

A prospective study of bipolar clavicle fractures treated with Dual anatomical plates

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Abstract

Background: Clavicular fractures account for 4% of all adult fractures. However, simultaneous medial and lateral fractures occurring in the same clavicle (the so-called 'bipolar clavicle fracture') are rare. Treatment for this type of fracture is not well established. Herein, we report our experience of the operative management of bipolar clavicle fractures using two anatomical locking plates.

Methods: Patients who presented with bipolar clavicle fracture between Feb 2021 and December 2022 were prospectively enrolled in this study. All patients were operatively treated with open reduction and internal fixation (ORIF) using pre-contoured clavicle plate/recon plate for medial fractures and hook plate for lateral end fracture. Functional and radiological outcome evaluated

Aim: To evaluate the functional and Radiological outcome in patients with bipolar clavicle fractures treated with dual anatomical locking plates

Results: In all the patients, bony union achieved at an average duration of 17.9±1.4weeks. The mean shoulder forward flexion was 166°±11.4°, and the mean DASH score was 3.3±2.3 with four cases assessed as excellent and one case assessed as good. The mean abduction was 168±9.8°. No complications occurred, and each patient was able to resume their preinjury daily activity and was highly satisfied with their treatment.

Conclusion: Dual plating is an effective surgical procedure for treating bipolar clavicle fractures with very good functional results and early mobilization

Keywords: Bipolar clavicle fracture, dual plating, locking plate, open reduction and internal fixation

Introduction

Clavicular fractures are fairly common, accounting for 4% of all adult fractures ^[1]. However,

simultaneous medial and lateral fractures occurring in the same clavicle (the so-called 'bipolar clavicle fracture') are rare [2]. Reportedly, high-energy trauma can cause this type of fracture [3]. Elderly individuals are more susceptible to this fracture even with low energy trauma [2, 4]. Treatment for such clavicular fractures could be conservative or operative, according to the degree of displacement.

Herein, we report our experience of the operative management of five bipolar clavicular fractures using two anatomical locking plates and we present a review of relevant literature.

Methods

The study was conducted in the department of orthopedics in Mysore medical college and research institute, Mysore, India, on a series of 5 cases of bipolar clavicle fractures treated with open reduction and internal fixation (ORIF) using two anatomical locking plates. This study was conducted over a period of 2 years i.e., from February 2021 to December 2022. Clinical outcome is evaluated using DASH score at 6 months. Radiological outcome is evaluated by serial post-operative x-rays every month.

Inclusion Criteria: Patients coming to orthopedic department, K R Hospital with bipolar clavicle fracture irrespective of age group.

Study Procedure

After taking consent, physical examination was done for the assessment of both the motor and sensory components of all upper extremity peripheral nerves. Radiographs of the shoulder with clavicle antero-posterior view taken.

Patients were placed in beach-chair position with the affected arm in a mobile position. Clavicle exposed using conventional incision and dissection. First mid-shaft fracture reduced and fixed with a 2mm k-wire. Second, the lateral end fracture was fixed with another 2mm k wire. Later

fixed with using either pre-contoured clavicle plate/ recon plate for medial and middle third fractures or hook plate for lateral third fractures.

All the patients advised mobilization of shoulder from post-operative day 1. Codman pendulum exercises and passive shoulder movements started from post-operative day 1. Active resistance exercise training started from 6 weeks post-op.

Follow-up

Patients discharged with an arm sling support on post-op day 3 and suture removal done on post-operative day 15. Functional assessment done using DASH score every month and radiological assessment done by serial x-rays at every month follow-up.

Sl. No.	Name	Age/sex	Side	MOI	Associated injuries	Implants used	Time of union (weeks)	Flexion at 6 months	Abduction at 6 months	DASH score at 6 months	Outcome
1	Sharath	26/M	Right	RTA	I/L Bimalleolar ankle fracture	Pre-contoured clavicle plate Lateral hook plate	18	180°	180°	0.8	Excellent
2	Sanju	26/M	Right	RTA	I/L Femur shaft fracture	Recon plate Hook plate	18	160°	170°	1.6	Excellent
3	Nagendra	32/M	Left	RTA	Nil	Pre-contoured plate Hook plate	16	170°	170°	2.5	Excellent
4	Siddaraju	34/M	Left	RTA	Nil	Pre-contoured plate Hook plate	16	170°	170°	4.15	Excellent
5	Nagesh	36/M	Right	RTA	I/L bothbone forearm fracture	Recon plate Hook plate	20	150°	150°	7.4	Good

MOI- Mode Of Injury, RTA- Road Traffic Accident, I/L- Ipsilateral, DASH- Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH)

Results

All the patients were followed up for upto 6months, mean time of union was found to be 17.9 ± 1.5 weeks, mean flexion at 6months was found to be 166 ± 11.4 degrees, mean abduction was found to be 168 ± 9.8 degrees and mean DASH score was found to be 3.2 ± 92.33 . No complications occurred.



