



## A Prospective Study of Fixation of Lateral end Clavicle with Tension band Wiring

Authors

**Ramprasad Rallapalli, Ankur Mittal, Siva Prasad Y, Kumar Babu B.L.S.**

Dept. of Orthopaedics, Narayana Medical College & Hospital, Nellore-524003

Correspondence Author

**Dr. Ramprasad Rallapalli**

Assistant Professor, Dept. of Orthopaedics, Narayana Medical College & Hospital, Nellore-524003

Email: [drmahaboobvs@gmail.com](mailto:drmahaboobvs@gmail.com)

### Abstract:

**Background:** *Displaced lateral end clavicle fractures have high incidence of delayed union or non-union, hence several authors suggested operative management for these fracture. Adequate reduction and minimal soft tissue dissection during implant placement and early removal is ideal for these fractures. METHODS: 20 patients with displaced lateral end clavicle fractures were included in our study. The fracture were reduced by open reduction and fixed with 2 K-wires and additional TBW with SS wire. Implant removal was done after six months.*

**Results:** *All 20 fractures united. The mean average age was 27.5 years ranging from 20years to 55 years. The mean average time of union was 8.6 weeks ranging from 6 weeks to 14 weeks. All patients regained near normal range of motion and 15 patients had excellent constant murley score, 3 had good and 2 had fair results.*

**Conclusion:** *The clinico-radiological outcome of displaced lateral end clavicle fractures treated by K-wires with TBW is encouraging and comparable with earlier studies.*

**Keywords:** *Lateral end clavicle fractures, tension band wiring (TBW), Stainless Steel wire (SS wire).*

### INTRODUCTION

Clavicle fractures are one of the most common fractures encountered in orthopaedic practice. Previous epidemiologic studies suggest that clavicle fractures represent up to 5% of all adult

fractures and up to 44% of all shoulder girdle fractures<sup>[2-4]</sup> The incidence of injury also is characterized by bimodal age distribution with peak under age 40yrs. With respect to the incidence of different fracture types, fractures of

middle third of the clavicle are most common accounting for 69% to 81%. The second most common type is fracture of lateral or distal third of clavicle, accounting for 16% to 30%. Less than 3% of all clavicle fractures are fractures of medial or proximal third of the clavicle<sup>[2-4]</sup> Clavicle fractures are often treated conservatively. However, lateral end fractures need special attention, more so with the displaced variety Neer in 1968 classified distal clavicle fractures according to the location in relation to the coraco-clavicular ligaments. Type 1 fractures are stable fractures are stable fractures located lateral to coraco-clavicular ligaments. Type 2 fractures are complex unstable fracture dislocation which leaves the distal end of clavicle and the AC joint untouched, separating the clavicle from the underlying coraco-clavicular ligament complex through a vertical or oblique fracture line.

Type 3 fractures are intra-articular fractures of AC joint. The deforming forces acting in the lateral end clavicle makes the lateral end mobile and prone for non-union leading to loss of terminal loss of abduction. There are studies which shows high rate of delayed union and non-union in displaced lateral end clavicle (Neer's Type 2 fractures).<sup>[1,7,15]</sup> Nonunion of the lateral end of the clavicle is painful and several authors have recommended open reduction and internal fixation for type 2 fractures of the distal clavicle because of their tendency to slow healing and residual shoulder disability. Several authors recommended operative treatment for displaced lateral end clavicle fractures and reported good clinical and radiological outcomes with few complications.

Many surgical methods have been introduced for treatment of displaced lateral end clavicle fractures like K-wire fixation, TBW, hook plate, Bosworth coracoclavicular screw, Knowles pin etc. But still there is no gold standard treatment for displaced lateral end clavicle fractures.

In view of these considerations, the present study is of Surgical Management of Displaced Lateral End Clavicle Fractures with minimal soft tissue dissection using K-wires and Tension band wiring.

## MATERIALS AND METHODS

This was a prospective study of twenty patients presenting to orthopedics department of a teaching medical college in Nellore, India from May 2012 to March 2014 with displaced lateral end clavicle fractures were included. The current study has been taken ethical clearance by Narayana Medical College & Hospital Ethics Committee, Nellore, PSRR district.

