

# Fixation of type II Lateral third clavicle fracture by distal radial plate with screw stabilization of coracoclavicular interval

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## Abstract

### Purpose:

The purpose of this study is to evaluate the results of lateral third clavicle fixation using a distal radial plate and a coracoclavicular screw stabilization.

### Patients and Methods:

In this prospective study, 13 cases were included and treated in Tanta university hospitals, Egypt, from January 2019 to January 2021. They were ten males and three females. The mean age was 27.2 years. The left side was involved in six cases, and the right side in seven cases. The dominant side was affected in eight cases, and the non-dominant one in five cases. Six of the involved patients were smokers. All of the fractures were type 2 according to Neer's classification. Fixation was done using the distal radial plate, with a coracoclavicular screw, which was exchanged with a short screw in all cases after 6 weeks.

### Results:

The mean follow-up was 10 months. The union was achieved in all cases within five to eight weeks (average 6.4 weeks). According to the modified DASH score, the mean score was 11.5. The outcome was considered excellent in seven cases, good in six cases,

### Conclusion:

Displaced distal clavicle fractures treated with distal radius plates together with coracoclavicular screws achieved excellent results in terms of bony union and the functional outcome, without any significant complications.

### Keywords:

Lateral third clavicle. coraco-clavicular screw. distal radius plate.

## Introduction

Fractures of the clavicle are among the commonest fractures, accounting for 2.6–4% of fractures in adults. 12% to 15% of all clavicle fractures involve the distal third (1-3). Such injuries are usually caused by direct trauma, or due to falling on the outstretched hand. Moreover, it has a bimodal age distribution, occurring in young active individuals, and the elderly osteoporotic females (1-3).

Lateral third clavicle fractures are classified by Neer according to the relation to the coracoclavicular (CC) ligaments (4,5). Neer types I, III, and IV are generally treated conservatively secondary to their stable nature. Conversely, Neer type II and V are considered unstable and usually require surgical management. Non-operative management in these unstable types can result in a high incidence of non-union ( up to 50%) (1-3,5,6). In addition, the conservative approach necessitates a prolonged shoulder immobilization time which can result in bone resorption, shoulder stiffness, and an altered surgical field that makes any subsequent surgical intervention more difficult (7)

The high incidence of nonunion is due to the displacing forces acting on the two sides of the fracture: the trapezius muscle that pulls the medial fragment superiorly and the weight of the arm which draws the lateral fragment inferiorly, thus generating enough instability that prevents union of the fracture.

Various surgical techniques have been described for distal third clavicle fracture fixation, including K-wires, hook plate fixation, CC screw, and CC sling procedure. Each technique has its own drawbacks, which include wire migration, subacromial impingement, acromioclavicular joint arthrosis, and implant failure. (8-15). In this study, distal radius locking plates were used, they were found to provide a better bony purchase in the distal short part of the clavicle, which is also a broad part thus fitting the T or the L segment of the plate without being prominent. Moreover, the plates are of low profile, thus, ideal for the subcutaneous position of the clavicle.

The present study aimed to evaluate the clinical and radiographic outcome lateral third clavicle fixation by the distal radial plate with screw stabilization of CC interval using CC screw in a

series of patients with unstable Neer type II fractures.

## Patients and methods

This prospective study included the cases of 13 patients with Neer type II lateral clavicle fractures, who presented in the periods from January 2017 till January 2019.

The mean age was 27.2 years (19-41 years). The mechanism of injury in seven patients was road traffic accidents and falling in six patients. None had significant associated injuries. The right side was affected in eight patients, and the left side in

five patients. The dominant side was affected in eight cases.

At the time of presentation, two radiographic views (AP and Zanca) of the distal clavicle were obtained. Surgery was performed in all patients within 14 days of injury. (Table 1)

The Inclusion Criteria of this study were: Adult (skeletally mature) patients, recent fractures (within 14 days), closed Type II fractures, with the absence of pre-existing subacromial pathology, while Exclusion Criteria included: 1. Other types of distal clavicle fractures according to Neer's classification 2. Open fractures 3-Late presenting fractures 4. Skeletal immaturity patients.

