INTRODUCTION

15% of all clavicle fractures involve the lateral end of the bone.¹,² These fractures are unstable because of four displacement forces that prevent the union, which are linked to the destruction of the coracoclavicular ligaments. Surgery is advised for unstable distal clavicular fractures because the non-union rate is about 30%, resulting in discomfort and reduced shoulder girdle and upper limb function. To treat these injuries surgically, clavicle hook plates are currently accepted. This study analyses the results of clavicle hook plates compared with the literature. We will be analyzing the results based on clinical outcomes and radiological assessment to ascertain the efficacy of this procedure. The aims and objectives are to study fracture union clinically and radiologically in lateral end clavicle fractures, to evaluate the functional outcome of the clavicle hook plate for fractures of the lateral end of the clavicle, to assess functional outcomes in terms of shoulder range of movements, Complications associated with implant failure. Materials and Methods: This study is a descriptive analysis approved by the Institution Review Board and the Ethic Committee to evaluate the results of hook plate fixation for fractures of the lateral end of the clavicle. 1st November 2020 to 31st May 2022. Result: Thirty-two patients were followed prospectively from November 2020 to May 2022, of which 25 were males, and 7 were females. Eighteen patients returned to pre-injury status at a mean of 53.5 weeks (24-104 weeks). Six patients returned to pre-injury level at six months, two at nine months, and four at 12 months of surgery. Though the remaining four patients returned to work within one year, returning to pre-injury took 1 ½ to 2 years. Conclusion: A hook plate is a good option for the treatment of unstable lateral end clavicle fractures.

Biomechanism of Fracture of the Lateral end of Clavicle: A lateral impact force on the shoulder's point is the cause of the injury. Displaced fractures are caused by more significant trauma, like a fall from a height, a car accident, or a brutal hit. Displacements are secondary to four displacing forces.

The weight of the arm.
The pull of pectoralis major, pectoralis minor, and latissimus dorsi.
The scapular rotation affects the distal segment.

Trapezius muscle, which draws the medial part posterior and superior

Incidence
About 10% to 20% of all clavicle fractures are lateral one-third fractures.³ Another study found a higher
prevalence of 21% to 28%, with the initial and highest peak incidence occurring in males under 30. Neer found a 10% prevalence of concomitant head and neck injuries among patients with distal clavicle fractures. Coracoid and first rib fractures, lung injury, brachial plexus injury, and subclavian vein injuries are possible additional findings.[7-9]

**Treatment Options**
The following are surgical indications for a lateral end clavicle fracture:

**Early:**
1. Double disruption of the shoulder suspensory complex
2. Fracture in a young active person
3. Athlete
4. Manual laborer

**Late:**
1. Symptomatic nonunion
2. Symptomatic malunion
3. AC joint arthritis

**Aims and Objectives**
1. To study fracture union clinically and radiologically in lateral end clavicle fractures
2. To evaluate the functional outcome of the clavicle hook plate for fractures of the lateral end of the clavicle
3. To assess functional outcomes in terms of shoulder range of movements.

**MATERIALS AND METHODS**

This study is a descriptive analysis approved by the Institution Review Board and the Ethic Committee to evaluate the results of hook plate fixation for fractures of the lateral end of the clavicle.

**Inclusion Criteria**
- Patients with lateral end clavicle fracture
- Patients with an age group of 18-60 years

**Exclusion criteria**
- Patients of age less than 18 years and more than 60 years
- Patients who had open fractures
- Patients who had associated brachial plexus injury
- Patients who had associated acromioclavicular joint disruption
- Severely ill patients

**Methods**

This study is a descriptive analysis of patients from 1st November 2020 to 31st May 2022. We reviewed all patients who fit our criteria and had undergone surgery with our local customized hook plate and in our hospital.

1. All patients were either from the Out-patient department or Emergency
2. Preoperative shoulder X-rays in AP and Axillary view were taken.
3. The injuries were classified as per the inclusion criteria.
4. All surgeries were performed in a specified manner
5. A locally available hook plate was used.
6. Specified postoperative protocol was followed for all patients.
7. One examiner measured the outcome based on the Quick DASH questionnaire at 6-, 12-, and 24-week intervals.
8. Radiological assessment was done at 6, 12, and 24-week intervals.
9. Wound sepsis, time taken to the bony union, and reaching pre-fall injury status were also noted

Our hook plates were locally available - a 4-7 hole, 3.5mm, known for right and left side for optimal sizing and screw positioning for everyone.

**Surgical Procedure**

All procedures were done with the patient supine with a bolster placed beneath the scapula.[10,11] The only soft tissue dissection was the cutting of the deltrotrapezial fascia, while the AC joint was left undissected.[12,13] AC depth was measured with a depth gauge, and the appropriate hook plate was used.[14,15]

Ligament repair was not done in any of the cases, and the deltoid and trapezium fascia were resutured at the time of closure.[16,17] Pendulum exercises were started on the 2nd postoperative date and passive.[18,20] Mobilization started as the patient tolerated it. Active exercises were formed within three weeks, and a full range of movement was created after three weeks.[21-23]

We have used the Quick DASH score as they reflect the subjective and objective perspective of the shoulder function. The quick DASH scores range from 0-100, where zero is the best score and indicates excellent results. The forms were filled in at each visit and at which time they were evaluated for signs of implant failure, irritation, impingement, or infection.[24-29]

X-rays were taken preoperative, immediately postoperative, and subsequently at six weeks and six months. Placement of plate, reduction of AC joint or fracture, implant loosening, osteolysis at the tip of the hook, cut out of the hook, and the union was assessed at serial intervals.[30-32]

Signs to elicit subacromial impingement were done at each visit, including the Neer impingement sign, Hawkins-Kennedy sign, and Jobe supination test. Zanca’s view was taken to assess the coracoclavicular reduction compared to the opposite side.