### Inclusion Criteria

- Neer's type 2 displaced fracture
- Less than three weeks duration
- Adults from 20 to 60 years
- controlled medical comorbidities

### Exclusion Criteria

- Children
- Uncontrolled associated comorbidities

All Patients were followed for a period of 6 months at 1<sup>st</sup> month, 3<sup>rd</sup> month and 6<sup>th</sup> month

Pre-operative assessment was made by X-ray AP view for all patients.

**Position:** Supine with sand bag under the medial

border of scapula

**Anaesthesia:** Interscalene block

### **Surgical technique**

A small incision of about 3cms was made antero-superiorly centering over the fracture site. Cautey dissection was carried out to minimize bleeding from the subcutaneous plane onwards. Every care was taken not to disturb acromioclavicular ligaments. The fracture site was visualized and the hematoma was curetted and washed. Retrograde two 2.0mm Krischner wires was passed through the fracture site coming out from the lateral end of clavicle and then fracture was reduced and k wires passed to the medial fragment. Reduction was checked with an image intensifier. An anteroposterior drill hole was made with 2mm drill bit on proximal part of the fracture. A stainless steel wire was passed through the hole. The 18 gauge SS wire was tied in a figure of eight manner keeping the knot superiorly around the K-wires. The K-wires were bent and buried inside the skin. The wound was irrigated with saline and closed in layers over drain.

Postoperative:

- The arm was supported in an arm pouch for six weeks.
- Pendulum exercises were commenced from the third postoperative day.
- Passive flexion and extension and abduction up to 90 degree was started from the fifth post operative day.
- After suture removal i.e. 10<sup>th</sup> day complete abduction was allowed.
- Implant removal done routinely after 6

months post op as patient experienced significant discomfort in terminal abduction but after removal patient had no discomfort later.

- Clinico-radiological follow-up was done in 1<sup>st</sup> month, 3<sup>rd</sup> month and 6th month

We confirmed union with plane radiographs, anteroposterior view of shoulder. Cortical continuity in cortices, medullary cavity reconstitution, no increase in fracture line gap in consecutive radiographs, and a nontender fracture site clinically were considered evidence of union at fracture site

## **RESULTS**

### **Age Distribution**

Most of the patients present in the range of 20 -55 years. The average age was 27.5 years (**Table no. 1**)

### **Gender**

Out of 20 patients operated 5 were women and remaining 15 were men.

### **Affected Side**

Right side clavicle fracture was seen in fifteen patients and five patients had left side involvement.

### **Mechanism of Injury**

Out of 20 patients, 8 fractures occurred on fall on outstretched hand, 9 were as a result of road traffic accidents (RTA), and 3 due to fall on shoulder. (**Table no 2**)

### **Time from Injury to Surgical Intervention**

Time period from injury to surgical intervention ranges between 2 to 5 days

### **Status of Associated Lesions at the Time of**

**Surgery and their management:**

One patient had an associated ipsilateral dislocated shoulder which required closed reduction under anesthesia and five patients had additional ipsilateral multiple rib and a scapula fracture which were treated conservatively. One patient had associated acromia-clavicular joint dislocation for which transacromian k wire

fixation was done with TBW. All 20 fractures united. The mean average time of union was 8.6 weeks ranging from 11 weeks to 14 weeks. All patients regained near normal range of motion and 15 patients had excellent constant murley score, 3 had good and 2 had fair results. (Table. 3)

