Medial clavicle unstable

**II. Materials and Methods:**

The study was a prospective study done between 2009 and 2014. We had 34 cases and after excluded cases there were 24 cases. History and clinical details were noted. X ray of the affected side clavicle in thoracic plane was taken. We excluded cases having cervical spondylosis, peri arthritis of the shoulder, frozen shoulder.

After the patient is fit the patient is operated. On table patient was put in beach chair position, lateral end of the clavicle and adjoining AC joint were exposed through an anterior incision centering over fracture site which is the standard Thompson incision<sup>15</sup>. Platysma divided and minimal soft tissue and periosteal dissection done. 3.5 mm reconstruction plate was placed over the clavicle in the superior aspect<sup>4</sup> and fixed with screws. The plate was contoured if needed. After that a suction drain was kept and wound closed layers.

Post operatively arm held in a sling and immobilized. Light activities like eating, writing allowed after third post-operative day as pain has subsided. Patient was discouraged doing heavy works like driving till radiological union is achieved<sup>9</sup>. X – Ray was taken every follow up which is 6, 12, 18 and 24 weeks intervals. Functional outcome is recorded using Constant and Murley scoring system. In our study we considered fracture union within 12 weeks as normal union and beyond that delayed union. Fracture is considered as nonunion if no union beyond 24 weeks. Radiological union is bony integration without any radiolucent line<sup>2</sup>.

Constant and Murley scoring system was followed because 1) it is one of the most widely used 2) Only scoring for shoulder validated 3) Can be used for shoulder assessment irrespective of diagnosis 4) The scoring system used both subjective and objective criteria 5) It uses day today activities to evaluate 6) Simple to understand and easy to use 7) Low inter and intra observer errors.

**III. Results:**

We had 24 cases and the most common age group is 20 – 40 years of age<sup>4</sup>. And second peak around 50 – 60 years<sup>2</sup>. We excluded 5 cases with cervical spondylosis, 4 cases with peri arthritis shoulder and 1 case with frozen shoulder<sup>2</sup>.

In our study most common mode of injury is road traffic accident and fall on an outstretched hand<sup>1, 9</sup>. Left side is more commonly affected which is 16 on the left side and 8 on the right side. Men more commonly<sup>1, 2</sup> had lateral third clavicle fracture that is 18 males and 6 females. Union rate is 90% which was seen around in 12 weeks<sup>15</sup>. The most common indication is displaced fracture ends. Other common indications are nonunion and comminution. The cases were graded as in table 2 after evaluating clinically and radiologically. In our series patients had associated injuries as in table 3.

SCORE	GRADE
81 – 100	EXCELLENT
61 – 80	GOOD
31 – 60	FAIR
0 – 30	POOR

Bone affected	Side	Number
Tibial shaft	Ipsilateral	1
	Contralateral	1
Forearm Both bones	Ipsilateral	1
Traumatic paraplegia		1
Femur shaft	Ipsilateral	1
	Contralateral	2
Pubic rami	Ipsilateral	2
Head Injury		1

The complications include shoulder restriction in 6, delayed union in 1, nonunion in 2, superficial wound infection in 2.

**IV. Discussion:**

We conducted a prospective study from 2009 – 2014. Totally 34 cases were collected and after applying the exclusion criteria we could get 24 cases. Even though there will be lot of clavicle fractures in this study period number of cases is less because lateral third clavicle fractures were also treated by other modalities and hence excluded.

We used a 3.5 mm reconstruction plate and placed it over the superior part of the bone. The difficulty we faced is proper position of the bone as the injured part is very near to the AC joint. Also while applying the screws we were extra cautious that the screws in the lateral aspect did not enter the joint. Apart from this we did not have any difficulty in performing the procedure in the cases.

