International Journal of Research in Orthopaedics
Nageswara RV et al. Int J Res Orthop. 2020 Jan;6(1):139-144
http://www.ijoro.org

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20195807

Management of lateral end clavicle fractures-using lateral clavicle locking plate: a prospective study

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Received: 16 September 2019
Revised: 13 November 2019
Accepted: 16 November 2019

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ABSTRACT

Background: Lateral end clavicle fractures are one of the common upper limb fractures. They constitute 21–28% of all clavicle fractures. Of these 10–52% is displaced fractures. The management of fractures of lateral end clavicle remains debated and challenging. The objectivbe of this study is to evaluate the functional outcome following surgical treatment of unstable/displaced (Neer type II lateral clavicle fractures, and acromio-clavicular joint dislocations Rockwood grade III to V) lateral end clavicle fractures using lateral clavicle locking plate.
Methods: It is a prospective study conducted in the orthopaedics department of GSL Medical College and General Hospital for a period of 3 years (April 2016 to March 2019) among a total of 60 patients.
Results: About 23 (38.3%) belonged to 41–50 years age group, followed by 16 (26.7%) to 31–40 years age group and 13 (21.7%) to >51 years age group and 8 (13.3%) to 18–30 years age group. The time from trauma to surgery ranged from 0-15 days with a mean of 5 days and the mean operating time was 41 minutes ranging between 23-70 minutes. Mean duration to union was 13.33±2.126 weeks and the mean Constant Murley score was 88.56. Functional outcome at 6 months follow up was excellent in 8 (13.3%), good in 37 (61.7%), fair in 13 (21.7%) and poor in 2 (3.3%) patients.
Conclusions: Although there is no consensus as to a "gold standard" fixation method for unstable distal clavicle fractures, satisfactory outcomes could be obtained using the lateral clavicle locking plate resulting in sufficient stabilization and good functional outcome.

Keywords: Lateral end clavicle fractures, Unstable, Functional outcome

INTRODUCTION

Clavicle fractures are common injuries in adults (2-5%) and children (10-15%) and constitute 44-66% of all shoulder fractures.[1,2] The first widely accepted classification system for clavicle fractures was given by Allman in 1967. He classified fractures of the clavicle into three groups according to the site of fracture (anatomically).[3] Lateral clavicular fractures constitute the second group (group II), approximately 15–25%, while the most common type are the middle third fractures (group I), about 80% cases and proximal third clavicular fractures (group III), the least, about 5% only.[4-6]

Lateral end clavicle fractures are one of the common upper limb fractures encountered in orthopaedic practice, constituting approximately a quarter of all clavicle fractures. These injuries are not uncommon and account

for 20% of all fractures of the clavicle.[5,7-10] The incidence is about 29 per 100,000 population per year[11] and accounts for 2.6–4% of the total adult fractures. Lateral end fracture constitutes 21–28% of all clavicle fractures. Of these 10–52% are displaced fractures.[12] Higher rate of nonunion is seen in displaced fractures compared to undisplaced fractures of the lateral end clavicle. The management of fractures of lateral end clavicle remains debated and challenging. There are no established criteria for conservative or surgical management of these fractures. Hence, several factors should be considered for management of these fractures, including patient's biologic age, functional demands and the type of lesion.[13]

Nonoperative management of lateral clavicle fractures results in a good outcome in up to 98% of minimally displaced or not displaced fractures while rates increase with displacing of the fractures.[14] The rate of nonunion following nonoperative treated distal clavicle fractures is higher, and in the literature ranges from 11% to 40% in small case series.[7]

The indication for surgical treatment of lateral-third clavicle fractures is based on the stability of the fracture segments, displacement and patient age. Displacement of the medial clavicle due to disruption of coracoclavicular ligaments (Edinburgh type 3B) leads to nonunion rates as high as 28%.[5] The risk of nonunion increases with advancing age and displacement.[8,14,15] Again, the presence of soft-tissue compromise, multiple traumas, and floating shoulder are also indications for operative treatment.[13]

Many surgical techniques have been proposed for fixation of lateral-end fractures. These include Kirschner wire fixation,[16] CC screws,[17] plate or hook-plate fixation,[18,19] and suture and sling techniques.[19-22] However, reported complication rates limit their utility. Open reduction and internal fixation with a superiorly placed locking plate is a recently developed technique.[23]

