

A Prospective Study On Functional Outcomes Of Displaced Lateral End Clavicle Fracture Treated With Open Reduction Internal Fixation With Tension Band Wiring.

Dr. Prasanta Das¹ (Associate Professor), Dr. Ashraf Alom² (PGT)

¹Department of Orthopaedics, Gauhati medical college and hospital, India

²Department of Orthopaedics, Gauhati medical college and hospital, India

Abstract:

Background: The clavicle is a subcutaneous bone which lies almost horizontally at the root of the neck, it is a crank-shaped cantilever that carries the scapula, so enabling the limb to swing clear of the trunk. It transmits part of the weight of the limb to the axial skeleton¹. The clavicle fractures are common injuries in young, active individuals, especially those who participate in activities or sports where high speed falls (bicycling, motorcycles) or violent collisions (football, hockey) are frequent, and they account for approximately 2.6%-4% of all fractures of the body and around 44% to 66% of fractures about the shoulder². Lateral end fractures need special attention, more so with the displaced variety. 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. 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 disability³. Many surgical methods and modalities have been introduced for treatment of displaced lateral end clavicle fractures over the years, Like K-wire fixation, Tension Band wiring, Lock plate, hook plate, Bosworth coracoclavicular screw, Knowles pin etc. But still there is no uniform consensus regarding the gold standard treatment for displaced lateral end clavicle fractures.

Aim and Objectives- Aim of study is to assess the functional outcome of displaced lateral end clavicle fracture treated with open reduction internal fixation with tension band wiring.

Materials and methods- This was a prospective study of 15 patients presenting with displaced lateral end clavicle fracture in the department of orthopedics, Gauhati Medical college and Hospital, Assam, India. which are treated with ORIF with TBW, during period of March 2021 to March 2022 and followed up for 6 months. Functional outcome were followed up using constant Murely Score and radiological outcomes using serial X-rays.

Result- Of the 15 patients, The age ranged from 26 to 56 years (mean 42 years). Maximum belonged to the age group of 31-40. This type of displaced lateral end clavicle fracture was more common in male than female. 15 out of 15 fractures united thus we achieved union in 100% patients. Overall average union time was an average of 12.53 weeks (range 10-16 weeks). At the end of 6 months post-operatively all patients attained almost normal range of motion. Out of 15 patients, 6 had excellent constant Murely score, 9 had good results.

Conclusion- The functional and clinical outcome of displaced lateral end clavicle fractures treated with TBW is promising and comparable with earlier studies.

Key words- ORIF (open reduction internal fixation), TBW (tension band wiring).

Date of Submission: 07-03-2023

Date of Acceptance: 20-03-2023

I. Introduction

The clavicle is a subcutaneous bone which lies almost horizontally at the root of the neck, it is a crank-shaped cantilever that carries the scapula, so enabling the limb to swing clear of the trunk. It transmits part of the weight of the limb to the axial skeleton¹. The clavicle fractures are common injuries in young, active individuals, especially those who participate in activities or sports where high speed falls (bicycling, motorcycles) or violent collisions (football, hockey) are frequent, and they account for approximately 2.6%-4% of all fractures of the body and around 44% to 66% of fractures about the shoulder². Middle third fractures account for 80% of all clavicle fractures, whereas fractures of the lateral and medial third of the clavicle account for 15% and 5%, respectively⁴. The Clavicle fractures are often treated conservatively. However, lateral end fractures need special attention, more so with the displaced variety. 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. 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 disability⁴. Many surgical methods and modalities have been introduced for treatment of displaced lateral end clavicle fractures over the years, Like K-wire fixation, Tension Band wiring, Lock plate, hook plate, Bosworth coracoclavicular screw, Knowles pin etc. But still there is no uniform consensus regarding the gold standard treatment for displaced lateral end clavicle fractures.