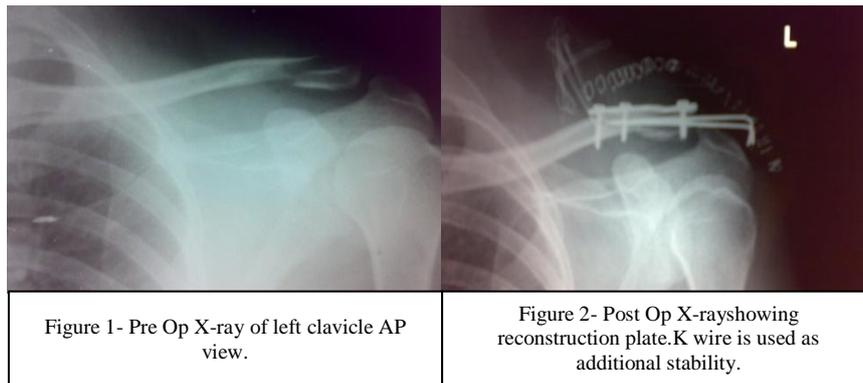
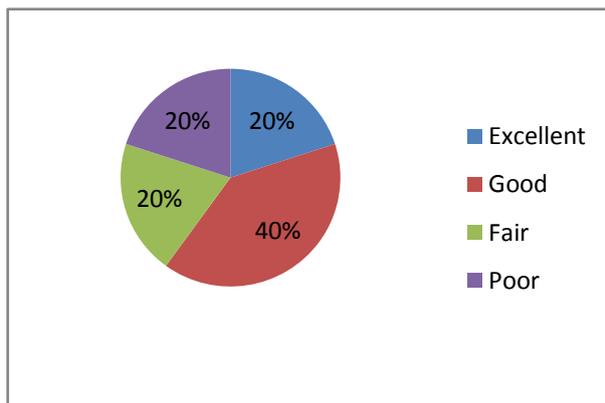


Figure 1- Pre Op X-ray of left clavicle AP view.

Figure 2- Post Op X-ray showing reconstruction plate. K wire is used as additional stability.

Table 5 – Outcome of our study.



In the post-operative period the operated side limb has to be rested till there is radiological union of the clavicle confirmed by the x ray taken in review visits. The 20% of cases which had radiological union at the end of twelve weeks<sup>9</sup> were encouraged heavy works like driving, lifting weights who were doing only light works like dressing, combing etc. They did not have any pain because of that works.

But the one patient with delayed union on taking X ray we found the fracture still visible and hence discouraged from heavy works. He was reviewed later on 18<sup>th</sup> week and x ray was taken and fracture found to be united and hence allowed to do heavy works. And we followed him at 24<sup>th</sup> week also and he had pain free movements.

We had two cases of superficial infections. They had pain and redness at the operated site and they were evaluated completely and started on appropriate antibiotics and the signs and symptoms subsided later giving relief to the patients. We had two cases of nonunion<sup>3</sup>. There was no fracture union at the fracture site in x ray with sclerosis of fracture ends which were closed. Hence both were operated and the plate was removed from both the patients and was replaced with another reconstruction plate and autologous bone grafting. Robinson et al<sup>14</sup> reported in their series that non operatively treated lateral end clavicle fractures have nonunion rate of 37% but we had 1%.

We had ipsilateral ACJ arthrosis in 6 patients at the end of 12<sup>th</sup> week. Flinkkila et al<sup>13</sup> in his series reported 30% patients had ACJ arthrosis but our series had 25%. They were given physiotherapy and symptomatic treatment. Three patients improved but 3 patients continued to have the pain and hence they were continued with the symptomatic treatment modalities and analgesics and the plate was removed at the end of 18 months. After that they did not have any pain. The outcome of our study is given in table 5. Recent studies have indicated that if fixation is good and if the fracture healing is satisfactory they can restore the acromio clavicular joint biomechanics and hence no repair of coraco clavicular ligament is needed<sup>9, 10, 11, 12</sup>. The plate fixation has given rigid internal fixation, immediate pain relief and can start using the limb early<sup>4</sup>. And the functions of the ipsilateral shoulder were normal in 80% patients.