The use of a pre-contoured superiorly placed locking plate and screws, for fixing fractures of the lateral end of the clavicle, is a recent development.[24,25] This mode of fixation is an extension of the fixed angle, locking screws principle, which has been used in other fractures, most notably fractures of the proximal humerus and distal radius. Locking plates are fixed angle constructs which have greater resistance to screw pullout.[26] significant displacing forces acting at the lateral end of the clavicle. The forces causing clavicle displacement are the weight of the arm, the pull of pectoralis major, pectoralis minor and latissimus dorsi muscles, scapula rotation, and the pull of the sternocleidomastoid muscle.[27,28] Accurate plate placement and adequate fixation with the locking screws on the lateral end can be technically difficult. This technical difficulty has led to the lateral fragment being exposed up to the AC joint and iatrogenic injury to the joint capsule with resultant instability of the joint. Consequently there is displacement at the AC joint leading to subluxation and dislocation. Recent studies reporting the results of lateral clavicle locking plates have almost universally described the use of a coracoclavicular sling or coracoclavicular screw to augment locking plate fixation.[24,29,8]

The present study was done to evaluate the functional outcome following surgical treatment of unstable/ displaced (Neer Type II lateral clavicle fractures, and acromio-clavicular joint dislocations Rockwood grade III to V) lateral end clavicle fractures using Lateral Clavicle Locking Plate.

METHODS

It is a prospective study conducted in the Orthopaedics department of GSL Medical College and General Hospital for a period of 3 years (April 2016 to March 2019). A total of 67 patients reporting to the Orthopaedics OPD were considered for the study, of which complete details could be collected from 60 patients, since 7 patients were lost to follow up. All the patients who presented to the orthopaedic OPD with fractures of the lateral end of the clavicle during the first year (April 2016 to March 2017) of the study period, required surgical treatment and consented for the study were included. Exclusion criteria was patients presenting with pathological fractures, fractures of the middle or proximal thirds of the clavicle, past or present history of any injuries or fractures of the ipsilateral upper limb (humerus head/neck), scapula fracture, presence of neurovascular injuries along with fractures or fractures with associated bone disorders. A predesigned pretested questionnaire was used to collect data. The questionnaire had questions about the socio-demographic details, clinical and surgical details.

Figure 1: Lateral clavicle locking plate.

The implant/lateral clavicle locking plate

Lateral clavicle locking plate

The lateral clavicle locking plate (LCP) superior anterior clavicle plate with lateral extension is an anatomically precontoured fixation system with three to eight medial shaft holes for 3.5 mm locking or 3.5 mm cortex screws and six lateral 2.7 mm divergent locking or 2.4 mm cortex screws.

Preoperative procedure

Patients admitted with lateral end clavicle fractures were examined and X-rays of clavicle in AP was obtained. Arm pouch was used to prevent further displacement and to reduce the pain and spasm.

Oral and parenteral NSAIDs were used in most cases to relieve pain.

Routine blood investigations; hemoglobin level, urine routine, bleeding and clotting time, blood urea, serum creatinine, random blood sugar levels, electrocardiogram, chest x-rays were obtained as a part of the pre-anaesthetic evaluation.

Fractures were classified according to Neer's classification for lateral end clavicle fractures. Patient was advised to perform active finger movements. Pre-anesthetic evaluation was done for all cases. Prophylactic parenteral 2nd generation cephalosporin was administered one hour prior to surgery and postoperatively. Preparation of parts and scrubbing done prior to surgery.

Type of anaesthesia

Brachial block was used. For few patients' surgery was done under general anesthesia.

Surgical procedure

All patients underwent surgical intervention with open reduction and internal fixation (ORIF) in beach chair position with the affected arm in a mobile position, and in the supine position with a roll of towel in between the scapula to retract the clavicle. The head of the patient was turned towards the opposite side to get a clear view of the operating site. A horizontal incision was taken over the superior clavicle, centring the fracture. This was followed by subcutaneous dissection taking care of the supraclavicular nerves. Division of platysma exposed the clavicle. The reduction was achieved and maintained by a temporary Kirchner wire fixation. A pre-contoured locking compression plate (LCP) lateral clavicle locking plate was used to fix the fracture, with the help of 3.5 mm locking and cortical screws on the medial side and 2.7 mm locking screws on the lateral side. The closure was done in layers. Post-surgery the arm was immobilized in an arm pouch.

Postoperative physiotherapy

Patients started physiotherapy on the first postoperative day following a standard rehabilitation protocol: active and passive range of movement was encouraged within the pain free arc. With decreasing pain, this training was progressed with strengthening exercises of the rotator cuff and shoulder muscles. Return to sportive activity of the upper extremities was allowed after radiological union of fracture.

X-rays were taken preoperative, immediate postoperative and subsequently at 4 weeks, 8 weeks, 12 weeks and 6 months. Placement of plate, implant loosening, osteolysis, cut out of the plate and fracture union were assessed at serial intervals.