Tension band wire fixation for distal end clavicle fractures are commonly done procedures, which is simple, involves less soft tissue dissection and is cost effective but comes with considerable risks for complications, especially loss of reduction, k wire back out, pin prominence, pin migration and skin ulceration due to pin irritation⁵.

II. Materials and method

This prospective study was carried out in the patients with displaced fractures of lateral third clavicle, attending the Orthopaedics OPD and the Emergency Department at Gauhati Medical College and Hospital, Guwahati, Assam, India. from March, 2021 to March, 2022, aged between 20 to 60 years of both sexes who met the inclusion criteria. The patients were treated operatively using Tension band wiring with K-wire and SS wire. Subsequently these patients were followed up regularly and clinical as well as radiological outcomes were evaluated. An informed consent was obtained from each patient after discussing the procedure prior to participation in the study.

Sample size – 15 patients.

Study Type- This study is a prospective study

Methods of collection of data –

Inclusion criteria-

- Patients with displaced fractures of the lateral 1/3rd of clavicle (Neer type II).
- Only Closed fractures of the lateral 1/3rd of clavicle.
- Only those patients who gave consent were included in the study.
- Patients between 20 and 60 years of age.
- Duration of injury <14 days.
- Without neurovascular deficit of the affected limb.
- Patients having near normal daily activities prior to the injury.
- Patients who fit for routine elective surgery.

Exclusion criteria-

- Patients who did not give consent.
- Patients aged <20yrs and >60yrs.
- Open fractures.
- Undisplaced fractures.
- Patients with ipsilateral upper limb injury
- Duration of injury ≥15days.
- Doubtful distal neurovascular status of the affected limb.
- Medical contraindications for surgery/anaesthesia.

Ethical clearance - The Institutional Ethical clearance obtained prior to the initiation of study.

Initial Work Up-

All the patients in this study were admitted either through out-patient department or through emergency department of the college. On receiving the patient, initial symptomatic treatment and a detailed history of the patient in regard to age, sex, socio-economic background, duration & mode of injury, previous illness or treatment, was taken as per the proforma. All details of the participating patients were recorded. A thorough clinical examination was carried out to exclude any associated injury & other medical and surgical illness which may require necessary treatment. The patients profile was studied in terms of age, sex, mode of injury, side involved, any other associated injury or any co-morbid state like diabetes mellitus, ischemic heart disease, Hypertension, Thyroid disorders etc. Injured limb was examined thoroughly for any other fractures, distal neurovascular status. The limb is initially supported with an arm sling. Initial radiographs were then advised taking antero-posterior view of clavicle including shoulder joint. Radiographs were examined for location of the fracture, displacement of fragments, comminution etc. Patient and the family members were then explained about the nature of the fracture, prognosis of non operative and operative treatment and also regarding the need for open reduction and internal fixation. An informed consent was obtained from each patient prior to participation in the study.

Preoperative evaluation-

All the patients was examined in detail and worked up to obtain pre-anaesthetic clearance with the following investigations as listed:- Hb%, TLC, DLC, Platelet count, RBS, Creatinine, Sodium, Potassium, PT with INR, TSH, viral marers, Chest X-ray PA view and ECG. Clinical and radiological parameters recorded.

Surgical technique:- The skin and the subcutaneous layer are developed, cautery dissection was carried out to minimize bleeding and the delto-trapezial myofascial layer is incised directly over the distal clavicle and reflected anteriorly and posteriorly. The AC joint is identified. Every care was taken not to disturb acromioclavicular ligaments. The fracture site is identified and cleaned of debris and hematoma. After reduction tension band wire fixation was performed through the acromioclavicular joint or transacromially with 2 parallel K wires and the 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 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 soft tissue . After being certain of a stable fixation the wound is closed in layers. Following dressing an arm sling pouch is applied.