**Table. 1.** Age Distribution

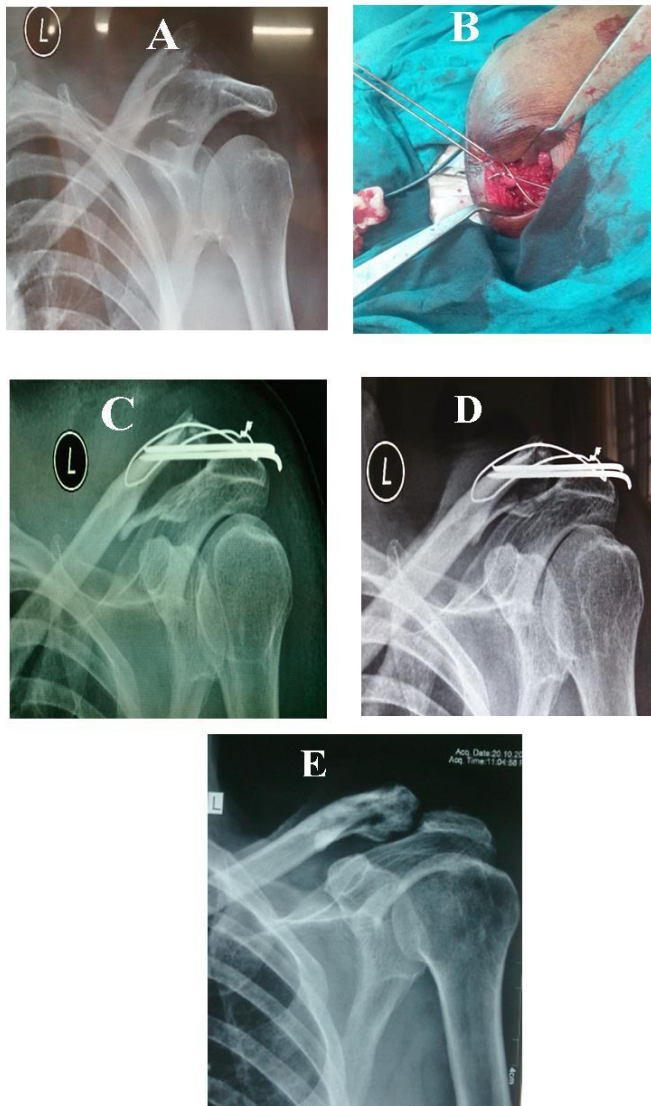
Age	No. Of Cases	Percentage
0-20	1	5
21- 40	16	80
41-60	3	15

**Table. 2.** Mode Of Injury

Nature	No. Of Cases	Percentage
Fall on an outstretched hand	8	40
RTA	9	45
Fall on shoulder	3	15

**Table. 3.** Constant Murley Score

Results	No Of Cases	Percentage
EXCELLENT	15	75
GOOD	3	15
FAIR	2	10
POOR	NIL	NIL



**Figure.1.** A. Pre-operative X-Ray, B. Intraoperative Photograph, C. Post-operative X-Ray, D. Follow-up X-Ray-6weeks, E. X-Ray after implant removal.

### COMPLICATIONS AND THEIR MANAGEMENT

- In our study two patients had K-wire back out without loss of reduction, which is managed by early implant removal.
- Skin impingement with bent Kirshner wires was noted in four cases
- No wound related complications like infection was noted.

Return to sporting activities was only allowed after clinico-radiological union.

### DISCUSSION

Clavicle fractures are one of the most common fractures encountered in orthopaedic practice. Previous epidemiologic studies suggest that clavicle fractures represent up to 5% of all adult fractures and up to 44% of all shoulder girdle fractures.<sup>[2-4]</sup> The incidence of injury also is characterized by bimodal age distribution with peak under age 40 yrs. With respect to the incidence of different fracture types, fractures of middle third of the clavicle are most common accounting for 69% to 81%. The second most common type is fracture of lateral or distal third of clavicle, accounting for 16% to 30%. Less than 3% of all clavicle fractures are fractures of medial or proximal third of the clavicle. Neer in 1968 classified distal clavicle fractures according to the location in relation to the coraco-clavicular ligaments.<sup>[7]</sup>

Neer original series of clavicle fractures observed unusually high rate of non-union or delayed union in displaced lateral third clavicle.<sup>[1]</sup> The rotational movement that occurs at the acromioclavicular joint is transferred to the fracture site, making the fracture going to nonunion.

So Neer suggested operative stabilization for displaced lateral end clavicle. He showed successful results with K-wire fixation with few complications.<sup>[7]</sup>

Consequently, various surgical modalities have been advocated with various techniques of fixation with better outcomes. But still there is no



gold standard method of fixation for displaced lateral end clavicle. Gaining control over such rotational movement with some sort of semi rigid to rigid fixation would prevent non-union.

Coracoclavicular reconstruction is generally not required as the ligaments are intact and attached to the distal clavicle.