Follow up

Post–operatively, all the patients were followed up at 4, 8, 12 weeks and 6 months. Functional assessment was done using Constant Murley score at each follow up.[30]

Statistical analysis

The data collected were entered in the Microsoft excel sheet and double checked for errors. Categorical variables are expressed in percentages and proportions while mean and standard deviation are used to express continuous variables. Association between continuous variables are determined using independent samples't' test and Chi – square test is used to determine the association between categorical variables. P value of <0.05 is considered statistical significant and <0.01 highly statistically significant.

Ethical clearance

Obtained from the institutional ethics committee. All the participants were explained about the purpose of the study in vernacular language in understandable manner. Confidentiality of the information was assured and the participants were free to withdraw anytime from the study if there was any breach in ethics during the course of the study.

RESULTS

The time from trauma to surgery ranged from 0-15 days with a mean of 5 days and the mean operating time was 41 minutes ranging between 23-70 minutes. Mean duration to union was 13.33±2.126 weeks and the mean Constant Murley score was 88.56.

Table 1: Socio–demographic and clinical profile of the study population (n=60).

Characteristic	Number	Percentage (%)
Age (in years)		
18–30	08	13.3
31–40	16	26.7
41–50	23	38.3
>51	13	21.7
Gender		
Male	46	76.7
Female	14	23.3
Side of fracture		
Right	38	63.3
Left	22	36.7
Mode of injury		
RTA	42	70.0
Fall	18	30.0
Associated injuries		
Ipsilateral rib fracture	07	11.7
Ipsilateral tibia fracture	02	03.3
Contralateral lateral malleoli fracture	02	03.3
Ipsilateral radius fracture	02	03.3
None	47	78.4
Complications		
AC joint dislocation	06	10.0
Plate back out with dislocation	02	03.3
None	52	86.7
Functional outcome at 6 months (Figure 2)		
Excellent	08	13.3
Good	37	61.7
Fair	13	21.7
Poor	02	03.3

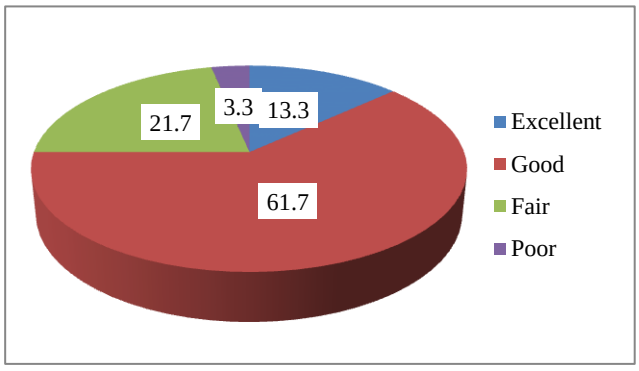

Figure 2: Functional outcome in patients.

DISCUSSION

Lateral end clavicle fractures are one of the common upper limb fractures encountered in orthopaedic practice, constituting approximately a quarter of all clavicle fractures. These injuries are not uncommon and account for 20% of all fractures of the clavicle.[5,7-10] The incidence is about 29 per 100,000 population per year.[11] Nonoperative management of lateral clavicle fractures results in a good outcome in up to 98% of minimally displaced or not displaced fractures while rates increase with displacing of the fractures.[14] The rate of nonunion following nonoperative treatment of unstable distal clavicle fractures is higher, and in the literature ranges from 11% to 40% in small case series.[7] Therefore, operative management is preferred for most displaced fractures. The use of a precontoured superiorly placed locking plate and screws, for fixing fractures of the lateral end of the clavicle, is a recent development.[24,25] In the case of an unstable fracture of the distal clavicle, the plate only neutralizes the horizontally applied force and hence, a locked plate placed superiorly does not adequately neutralize all of the forces acting at the fracture site, which act predominantly to pull the lateral fragment inferiorly.[28]

In the present study, mean duration to union was 13.33±2.126 weeks, which is similar to other studies by Robinson et al and Rokito et al.[31,32] Fleming et al reviewed 19 patients who underwent surgery with superior pre-countered locking plates for displaced distal-third clavicle fractures. All patients achieved union by 4 months and no plates have been removed.[33] In the study conducted by Klein et al use of locking plates, had a high union rate (near 100% overall) and relatively few

complications.[8] Of 64 total patients, there were five reported complications, including two infections, two occurrences of screw loosening, and one malunion.[8]