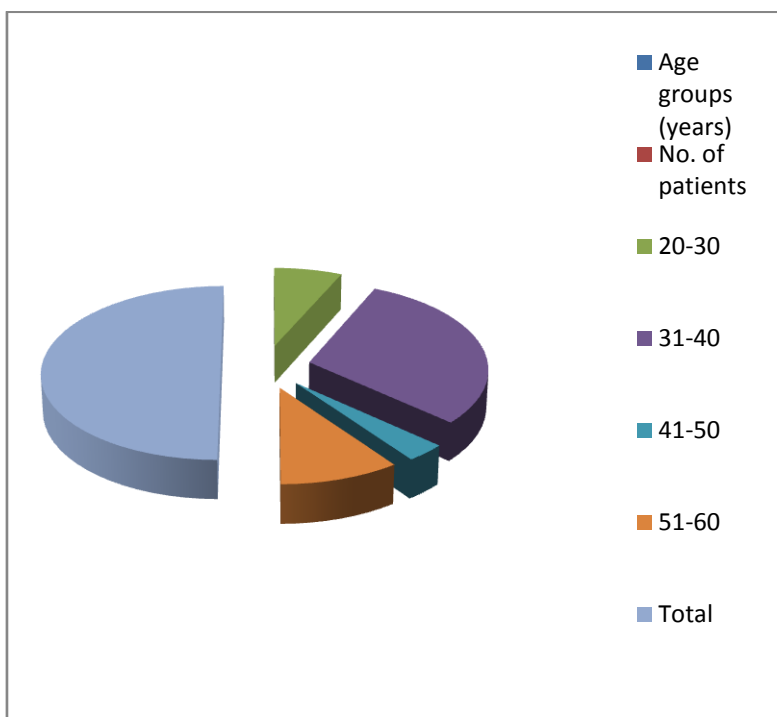
III. Results

During the period from March, 2021 to March 2022, we came across 20 cases of displaced lateral third clavicle fractures. Of them 5 cases were excluded from the study, as they didn't met with the inclusions criteria. All the patients were followed up for a minimum period of six months and. Follow up was carried out at 2nd and 4th week then 4 weekly interval for first 6 months. Final assessment was done at the end of 6 months from the date of operation in all the cases.

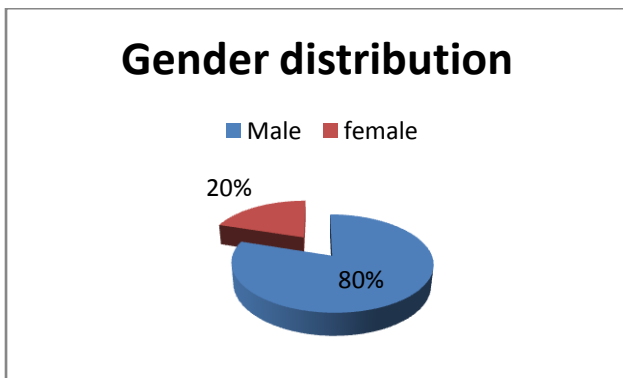
The observations in our study were as follows:

Age distribution- Of the 15 patients, the age ranged from 26 to 56 years (mean 42 years). Maximum belonged to the age group of 31-40.

Age groups (years)	TBW	
	No. of patients	%age
20-30	2	13.33%
31-40	9	60%
41-50	1	6.66%
51-60	3	20%
Total	15	100%



Sex distribution- Out of 15 patients, 12 male and 3 female patients were in the study. Male predominance is seen due to more outdoor activities and travelling.

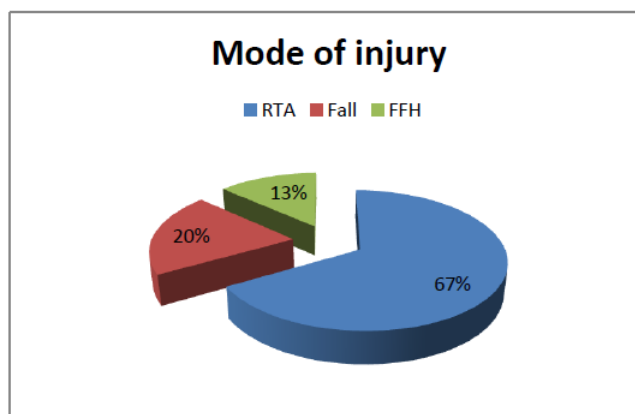


Gender	No of patients	Percentage
Male	12	80%
Female	3	20%
total	15	100%

MODE OF INJURY:

The commonest mode of injury was RTA (Road traffic accident) followed by Fall, RTA comprises of 66.66% of patients while 23.33% of patient had simple fall, 10% of patients had fall from height.

