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Original Article

Treatment of unstable distal third clavicular fracture with locked distal radius plate

Ashraf Abdeldayem, Waleed Nafea, Abdelsalam Eid*

Department of Orthopaedic Surgery, Faculty of Medicine, Zagazig University, Zagazig, 44519, Egypt

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ABSTRACT

Background: The ideal surgical fixation for displaced distal clavicle fractures should not involve restrictions of the movements of nearby joints.

Aim of the work: To evaluate the results of internal fixation of unstable displaced distal third clavicle fractures using locked distal radius plates.

Patients and methods: Fifteen patients with Type II distal clavicle fractures were treated with open reduction and internal fixation using locked distal radius plates.

Results: Thirteen patients achieved full range of motion of the shoulder while two patients had minor limitations. The mean modified shoulder score was 18.3 at the final follow-up. None of the patients developed implant failure, loss of reduction, wound breakdown, or deep infection.

Conclusion: Good clinical results can be achieved with locked distal radius plate fixation in Type II fractures of the distal clavicle. With this technique, range of shoulder movement could be restored early without the needs for implant removal.

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1. Introduction

Clavicle fractures are categorized into proximal, midshaft, and distal fractures. Distal end clavicle fractures are further classified by Neer¹ into five types. Type II fractures are unstable and are further sub-categorized into Type IIA in which the fracture occurs medial to the CC ligament and Type IIB in which the fracture occurs more laterally with the CC ligament disrupted from the proximal fragment.¹

Many different surgical procedures have been developed for fixation of the distal clavicle fracture since Neer¹ first recommended the use of transacromial Kirschner wires (K-wires). These include Bosworth coracoclavicular screw² Dacron tape coracoclavicular loop³ cannulated

coracoclavicular screws⁴ or the clavicle hook plate.⁵ Numerous disadvantages have been shown to complicate such techniques including: pin migration, screw breakage, rotator cuff irritation and rupture, infection, osteomyelitis, refracture, osteoarthritic changes, and ankylosis.^{1–5}

To overcome the disadvantages of previously described methods the utilized method of fixation should be low profile and should provide stable fixation while not fixing the clavicle to either the coracoid or to the acromion to facilitate early restoration of the range of motion. Our hypothesis was that distal radius locked plates 3.5 mm could be used to stably fix type II distal clavicle fractures until union occurred while allowing early restoration of the shoulder range of motion and without the need for implant removal.

* Corresponding author. 5 Mahfouz Street, From Ahmed Ismail Street, Zagazig 44511, Egypt. Tel.: +20 1005440204.

E-mail address: eid_md@yahoo.com (A. Eid).

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2. Patients and methods (Table 1)

Between January 2009 and June 2011, 15 patients with displaced unstable distal clavicular fractures underwent open reduction and internal fixation with locked distal radius plates in the casualty unit of our university hospital. All cases were Neer type II. Twelve cases were men.

Mean age was 31.6 years (range 18–50). Mean interval between trauma and surgical treatment was 6.1 days (Range: 12 h to 60 days).

Inclusion criteria were: type II fractures of the distal clavicle, closed injuries, and a minimum length of the distal fragment of 2 cm. Exclusion criteria were other types of distal clavicle fractures, open injuries, and distal fragment smaller than 2 cm.

Anteroposterior, axillary, and scapular Y view rays were obtained for all patients. CT scan was obtained in three cases with comminuted fractures. Associated fractures were present in 3 cases with Motor Vehicle Accidents (MVA).

All patients were operated on under general anesthesia and in supine position with the involved extremity draped free. Skin was incised along the axis of clavicle. Fracture ends were debrided and direct reduction was performed. Locked distal radius plate was then applied onto the superior surface of the distal clavicle so that the horizontal limb of the (T) sat on the lateral fragment and the longitudinal limb sat on the medial fragment. In nine cases we found it necessary to bend the T portion of the plate as it protruded slightly from the margins of the lateral fragment in order to prevent soft tissue problems. Coracoclavicular ligaments were repaired by direct sutures of the torn parts. The wound was closed in layers and a pouch arm sling fitted.

Control X-ray was obtained postoperatively and at six weeks follow-up.

Surgeon-supervised rehabilitation protocol started as soon as pain allowed. The patients were examined weekly during the first 6 weeks, then every two weeks till the end of the third month and given instructions regarding the Range of Motion (ROM) and muscle strengthening exercises. Pendulum exercises for the shoulder as well as active exercises for the elbow, wrist and fingers were allowed as soon as pain permitted. Active shoulder movements were gradually permitted with restriction of shoulder elevation or abduction to below 90°. A sling was worn between exercises and was discarded as tolerated by the patient. After four weeks, the patient was instructed to increase abduction and elevation gradually and to use the shoulder in the overhead position. Strengthening exercises were initiated by six to eight weeks.

Functional and radiological follow-up examinations were performed at three, six, and twelve months postoperatively. The average follow-up was 16.1 months (12 months–24 months).

3. Results

All fractures united. The average time to clinical union (evidenced by disappearance of pain, return of a functional ROM, improvement of shoulder strength) was 8 weeks (Range:

Table 1 – Patients' data.