Anatomical alignment and prevention of rotation will suffice for such fractures to unite. In view of these consideration our method is a minimally invasive with 2 K-wires and tension band wiring with SS wire, where tensile force is converted into compressive force.<sup>[30]</sup> We routinely remove Kirschner wires around six months by the time fracture become sticky and due to its intramembranous nature of ossification, union takes place if a conducive environment is provided. So early implant removal eliminates the complications like wire breakage which is shown in LaxmanRijal et al.<sup>[30]</sup>

With our method, minimal dissection is required to reduce the fracture. K-wires are passed through the fracture site to lateral end of clavicle and then passed to the medial end to hold the fracture in an anatomical position and compression at fracture site is given by tension band wiring. We keep the limb supported in an arm pouch for six weeks to make the patient aware that their shoulder needs protection and secondly, the stress exerted by hanging the limb is guarded. Both these facts minimize undue stress at the healing bone. Results of our method of fixation are encouraging with this small cohort study of 20 patients and comparable with other studies like LaxmanRijal et al.<sup>[30]</sup>.

Neer reported 100% union with Kirschner wire fixation and suggested displaced fractures should be stabilized for better results.<sup>[7]</sup> Kona et al reported 52.6% success rate with Kirschner wires and reported complications like loosening of K-wires, migration, undue stress during active mobilization, back out, and breakage.<sup>[11]</sup> Stabilization with a clavicular hook plate has yielded a success rate of up to 88% and 12% nonunion in a series of 18 patients by Tambe et al.<sup>[37]</sup>

Acromiosteolysis has also been reported in a 30% with hook plates. However, Lee et al<sup>[38]</sup> described the advantageous role of hook plate fixation in comparative study between role of hook plate and tension band. Anderson et al<sup>[40]</sup> reported 94% union rate with pre contoured superior locking plate for displaced distal clavicle fractures. Peri-implant fracture has been reported in one case and infected non-union in the other.

Levy<sup>[22]</sup> described single figure eight suture fixation with PDS suture with a success rate of 100%. Though alignment is secured, rotational stress during mobilization may awaken suture fixation. Their technique has been modified by Badhe et al,<sup>[27]</sup> that consists of two figure-eight sutures with non- absorbable polyester. Our method of fixation allows stable fixation with two Kirschner wires and figure of eight suturing with SS wire which provides compression at the fracture site. Early removal of implant allows active mobilization without the fear of implant related complications. Though we encountered two cases of K-wire back out around 12 weeks without the loss of reduction, we removed the K-

wires at 12th week and supported the limb in arm pouch and the union occurred around 14th week for that two cases.

In our study males are more commonly affected (87%) than female which is compared to LaxmanRijal et al<sup>[30]</sup> and Chi- Chuan Wu.<sup>[31]</sup> In our study 4 cases had associated rib fracture (27%) which is compared to Faisal Qureshi et al who showed 10% associated rib fractures.<sup>[40]</sup>

In our study most common mode of injury is fall with an out stretched hand (53%), RTA (27%) which is compared to Robinson who showed simple fall (25%), RTA (29%).<sup>[41]</sup> In our study we achieved 95% union in all cases which is compared to Neer who reported 100% union with K-wires,<sup>[7]</sup> Kona et al showed 52.6% union<sup>[11]</sup> and Yih-Shiunn Lee et al showed 95% union with tension band wires.<sup>[28]</sup>

Advantages of our techniques are:

1. Cost effective
2. Technically less demanding than hook plate
3. Good surgical outcome

Disadvantage

1. Implant removal is must
2. Prominence of k wires in lean patients

## CONCLUSION

Lateral end clavicle fractures are the second most common clavicle fractures encountered in orthopaedics practice which accounts 16% to 30%. The deforming forces and the rotational movements acting in the clavicle is the reason for the displacement of the fragments which is the

reason for delayed or non-union. Hence the displaced lateral end clavicle fractures necessitate fixation. Anatomical alignment and prevention of rotation will suffice for such fractures to unite. Our method is a minimally invasive with 2 K-wires and tension band wiring with SS wire, where tensile force is converted into compressive force which helps in fracture union. Full active mobilization is not allowed with the implants. Early implant removal as soon as there is a radiological signs of union may minimize implant related complications.

To conclude the clinical and radiological outcome with two K-wires and Tension band wiring with SS wire for displaced Neer Type 2 lateral end clavicle fractures were encouraging.

## CONFLICT OF INTEREST

None of the authors has any conflict of interest.

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