In the present study, there was 100% union and excellent to good outcome (By Constant Murley score) in 75% patients which is comparable to the study conducted by Qureshi et al for locking plates, which showed a union rate of 97.7% and Constant Murley score excellent to good outcome in 73% patients.[34] Studies have demonstrated high union rates following lateral clavicle fracture fixation with good-to-excellent functional outcomes and a combined complication rate of approximately 6%, when superiorly placed locking plates were used.[35]

In a systematic review of different modes of fixation it was found that rates of nonunion are similar between each mode of fixation.[25] Recent studies reporting the results of lateral clavicle locking plates have almost universally described the use of a coracoclavicular sling or coracoclavicular screw to augment locking plate fixation.[8,24,29] This "belt and braces" approach to the locking plate fixation technique reinforces the assertion that the plate itself does little to counteract the displacement forces at the fracture site.

CONCLUSION

Various techniques have been tried to manage unstable distal clavicle fractures. Although there is no consensus as to a “gold standard” fixation method for unstable distal clavicle fractures, satisfactory outcomes could be obtained using the lateral clavicle locking plate resulting in sufficient stabilization and good functional outcome. Lateral clavicle locking plate fixation is an absolute indication for the comminuted lateral clavicle fracture. It facilitates early mobilization of the shoulder postoperatively and results in a high percentage of union with a good objective and subjective shoulder function. The present study suggests that lateral clavicle locking plate fixation for the treatment of unstable distal clavicle fractures can achieve good results. Care should be taken when using a lateral clavicle locking plate particularly when the lateral fragment is small and comminuted. The locking plate technique does not cause rotator cuff injury or subacromial impingement and thus, does not require plate removal. AC joint dislocation in locking plate was one of the complication. As shown by other studies, reconstruction of the coracoclavicular ligaments additionally to locking plate osteosynthesis might show superior biomechanical stability results. More multicentric studies in large samples with longer follow up may be conducted. Comparative studies with other modalities are recommended for further evidence.

Limitations

This is a study done with a small sample in a single setting. There were no controls in the study for accurate comparison. However, comparison has been made with results from previous studies.

ACKNOWLEDGEMENTS

We sincerely acknowledge the patients for their kind co–operation for the study. We are grateful to the editor and the publisher of the journal.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Van der Meijden OA, Gaskill TR, Millett PJ. Treatment of clavicle fractures: current concepts review. J Shoulder Elbow Surg. 2012;21(3):423-9.
2. Toogood P, Horst P, Samagh S, Feeley BT. Clavicle fractures: a review of the literature and update on treatment. Phys Sports Med. 2011;39(3):142-50.
3. Allman FL. Fractures and ligamentous injuries of the clavicle and its articulation. J Bone Joint Surg Am.1967;49(4):774-84.
4. Nordquit A, Peterson C. The incidence of fractures of the clavicle. Clin Orthop Relat Res. 1994;300:127-32.
5. Robinson CM. Fractures of the clavicle in the adult. Epidemiology and classification. J Bone Joint Surg Br. 1998;80(3):476-84.
6. Postacchini F, Gumina S, De Santis P, Albo F. Epidemiology of clavicle fractures. J Shoulder Elbow Surg. 2002;11(5):452-6.
7. Khan LAK, Bradnock TJ, Scott C, Robinson CM. Fractures of the clavicle. J Bone Joint Surg Am. 2009;91(2):447-60.
8. Klein SM, Badman BL, Keating CJ, Devinney DS, Frankle MA, Mighell MA. Results of surgical treatment for unstable distalclavicular fractures. J Shoulder Elbow Surg. 2010;19(7):1049-55.
9. Flinkkilä T, Ristiniemi J, Hyvönen P, Hämäläinen M. Surgical treatment of unstable fractures of the distal clavicle: a comparative study of Kirschner wire and clavicular hookplate fixation. Acta Orthop Scand. 2002;73(1):50-3.
10. Nordqvist A, Petersson C, Redlund-Johnell I. The natural course of lateral clavicle fracture. 15 (11–21) year follow-up of 110 cases. Acta Orthop Scand. 1993;64(1):87-91.
11. Sajid S, Fawdington R, Maneesh Sinha M. Locking plates for displaced fractures of the lateral end of clavicle: Potential pitfalls. Int J Shoulder Surg. 2012;6(4):126-9.
12. Sambandam B, Gupta R, Kumar S, Maini L. Fracture of distal end clavicle: A review journal of clinical orthopaedics and trauma. 2014;5:65-73.
13. Paladini P, Pellegrini A, Merolla G, Campi F, Porcellini G. Treatment Of Clavicle Fractures. Translational Medicine @ UniSa. 2012;2(6):47-58.