**Table 1:** Preoperative and operative data of the included cases (n:13)

Case n.	Age	sex	side	dominance	smoking	Classification of the fracture	Time of operation
1	19	M	RT	D	No	2a	95
2	20	F	RT	ND	No	2a	70
3	30	M	LT	ND	Yes	2b	80
4	35	M	LT	ND	No	2a	80
5	19	M	LT	D	Yes	2a	80
6	24	M	RT	D	No	2a	80
7	28	F	LT	D	No	2b	70
8	27	M	RT	D	Yes	2a	65
9	39	M	RT	D	Yes	2b	70
10	41	M	LT	D	Yes	2a	70
11	23	M	RT	ND	Yes	2a	70
12	22	M	LT	ND	No	2b	90
13	27	F	RT	D	No	2b	90
Mean	27.230769						77.69230769

M: male, F: female, RT: right, LT: Left D: dependent, ND: non-dependent,

## Operative technique:

### Operative steps

The operation was performed under general anesthesia with the patient positioned in the beach-chair position. A transverse incision with a length of 4–5 cm was made along the axis of the clavicle, centered over the fracture, extended medially to allow the application of one screw medial to the CC screw, and laterally to permit the visualization of the AC joint. Deep dissection was carried on through the deltotrapezoid fascia which was incised in line with the clavicle, if not torn during the original trauma.

After exposure of the fracture, a small vertical incision was made over the coracoid, then a pointed reduction clamp was applied, one end under the coracoid and the other over the medial fragment of the fracture clavicle bone, in a position that allowed the application of the plate while the clamp was holding the fracture reduced.

The CC interval was then checked under fluoroscopy.

Fixation was accomplished with either a 3.5 mm locking T-plate ( $n = 12$ ), originally designed for distal radius fractures, or an L-shaped 3.5 mm distal radial locking plate ( $n = 1$ ). After fracture fixation, the coracoid process was fixed to the plate using a cortical screw. After checking the stability and reduction under fluoroscopy, the deltotrapezoid fascia was repaired and wound closure was performed in a standard manner.

For 4 weeks postoperatively, the arm was immobilized in a pouch arm sling. However, early passive mobilization (as tolerated by the patient) was allowed with abduction and forward flexion restricted to 90°. After 6 weeks, all patients were admitted for removal of the CC screw, which was exchanged with a short bicortical screw. Rehabilitation was continued with free range of motion and strengthening exercises. Return to sports as allowed 3 months after surgery. The

modified DASH score of all patients was evaluated at the 9-month follow-up visit.

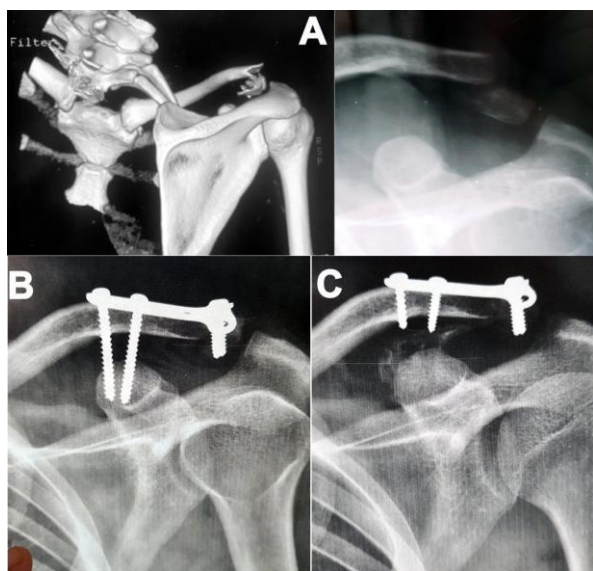
**Results**

In this study, 13 patients were included with a mean age was 27.2 years (19-41 years).. All suffered from Neer type II lateral clavicle fracture, eight of them were of Neer type IIa and

five were type II b. Follow up ranged from 11 to 13 months (mean 11.3 months) The radiological union was achieved in all cases in a mean period of 7.9 weeks ( range from 6 to 12 weeks). Modified DASH score mean was 11.53 (range: 4.5 to 25) points. According to the modified DASH score, results were excellent in seven patients, good in five patients, and fair in one patient. (Fig1. Table 2)

**Table 2:** Post-operative data of the included cases (n:13)

Case no.	functional score	Time to union (weeks)	follow up	complications
1	9.1	6	11	Superficial wound infection
2	4.5	7	12	none
3	9.1	6	10	none
4	11.4	8	12	none
5	6.8	10	10	none
6	6.8	8	12	none
7	13.6	6	13	none
8	20.5	8	12	none
9	6.8	7	10	none
10	13.6	12	10	none
11	9.1	6	12	none
12	13.6	9	11	none
13	25	10	13	none
Mean	11.53076923	7.923076923	11.3846154	



**Figure1:** A- Plain X-ray and CT show fracture of the distal clavicle type II. B- Fixation with distal radius plate with coracoclavicular screw. C- Exchange of coracoclavicular screw with short small fragment screw after 6 weeks.