Mode of injury	No. of patients	Percentage
RTA	10	66.66%
Fall	3	20%
Fall from Height	2	13.33%
Total	15	100%



Union Time:

Radiographic union was defined as evidence of bridging callus across the fracture sites or the obliteration of the fracture lines. 15 out of 15 fractures united, thus we achieved union in all 15(100%) patients treated with TBW. Overall average time of union was 12.53 weeks (ranging from 10week to 16 weeks).

Range Of Motion :

Passive mobilization was allowed from the first week postoperatively and gentle active movements are encouraged. Among the movements, Shoulder flexion and abduction are significant and thus are considered here:

A) Shoulder abduction-

Patients were assessed at 6th month and they were instructed to do the extremes of movements possible for them.

In our study we found average shoulder abduction of 142.67 degree.

B) Shoulder flexion:

In our study we found average shoulder flexion of 140 degree in patients treated with TBW

Functional Result:

At the end of 6 months of follow up, the final results were evaluated using the shoulder scoring system of Constant and Murley⁶.

Grading of the Constant Shoulder Score is done by taking the difference between affected and unaffected side as follows:

Difference between the affected and unaffected side	Grades
<11	Excellent
11-20	Good
21-30	Fair
>31	Poor

The mean Constant Score was 86.66 on the affected side.

Functional results:

Modality/Function	Excellent	Good	Fair	Poor
TBW	6	9	0	0



K Wire migration in TBW case

IV. COMPLICATIONS

In our study, there was no documented mortality. There were also no systemic complications from the performed operative procedure. The complications were like- 3(20%) cases of K-wire migration and 1(6.6%) case of pin prominence. The complications appeared early at the end of 3rd month. However in our studies K-wire migration did not result in loss of reduction.

Thus 4 patients (26.66%) had complications.

Table: complications:

	Complications	TBW	
		No. of cases	%age
1	K wire migration	3	20
2	Pin prominence	1	6.6

V. DISCUSSION

It is well acknowledged that displaced lateral end clavicle fractures require internal fixation. Although a wide range of lateral end clavicle fixation devices have been employed over the years, still there is controversy regarding the best fixation method for displaced lateral end clavicle fractures. The successful treatment of displaced clavicle lateral end fractures depends on various variables, such as the patient's age, general health, and the time between the fracture and treatment, Comminution, type of implant used, concurrent medical treatment. Sufficient knowledge regarding the biological and biomechanical principle of the available methods should be obtained, as each methods have advantages and disadvantages.

Although fixation with K wires and applying a tension band is an age old technique for distal clavicle fracture it has many disadvantages. This technique is usually done extra-acromially but sometimes the distal fragment will be so small or comminuted that trans-acromial tension band wiring has to be done. Usage of this technique needed no severe soft tissue stripping and no heavy hardware has to be inserted. If not applied trans-acromially AC joint also can be spared. K-wire migration, pin prominence, loss of reduction are significant concern^{3,7,8}.

The current study was undertaken to asses the functional outcomes in cases of tension band wiring in displaced fractures (Neer type II) of lateral third clavicle. The Study also aimed at recognizing and quantifying the various complications that may come along with the Tension Band Wiring or the surgical procedure itself or post operative damage the implants can inflict.

We regularly assessed the patients after the operation and final assessment was done 6 months post operatively for all patients. It was conducted at the Department of Orthopedics of Gauhati Medical College & Hospital, Guwahati, Assam, India.