**RESULTS**

Thirty-two patients were followed prospectively from November 2020 to May 2022, of which 25 were males, and 7 were females.
Table 1: sex distribution

<table>
<thead>
<tr>
<th>Gender</th>
<th>No. Of patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>32</td>
</tr>
<tr>
<td>Female</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
</tr>
</tbody>
</table>

The mode of injury was a road traffic accident in 28 patients and a fall from height in 4 patients.

Table 2: Mode of injuries

<table>
<thead>
<tr>
<th>Mode of injury</th>
<th>No. Of patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road traffic accidents</td>
<td>28</td>
</tr>
<tr>
<td>Fall from height</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
</tr>
</tbody>
</table>

Five patients had Diabetes mellitus, and two patients had hypertension.

At the last follow-up, 27 patients had an excellent outcome according to the Quick DASH score. Three had a good outcome, and 2 had a poor outcome. The score ranged from 2.3 to 2.5 (avg was 7.26).

The constant score is obtained from subjective and objective scoring, including pain, activities of daily living, range of movement, and muscle power. An excellent score is 100, and zero indicates a poor score.

Quick DASH is an abbreviated version of DASH and contains only 11 questions out of the 30 in DASH.\(^{28,29}\) The quick DASH is statistically equal to the DASH score.

Of the three patients who did not have excellent, patient No.17 had an excision of the lateral end of the clavicle for painful non-union with arthritis of the AC joint, and the last follow-up was at 24 weeks 9 (there has been a gradual improvement of scores throughout the six post-op weeks). Patient No.23 had shoulder stiffness and hydrostatic saline distension at 12 weeks and is due shortly to have the implant removed because of osteolysis. Patient No.32 had developed bilateral shoulder stiffness (probable idiopathic frozen stiffness) and had the implant removed recently, which will be reassessed in 6 weeks.

Ten patients had their implants removed during this study for impingement and osteolysis. Union in the fracture cases was seen at a mean duration of 13 weeks (6-24 weeks). None of the patients had an infection.

Three patients developed calcification of the CC ligament or AC joint capsule. Two had calcification of coracoclavicular ligament and 1 had calcification of AC joint capsule.

The complications seen in our study were:

1. Impingement 3
2. Osteolysis at the tip of the hook 14
3. Cut out of the hook 1
4. Calcification 3

One of the three patients with non-union was found to have developed arthritis of the AC joint at the last follow-up. In all 10 cases where the implants were removed, no increase in the CC distance (demonstrated by stress Zanca views) was observed, implying the healing of the AC joint capsule and ligament.

Return to pre-injury status was seen in 18 patients of the 22.

Eighteen patients returned to pre-injury status at a mean of 53.5 weeks (24-104 weeks). Six patients returned to the pre-injury group at six months, while two returned at nine months and four at 12 months of surgery. Though the remaining four patients returned to work within one year, returning to pre-injury took 1½ to 2 years. This may be due to the presence of mild pain at the operated site or due to the development of painful osteolysis.

Of the two patients yet to return to pre-injury status, one is awaiting implant removal for impingement, and one recently underwent implant removal.
DISCUSSION

The hook plate, Kirschner wires, tension band wires around the coracoid and clavicle, trans fixation of the clavicle to the coracoid with screws 49, and other implants have all been used in the past. Some surgeons recommend excising the clavicle's lateral end in chronic painful dislocations. The rate of migration for Kirschner wire fixation is higher, whereas the Bosworth screw required extensive surgical exposure but offered a firm fixation that resulted in rotation loss and screw cut-out. Hook plates are an effective and suitable treatment option for lateral end clavicle fractures. According to the Quick DASH scores used in this study, the outcomes for 27 participants were excellent. 2 patients had poor outcomes, whereas three patients had good outcomes. These findings are comparable to those of other hook plate studies. The following complications have been identified: 3 cases of impingement and 3 cases of frozen shoulder. While the specific cause of shoulder stiffness is uncertain, these findings are comparable to those of other investigations. It appears that shoulder stiffness is a result of a post-traumatic frozen shoulder. Reducing subacromial space or irritation of the subacromial bursa may cause impingement pain. The average time required to return to pre-injury level was 51 weeks, partly due to patients' lack of personal initiative, lack of prompt follow-up, and inability to attend physiotherapy appointments due to financial constraints.

CONCLUSION

From the analysis of this study, the following were noted:
1. Hook plate is a good option for the treatment of unstable lateral end clavicle fractures
2. Limited use of instrumentation
3. Short duration of the procedure
4. Low incidence of complications
5. Good objective and subjective outcomes
6. Stability to the AC joint is attained without ligament repair or reconstruction.
7. Short learning curve
8. Implant removal is advisable, but the decision depends on the presence or absence of osteolysis and impingement.

REFERENCES

4. Rockwood and Green's Fractures in Adults, 7th edition - home [Internet]. [cited 2010 Nov 27]; Available from: http://www.rockwoodadultsfractures.com/pt/re/bucholz/7e/home.htm;sessionId=MwDFCkDEkBQNP21im3pZ113Syh8fBTXTV2eh9jyhlK27TvZQSNjFj6b283095 951811956283 0911--!