

A Hospital-Based Assessment of the Various Aspects of Patients with Fracture of Lateral End of Clavicle Using Different Modalities of Management: A Comparative Study

Kumar Mayank¹, Ranjan Kumar Prakash², Dilip Kumar Singh³

¹Senior Resident, Department of Orthopaedic, Jawahar Lal Nehru Medical College & Hospital, Bhagalpur, Bihar, India

²Senior Resident, Department of Orthopaedic, Jawahar Lal Nehru Medical College & Hospital, Bhagalpur, Bihar, India

³Professor, Department of Orthopaedic, Jawahar Lal Nehru Medical College & Hospital, Bhagalpur, Bihar, India

Received: 05-02-2023 Revised: 08-03-2023 / Accepted: 03-04-2023

Corresponding author: Dr. Ranjan Kumar Prakash

Conflict of interest: Nil

Abstract

Aim: The objective of the present study was to evaluate various aspects of patients with fracture of lateral end of clavicle using different modalities of management.

Materials and Methods: The study was conducted in the Department of Orthopaedics Jawahar Lal Nehru medical College & Hospital, Bhagalpur, Bihar, India for a period of 1 year. A total of 50 patients reporting to the Orthopaedics OPD and casualty with fractures of the lateral end of the clavicle were considered for the study. Complete details were taken regarding mode of injury, age, limb affected. Patients operated with pre-counterlocked locking plate were included in Group A and those operated with clavicular Hook plates were included in Group B.

Results: The average age of patients was 24.8 years, ranging from 18 to 28 years. 25 cases were operated in Group A (pre-contoured locking compression plate) and 25 cases were operated in Group B (clavicular hook plate). Road traffic accident being the most common mechanism of injury (70%) followed by self-fall (24%). The time from trauma to surgery ranged from 0-7 days with a mean of 4 days in both group. Based on the Constant-Murley score, 24% of the patients in the operative group had an excellent outcome, 48% had a good and 16% had satisfactory functional outcome. In group B, 16% showed excellent outcome, 44% satisfactory outcome and 32% showed satisfactory outcome. The functional outcome was significantly better in the operative Group A than in Group B during the period of follow up.

Conclusion: In conclusion, precontoured locking plates provide adequate stable fixation for the lateral end clavicle fractures and are not associated with any major complications.

Keywords: Lateral end clavicle fractures, Neer's classification, Coraco-clavicular fixation, Constant shoulder score, Static tension band principle.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Fractures of the clavicle are common injuries of adults, accounting for about 3% of all injuries. [1] They are often caused by

either a direct blow to the anterior chest wall or by a fall on the outstretched hand. The commonest site of fracture in clavicle

is the midshaft followed by the lateral end, which accounts for about 25% of all the clavicle fractures. [2,3] Twenty-five percent of these fractures are unstable due to the displacing forces acting on the fracture fragments: an inferior force on the lateral clavicle fracture fragment and an anterosuperior force on the medial clavicle fragment. These fractures can be classified using the Neer's Classification. [4] The lateral fractured fragment is small and hence, it is difficult to get an anatomical reduction and also poses problems in its fixation, which results in instability of the lateral clavicle fractures. Many treatment modalities have been used for the management of such fractures.

Major factors which leads to displacement of these fracture patterns are the weight of affected side upper limb and pull of the latissimus dorsi, pectoralis muscles and scapular rotations pull the distal fragments downward and the trapezius pulls the proximal fragment superiorly. Unfortunately, there is no reference standard treatment recommendation for this fracture. [5] Conservative treatment of severely displaced clavicle fractures has been observed with poor outcomes like malunion and non-union (22%-50%) and shows good outcome up to 95%-98% in minimally displaced or Undisplaced fractures.