Fig 1: Pre-op x-ray patient 1



Fig 2: Associated injury of patient 1



Fig 3: Post-op Day 1



Fig 4: Post-op Day 10



Fig 5: Post-op Day 90



Fig 6: After Removal



Fig 7: 4 months after removal

Follow-up images



Fig 8: Clinical Outcome



Fig 9: Operated with pre-contoured plate and hook plate



Fig 10: Operated with recon plate and hook plate

Discussion

Only few cases on surgical management of bipolar clavicle fractures have been reported so far (Table 1).

Table 1: Summary of surgical treatment case studies on bipolar clavicle fractures

References	Year	Gender	Age	Trauma	Implants used
Heywood <i>et al.</i> ^[10]	2005	Male	54	Assault	Medial plate, Lateral hook plate
Miller <i>et al.</i> ^[11]	2009	Male	17	RTA	Medial plate, Lateral plate
Grossi <i>et al.</i> ^[12]	2011	Male	41	Fall from roof	Reconstruction plate, K-wire
Daolagupu <i>et al.</i> ^[13]	2013	Male	12	Fall	Medial plate, K-wire
Skedros <i>et al.</i> ^[14]	2014	Male	33		Reconstruction plate
Varelas <i>et al.</i> ^[2]	2015		68	Fall on ice	Medial plate, Lateral plate
Sopu <i>et al.</i> ^[15]	2015	Male	52	Fall from pushbike	Medial plate, Lateral no fixation
Yalizis <i>et al.</i> ^[7]	2016	Male	38	Fall from pushbike	Medial plate, Lateral hook plate
Ogawa <i>et al.</i> ^[5]	2017	Female	74	RTA	Medial no fixation, Lateral plate
de Ruitter <i>et al.</i> ^[3]	2019	Male	23	RTA	Medial plate, Lateral plate
Maalouly <i>et al.</i> ^[6]	2019	Female	78	RTA	Medial plate, k-wire
Present case	2021	Male	23	RTA	Medial plate, Lateral hook plate

RTA: Road Traffic Accident.

Table 2: Summary of conservative treatment case studies on bipolar clavicle fractures

References	Year	Gender	Age	Trauma
Pang <i>et al.</i> ^[16]	2003	Male	76	RTA

Serra <i>et al.</i> ^[17]	2011	Male	71	RTA
Sethi <i>et al.</i> ^[18]	2012	Female	70	Fall from stairs
Talboys <i>et al.</i> ^[4]	2016	Female	79	Stumbled over slipper

Previously high energy trauma was suggested to be the reason for bipolar clavicle fracture. The mechanism of clavicular fracture is thought to involve a direct traumatic force to the adducted shoulder ^[4]. Recently, bipolar clavicle fractures have been found to occur due to low-energy trauma in elderly patients, presumably due to osteoporosis ^[4-6]. A displaced fracture can easily be seen on a plain radiograph. However, the other minimally displaced fracture tends to be overlooked ^[7]. Computerized tomography (CT) is useful for detecting minor or non-displaced second fractures. In our study all five patients were within the age of 40years and all of them had history of RTA, and three patients had polytrauma which indicates of high energy trauma.

Conclusion

The treatment strategy for bipolar clavicle fractures remains controversial. Although, some studies on conservative treatment have reported good clinical outcomes ^[3, 4] (Table 2), rehabilitation should be initiated as soon as possible. We opted for open reduction and internal fixation for this patient to prevent disuse muscular weakness. Application of two anatomical plates to the different aspects of the clavicle was more feasible than bending a single long plate to fit the whole clavicle. We could not find the non-union case of bipolar clavicle fracture in the literature. One reason is the non-union rates after clavicle shaft operation are so low (2.6-10%) ^[8, 9] and the bipolar clavicle fracture is so rare that we could not find the non-union case. The selection of treatment must be appropriate in every case. The other reason is the publication bias. Treatment failure doesn't tend to be reported. In conclusion, dual plating is an effective surgical procedure for treating bipolar clavicle fractures.

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