14. Robinson CM, Court-Brown CM, McQueen MM, Wakefield AE. Estimating the risk of nonunion following nonoperative treatment of a clavicular fracture. J Bone Joint Surg Am. 2004;86-A(7):1359-65.
15. Kona J, Bosse MJ, Staeheli JW, Rosseau RL. Type II distal clavicle fractures: a retrospective review of surgical treatment. J Orthop Trauma. 1990;4(2):115-20.
16. Neer CS. Fracture of the distal clavicle with detachment of the coracoclavicular ligaments in adults. J Trauma. 1963;3:99-110.
17. Bosworth BM. Acromioclavicular separation. New method of repair. Surg Gynecol Obstet. 1941:73:866-71.
18. Faraj AA, Ketzer B. The use of a hook-plate in the management of acromioclavicular injuries. Report of ten cases. Acta Orthop Belg. 2001;67(5):448-51.
19. Hessmann M, Kirchner R, Baumgaertel F, Gehling H, Gotzen L. Treatment of unstable distal clavicular fractures with and without lesions of the acromioclavicular joint. Injury. 1996;27(1):47-52.
20. Goldberg JA, Bruce WJ, Sonnabend DH, Walsh WR. Type 2 fractures of the distal clavicle: a new surgical technique. J Shoulder Elbow Surg. 1997;6(4):380-2.
21. Levy O. Simple, minimally invasive surgical technique for treatment of type 2 fractures of the distal clavicle. J Shoulder Elbow Surg. 2003;12(1):24-8.
22. Webber MC, Haines JF. The treatment of lateral clavicle fractures. Injury. 2000;31(3):175-9.
23. Ravish VN, Bharath Raju G, Chopra A. Clinical and radiological outcome of lateral end clavicle fractures treated with locking compression plate: Prospective study of 19 cases. Int J Orthopaed Sci. 2017;3(2):19-22.
24. Andersen JR, Willis MP, Nelson R, Mighell MA. Precontoured superior locked plating of distal clavicle fractures: A new strategy. Clin Orthop Relat Res. 2011;469:3344-50.
25. Oh JH, Kim SH, Lee JH, Shin SH, Gong HS. Treatment of distal clavicle fracture: A systematic review of treatment modalities in 425 fractures. Arch Orthop Trauma Surg. 2011;131:525-33.
26. Egol KA, Kubiak EN, Fulkerson E, Kummer FJ, Koval KJ. Biomechanics of locked plates and screws. J Orthop Trauma. 2004;18:488-93.
27. Neer CS. Fractures of the distal third of the clavicle. Clin Orthop Relat Res. 1968;58:43-50.
28. Post M. Current concepts in the treatment of fractures of the clavicle. Clin Orthop Relat Res. 1989;245:89-101.
29. Largo RD, Rudin MA, Hotz TK, Valderrabano V, Käch KK. Anatomic reconstruction of unstable lateral clavicular fractures. J Trauma. 2011;71:1348-51.
30. Constant CR, Murley AG. A Clinical Method of Functional Assessment of the Shoulder. Clin Orthopaed Rel Res. 1987; 214-6.
31. Robinson CM, Akhtar MA, Jenkins PJ, Sharpe T, Ray A, Olabi B. Open reduction and endobutton fixation of displaced fractures of the lateral end of the clavicle in younger patients. J Bone Joint Surg Br. 2010;92-B(6):811-6.
32. Rokito AS, Zuckerman JD, Shaari JM, Eisenberg DP, Cuomo F, Gallagher MA. A comparison of nonoperative and operative treatment of type II distal clavicle fractures. Bull Hosp Jt Dis. 2002;61(1-2):32-9.
33. Fleming MA, Dachs R, Maqungo S, du Plessis JP, Vrettos BC, Roche SJ. Angular stable fixation of displaced distal-third clavicle fractures with superior precontoured locking plates J Shoulder Elbow Surg. 2015;24(5):700-4.
34. Faisal Q, Mahesh SG, Gudda NL, Sudhakar BK, Chaitanya W. Treatment of lateral third clavicle fractures by locking compression plate- a prospective study. Intl J Clin Diag Res. 2017;5(4):78-84.
35. Ieong E, Ferran NA. Lateral Clavicle Fracture Fixation Using a Superiorly Placed Locking Plate. JBJS Essent Surg Tech. 2016;6(4):e40.

Cite this article as: Nageswara RV, Ravichandra V, Lavanya KM, Swamy CG. Management of lateral end clavicle fractures-using lateral clavicle locking plate: a prospective study. Int J Res Orthop 2020;6:139-44.