Age Distribution:

All the patients were between 20-60 years of age, the mean age was found to be 42 years. This is comparable to the other previous studies .

Sex Distribution:

In our study the gender distribution for the group of fracture lateral end of the clavicle was 80% male and 20% female. This is almost comparable to previous studies like that of **Rallapalli Ramprasad et al**⁵. The predominance of male patients is due to the fact that males are more involved in outdoor activities and activities concerning numerous hazards. Hence injury sustained by them is more and are also far more severe than the female population in our society.

Mode Of Injury:

Referring to the mode of injury in our study, RTA comprised of 66.66% (10 out of 15) patients, while 20% (3 out of 15) patients had simple fall, 2 patients (13.33%) had fall from height. Thus it is seen that in our study the principal mode of injury was RTA followed by fall. In the study by **Rallapalli R et al**⁵ found RTA to be the mode of injury in 45% of their patients tallying our result.

It is seen that studies from different geographical areas have difference in the mode of injury and is probably due to difference in the population distribution involved in various day to day activities.

Fracture Union:

Fracture union in our study was found to be 100 %. Radiographic healing was defined as evidence of bridging callus across the fracture sites or the obliteration of the fracture lines. The overall average time was 12.53 weeks (Ranging from 10-16 weeks) It is uniformly seen in studies, that the follow up pattern is such that patients are evaluated radiologically 4weekly and union occurs between 8 and 12 weeks following operation.

Functional Results:

Grading of the Constant Shoulder Score is done by taking the difference Between affected and unaffected side. In our study at the end of 6 month post operative , 6 cases out of 15 patient had Excellent outcome and 9 patient had good functional outcomes. One of study conducted by **Ramprasad Rallapalli et al**⁵ they found that there are significant amount of complications in patient treated with TBW for displaced lateral end clavicle fractures. Most of the literature compared the outcome in term of scoring values and have not graded them.

Complications:

In our study, the major complications encountered were 3(20%) cases of K-wire migration. And 1(6.6%) case of pin prominence. In our study, although had high union rate (100%), frequent complications (26.66%) were noted. In our series, K-wire fixation with an additional cerclage wire tension band was used to achieve more stability. Although, there are 3 cases of K-wire migration but none resulted in loss of reduction. Probably use of threaded pins could have addressed pin migration. In TBW group, K-wire migration occurred more frequently in older population subgroups probably due to osteoporosis. At the earliest documentation of K-wire migration, we restricted mobilization till union to prevent further migration which would result in loss of reduction.

VI. CONCLUSION

From this prospective study conducted on 15 patients with displaced fractures of lateral third clavicle we came to the following conclusion:

Although clavicle fracture is quite common, displaced fractures of the lateral clavicle is relatively less common.

Displaced fracture of lateral end clavicle is highly unstable and requires operative fixation.

Non operative treatment results in significant number of non-union and delayed union cases. Gravity of prognosis of which was realized only in the last few decades.

Open reduction and internal fixation should be the treatment modality of choice.

In terms of final functional outcome TBW (with K-wire and SS wire) has high union rate and with more complications also . This study indicates that early surgical fixation coupled with adequate post-op physiotherapy protocol is the key to offer best results to the patients. Considering the limitations, we recommend further studies comprising of larger sample and of longer follow up to establish the clinical utilities in the management of displaced lateral third clavicle fractures.

As soon as there are radiographic confirmation of union, an early implant removal may help to reduce implant-related problems. In conclusion, the clinical and functional results for displaced Neer Type 2 lateral end clavicle fractures treated with two K-wires and tension band wiring with SS wire were promising.

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Dr. Prasanta Das, et. al. "A Prospective Study On Functional Outcomes Of Displaced Lateral End Clavicle Fracture Treated With Open Reduction Internal Fixation With Tension Band Wiring." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 22(3), 2023, pp. 51-57.