Case number	Sex	Age	Side	Mechanism of injury	Associated injuries	Time to surgery (day)	Operative time (minutes)	Time to full ROM	Clinical union (weeks)	Radiological union (weeks)	Follow-up (months)	MSRS	Complications
1	M	36	RT	MVA	No	0.5	120	6	8	12	12	20	No
2	M	40	RT	Simple fall	No	1	110	6	10	10	16	18	No
3	M	27	LT	MVA	Humeral fracture	5	90	5	6	8	14	17	No
4	F	35	RT	Simple fall	No	60	100	**	8	12	12	16	No
5	M	24	LT	Sport injury	No	1	80	5	8	12	12	19	No
6	F	41	LT	MVA	Colles fracture	0.5	90	5	10	12	18	20	No
7	M	20	RT	Fall from height	Femoral fracture	3	70	8	8	10	18	16	No
8	M	50	RT	Simple fall	No	0.5	60	8	6	10	12	18	No
9	M	38	RT	MVA	No	1	110	**	8	12	14	16	Superficial infection
10	F	29	RT	Simple fall	No	1	80	6	8	10	24	19	No
11	M	29	LT	Simple fall	No	0.75	70	5	8	12	12	18	No
12	M	18	LT	Simple fall	No	0.5	80	6	10	10	16	19	No
13	M	27	RT	MVA	No	3	75	6	8	8	20	19	No
14	M	31	RT	MVA	No	7	90	6	6	12	24	19	No
15	M	29	LT	Simple fall	No	2	100	8	8	10	18	20	No

6–10). The average to radiological union (evidenced by bone trabeculae obliterating the fracture gap) was 10.7 weeks (Range: 8–12) (Figs 1 and 2).

Thirteen patients achieved full range of motion as compared to the healthy side at 6.2 weeks postoperatively (Range: 5–8 weeks), while two cases had minor residual limitation of shoulder movements although they still had near normal ROM.

Modified Shoulder Rating Scale (MSRS)⁶ for distal clavicular fractures was used to evaluate the patients' functional status. Mean MSRS was 18.3 at the final follow-up (Range: 16–20).

4. Complications

No implant failure, loss of reduction, or skin breakdown was observed in this series. Superficial infection occurred in one case and was controlled with repeated dressings and antibiotics. Patients did not report any complaints related to rotator cuff during the follow-up period.

Fig. 1 – a) Preoperative X-ray. b) After union. c) ROM.

Fig. 2 – a) Preoperative X-ray. b) After union.

5. Discussion

Distal clavicle fractures with disruption of the attachment of the coracoclavicular ligament to the medial clavicular fragment (Neer type II) do not readily heal without surgical intervention. Several authors^{1,7,8} reported high rates of nonunion or delayed union (67–75%) in Neer type II distal clavicle fractures with conservative treatment. Many surgical methods have been introduced for distal clavicle fractures, including, transacromial Knowles pins,⁹ hook-plate fixation,^{5,10} and coracoclavicular stabilization with suture loops,¹¹ or screws.¹²

Techniques using internal fixation that includes rigid coracoclavicular or acromioclavicular fixation have the disadvantage of interfering with the normal rotational movement of the clavicle in relation to the coracoid and acromion. Therefore, the metallic fixation should be removed before full mobilization is started; otherwise implant breakage or more seriously fracture of the anchorage points will occur.

In addition, transacromial wires alone are known to have a high rate of complications including nonunion, infection, and pin migration.¹³ Specially designed hook plates proposed in the last decade improved the initial stability of the fracture. However, later reports showed increased incidence of complications such as subacromial impingement, rotator cuff ruptures, acromion fractures, acromial osteolysis and pain.¹⁰

The technique presented in this study provides rigid fixation of the distal clavicle fracture itself and does not limit the

motion of neighboring joints. This technique has the advantage of early rehabilitation without limitation of range of motion.

In this series, full ROM was attained by 6.2 weeks in 13 patients, while all patients regained a functional painless ROM with improvement of shoulder strength at an average of 8 weeks. This supports our hypothesis that distal radius locked plates 3.5 mm could be used to stably fix type II distal clavicle fractures until union occurred while allowing early restoration of the shoulder range of motion and without the need for implant removal.

Kalamaras et al¹⁴ published a series comprised of nine lateral clavicular fractures treated with 2.7 mm locked distal radius plate. Their postoperative rehabilitation program included immobilizing the shoulder in an arm sling during the first 6 weeks. They augmented their repair by a FiberWire suture loop around the coracoid in 6 cases. The mean constant score in that series was 96. Our results are comparable to this series although in our series the active shoulder mobilization was started earlier and the sling was discarded earlier according to the patients' tolerance.

Daglar et al¹⁵ reported the results of fourteen cases of distal clavicular fracture treated with locked distal radius plate. In their series they initiated immediate full range of motion exercises and as patients pain tolerate they discontinued the sling immobilization. Their patients had a mean MSRS of 18.7, which is comparable to our results.

The limitations of this study include: the relatively small number of patients and the lack of a control group.

Main advantage of this technique is that it enables initiation of early active motion. Also it does not require a second operation for implant removal before the initiation of full range of motion exercises. In this study, good and excellent results were achieved without major complications at short term follow-up.

6. Conclusion

Distal radius locked plates 3.5 mm could be used to stably fix type II distal clavicle fractures until union occurred while allowing early restoration of the shoulder range of motion and without the need for implant removal.

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Conflicts of interest

The author has none to declare.

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