It is difficult to get an anatomical reduction due to various deforming forces which also poses problems in its fixation resulting in instability of the lateral clavicle fractures as the fractured fragment is small. [6] Flexible or rigid surgical fixation helps to avoid the deforming forces acting on these fragments and help in maintaining reduction. Surgical options described in literature are K-wire fixation [7], lateral end of the clavicle excision, screw stabilisation from the clavicle to the coracoid process, coracoclavicular screws [8-10], tension bands, CC screws [11], hook plates [12,13], nonlocked plate and superiorly placed locking plates. [14]

Although fractures of the clavicle do not pose a significant diagnostic dilemma, there have been few injuries with as much controversy in regards to treatment of these fractures. The management of fractures of the distal clavicle or the lateral end, has been a matter of great debate in literature. The objective of the present study was to study various aspects of patients with fracture of lateral end of clavicle using different modalities of management.

Materials and Methods

The study was conducted in the department of Orthopaedics Jawahar Lal Nehru medical College & Hospital, Bhagalpur, Bihar, India for a period of 1 year. A total of 50 patients reporting to the Orthopaedics OPD and casualty with fractures of the lateral end of the clavicle were considered for the study. Complete details were taken regarding mode of injury, age, limb affected. Patients operated with pre-counteracted locking plate were included in Group A and those operated with clavicular Hook plates were included in Group B.

Patients

All patients were more than 18 years, and no minors were included in this study. Patients presenting with an acute fracture of lateral end clavicle (Neer's Type II) were considered for the study. Fractures more than 7 days old, with neurovascular deficits, severe brain injury, intubated patients, those with open fractures and those with injury preventing operative fixation within 7 days of admission were excluded from our study. Patients were included in this study after explaining the procedure in their own language and necessary consent was obtained after the patients showed their willingness to participate in the study. A detailed history was elicited regarding mechanism of injury and enquiry was made to note site of pain and its nature. Decision to operate was made based on surgeon's assessment

and patient's consent. Plain x-ray of clavicle with both shoulders in anteroposterior view was taken to assess the site of fracture and the fracture type.

Preoperative procedure

Oral and parenteral NSAIDs were used in most cases to relieve pain after their admission and arm sling was given to prevent further displacement, to reduce spasm and pain. Patient was advised to perform active finger movements. Fractures were classified according to Neer's classification. [7] Pre-anaesthetic evaluation was done for all cases. Preparation of parts and scrubbing was done prior to surgery. Prophylactic parenteral 2nd generation cephalosporin was administered one hour prior to surgery and postoperatively.

Surgery

Surgery was planned and the patient underwent surgery as soon as possible after initial assessment and workup for operative intervention. In all the patients selected for our study, open reduction and internal fixation (ORIF) was done using either a 3.5 mm pre-contoured locking plate or with clavicular Hook plates.

All the surgeries were performed under general anaesthesia either in a beach chair position with the affected arm in a mobile position or in supine position with roll of towel between scapula to retract clavicle. Head being turned to opposite side for

better view in both positions. Centring over the fracture site, horizontal incision was taken over superior clavicle. Subcutaneous tissue and platysma is separated to expose the fracture site and fracture was fixed with either of the plates. The closure was done in layers.

Postoperative protocol

In both the groups, post-surgery the arm was immobilized in an arm pouch and Antibiotic coverage was given for 5 days. Sutures were removed on 12th day post-operatively. 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. Active range of shoulder motion with abduction limited to 80 degrees was started 4 to 6 weeks post-operatively. X-rays were taken preoperative, immediate postoperative and subsequently at 4 weeks, 8 weeks, 12 weeks and 6 months where serial monitoring was done regarding placement of plate, implant loosening, osteolysis, cut out of plate and fracture union.

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. [15,16]

Results

Table 1: Patient details

| Characteristics | Group A(n=25) | | Group B(n=25) | |
|-------------------------|---------------|----------------|---------------|----------------|
| | Number(n) | Percentage (%) | Number(n) | Percentage (%) |
| Age (in years) | | | | |
| 18-35 | 12 | 48 | 13 | 52 |
| 36-55 | 9 | 36 | 8 | 32 |
| >56 | 3 | 16 | 4 | 16 |
| Gender | | | | |
| Male | 18 | 72 | 19 | 76 |
| female | 7 | 28 | 6 | 24 |
| Side of fracture | | | | |
| Right | 11 | 44 | 10 | 40 |
| left | 14 | 56 | 15 | 60 |

| Mode of injury | | | | |
|----------------|----|----|----|----|
| RTA | 15 | 60 | 20 | 80 |
| Self-fall | 8 | 32 | 4 | 16 |
| others | 2 | 8 | 1 | 4 |
| Union time | | | | |
| ≤ 8 weeks | 23 | 88 | 20 | 80 |
| > 8 weeks | 2 | 12 | 5 | 20 |