Superficial wound infection occurred in one case only, the patient was readmitted for debridement, samples were taken for culture and sensitivity, but there was no evidence of deep infection. An IV Antibiotic ( 3<sup>rd</sup> generation cephalosporin) was

given for one week. The infection resolved without any further sequelae. There were no cases of implant failure, non-union, shoulder stiffness, or subacromial pathology.

**Discussion**

Distal third clavicular fractures are difficult to treat due to their biomechanically unstable behavior. The sternocleidomastoid muscle acts on the medial fragment pulling it upwards, while the gravity and the action of the pectoralis muscle drag the lateral segment downwards, creating significant instability at the fracture site, particularly when the CC ligaments are torn. Such unstable patterns are categorized as type II according to Neer’s classification. Thus, a stable construct is required to achieve sufficient stability for the union to occur. Moreover, The lateral fragment itself is usually short, that is why bony purchase in it is challenging. Various methods of operative treatment are described in the literature. In this study, we tried to achieve union for such unstable fractures, using a stable, reliable, reproducible, and relatively cheap construct, with few or no complications. Thus, the distal radial locking plates, together with the CC screw, were tested in our study. The

results were comparable to those reported in the literature.

On review of other studies, our results are consistent with the findings of **Sclliemann et al** (16), who published a series of fourteen patients, treated with a combination of locked plate fixation and a minimal-invasive CC ligament reconstruction. Bony union was achieved in all cases within 6–10 weeks. all 14 patients achieved excellent Constant-Murley scores results, The mean Constant-Murley score of the affected shoulder was 93.5 points compared to 97.2 of the contralateral unaffected shoulder. Also, **Martetschlager et al** (17) reported using locking T-plate and additional PDS cerclage in thirty patients with Neer type 2 fracture distal clavicle, healing was achieved within 10 weeks. All patients regained good to excellent shoulder function and returned to previous occupation and activity levels. The DASH score was 6.2 points and the mean Constant was 92.3 points.

**Kalamaras et al.** (18) reported using a distal radius locking T-plate (a 2.4-mm LCP distal radius plate) with an additional Fiberwire loop around the coracoid process and through the distal part of the clavicle in 6 of 9 cases, with 100 % union rate and an excellent functional outcome in all patients. Moreover, **Herrmann et al.** (19) published a series of 7 patients treated with a distal radius locking T-plate and one or two additional suture anchors, knotting the sutures over the plate, with comparable results.

**Largo et al.** (20) evaluated 19 patients at a mean follow-up of 5.3 years after treatment for unstable distal clavicle fractures using a T-plate and a coracoclavicular PDS cord. They also reported excellent clinical results with a mean Constant score of 91.5 points and a bony union at 6–14 weeks in all except one. Furthermore, **Fleming et al.** (21) reported nineteen patients with a mean follow-up of 25 months, who underwent angular stable plate fixation of Neer type II clavicle fractures. All patients achieved union within 4 months. All patients had returned to full function and sporting activities resulted in a 100% union rate with an excellent return of function with no mandatory need for removal.

It is clear that the CC screw technique, compared to the other CC interval stabilizations techniques mentioned, produced comparable results, with the advantage of being much cheaper, and easier application.

In comparison to the fixation by hook plate, which is a common procedure and gives satisfactory results, however, they appear to have a significant rate of complications, such as impingement,

rotator cuff tears, non-union, implant failure, hook migration, and even acromial fracture. (12,22-25). The locking T or L distal radial plate shape matched the distal clavicle bone configuration and allowed the application of more screws in the distal short bony fragment, however, they are not anatomical and did not match the distal clavicle curve, so short ones (maximum five screw holes) were allowed only. In our treatment protocol, exchange of the cc screw with a short bicortical one at 6 weeks allowed a free range of motion, particularly abduction range, without the risk of CC screw breakage.

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## Conclusion

Operative treatment for unstable distal clavicular fractures (Neer type 2b) using locking plate osteosynthesis and CC interval stabilization by CC screw results in good and excellent shoulder function. Complications, such as non-union or instability, were not seen in this group. Longer follow-ups will be necessary to assess the incidence of AC arthritis or pain

## Conflict of interest:

The authors have no conflict of interest.

## Ethical approval:

All procedures performed in studies involving human participants were following the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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