### V. Conclusion

Good radiological union is seen around 12 weeks. Good clinical union is seen around 16 – 30 weeks. Due to deforming forces acting on both the ends fracture early plate fixation of distal third clavicle fractures is good option<sup>1, 9, 15, 16</sup> and hence it should be considered as a primary treatment modality. Pain subsided around seven to ten days post-operative period. Plate should be fixed to the superior part of the clavicle. If affected shoulder is affected after surgery it had shown good improvement with physiotherapy. Shoulder movements usually affected are abduction, internal rotation and flexion.

### Bibliography

- [1]. Fracture of Lateral end of Clavicle with Coracoclavicular Ligament Rupture Treated with Coracoclavicular Screw and Stainless Steel Wire-A Series of Eleven Cases, Pashupati Chaudhary ET AL, Health Renaissance, September-December 2010; Vol 8 (No.3);147-151
- [2]. Hook plate fixation for displaced Neer type ii, lateral clavicle fracture, Abdalla.S et al, AAMJ, vol. 10, n. 3, Sep, 2012, and suppl-1
- [3]. Hook plate fixation of acute displaced lateral clavicle fractures: mid-term results and a brief literature overview, Davut Tiren et al, Journal of Orthopaedic Surgery and Research 2012, 7:2
- [4]. Fractures of the Clavicle, By L.A. Kashif Khan et al, J Bone Joint Surg Am. 2009; 91:447-60
- [5]. Neer et al, 1984, JBJS-B, 1991, 73B, 291-4
- [6]. Chi - Hwa Chen et al, J of Trauma, Jan 2002
- [7]. Management of distal clavicle fractures, Ilias BISBINAS et al, Acta Orthop. Belg., 2010, 76, 145-149
- [8]. Locking plates for displaced fractures of the lateral end of clavicle: Potential pitfalls, Soha Sajid et al, J Shoulder Surg. 2012 Oct-Dec; 6(4): 126-129
- [9]. Precontoured Locking Plate Fixation for Displaced Lateral Clavicle Fractures, Sang Ki Lee et al, Orthopedics June 2013 - Volume 36 · Issue 6: 801-807
- [10]. Robinson CM, Akhtar MA, Jenkins PJ, Sharpe T, Ray A, Olabi B. Open reduction and endobutton fixation of displaced fractures of the lateral end of the clavicle in younger patients. JBone Joint Surg Br. 2010; 92(6):811-816.
- [11]. Lee KW, Lee SK, Kim KJ, Kim YI, Kwon WC, Choy WS. Arthroscopic-assisted locking compression plate clavicular hook fixation for unstable fractures of the lateral end of the clavicle: a prospective study. Int Orthop. 2010; 34(6):839-845 doi: 10.1007/s00264-009-0925-8
- [12]. Tan HL, Zhao JK, Qian C, Shi Y, Zhou Q. Clinical results of treatment using a clavicular hook plate versus a T-plate in Neer Type II distal clavicle fractures. Orthopedics. 2012; 35(8):e1191-e1197
- [13]. Flinkkila T, Ristiniemi J, Lakovaara M, Hyvönen P, Leppilahti J. Hook-plate fixation of unstable lateral clavicle fractures: a report on 63 patients. Acta Orthop. 2006 Aug; 77(4):644-9.
- [14]. Robinson CM, Cairns DA: Primary nonoperative treatment of displaced lateral fractures of the clavicle. J Bone Joint Surg Am 2004, 86-A: 778-782.
- [15]. Qingjun Liu et al, Surgical Treatment for Unstable Distal Clavicle Fracture with Micromovable and Anatomical Acromioclavicular Plate, International Journal of Medical Sciences, 2012; 9(4):301-305
- [16]. Olivier A. et al., Treatment of clavicle fractures: current concepts review, Journal of Shoulder and Elbow Surgery 2011, 1 - 7