The average age of patients was 24.8 years, ranging from 18 to 28 years. 25 cases were operated in Group A (pre-contoured locking compression plate) and 25 cases were operated in Group B (clavicular hook plate). Road traffic accident being the most common

mechanism of injury (70%) followed by self-fall (24%). In Group A, 88% had union time of 8 weeks or less whereas in Group B 80% had union time of 8 weeks or less with 14% showing excellent outcome.

Table 2: Functional outcome

| Functional outcome at 6 months | | | | |
|--------------------------------|---------|----|---------|----|
| | Group A | | Group B | |
| Excellent | 6 | 24 | 4 | 16 |
| Good | 12 | 48 | 11 | 44 |
| Fair | 4 | 16 | 8 | 32 |
| poor | 3 | 12 | 2 | 8 |

Based on the Constant-Murley score, 24% of the patients in the operative group had an excellent outcome, 48% had a good and 16% had satisfactory functional outcome. In group B, 16% showed excellent

outcome, 44% satisfactory outcome and 32% showed satisfactory outcome. The functional outcome was significantly better in the operative Group A than in Group B during the period of follow up.

Table 3: Complications

| Complications | Group A | Group B |
|-----------------|---------|---------|
| Infection | 0 | 0 |
| Implant failure | 1 | 1 |
| Non-union | 0 | 0 |
| malunion | 0 | 1 |

One implant failure (in the form of screw loosening) was noted in both group and there was one incidence of Malunion in Group B.

Discussion

Clavicle fractures are categorized into proximal, mid-shaft and distal fractures. Most of them are mid-shaft fractures that unite satisfactorily with non-operative treatment. In contrary, fractures of the distal one third of clavicle are an exception that carries a high non-union rate.

Therefore it is important to recognize this distinct clavicle fracture as different entity and treat it properly. With the advent of newer techniques of fixation, it is expected that the problems related to its fixation, complications, and outcomes would be reduced significantly. Clavicle fractures were generally treated by non-operative means. The lateral end clavicle fractures where the distal fractured fragment is small and the deforming forces are great, the nonoperative treatment fails as it is associated with the significant incidence of

complications like malunion, nonunion, joint stiffness, etc. The deforming forces are due to the powerful pull of the muscles along with the presence of the coracoacromial ligament and the coracoclavicular ligament and the weight of the arm. They are responsible for the instability of the fracture along with malunion and nonunion, which leads to functional disabilities. Hence, the need for surgical management in the form of stable fixation is necessary. Various surgical procedures for lateral clavicle fractures have been used like K-wire fixation, screw fixation, tension band wiring, hook plates, non-locking and locking plates.

Operative management is preferred for most displaced fractures as the rate of non-union is higher following non-operative treatment of unstable lateral clavicle fractures and the literature ranges from 11% to 40% in small case series. [17] However other associated injuries like rib fracture, scapula injury, humerus fracture, Radius and/or ulna fracture of ipsilateral side also affects the functional outcome of that affected upper limb. There are numerous options available for the operative management. Special pre-contoured locking plates [18,19] clavicular hook plates [20,21] were two of most commonly used fixation tools for unstable lateral clavicular fracture where both showed good functional outcome and union rate when compared to other modes of fixation. AO hook plate result in rotator cuff injury, shoulder stiffness, and acromioclavicular joint osteoarthritis which has been reported by Henkel et al. [22] It is such that it has no rotational stiffness but allow normal rotation at the AC joint allowing undisturbed bone healing.

Sambandam et al. [23] commented that hook plates result in major complications despite giving good functional outcome. Distal clavicle fracture can also be fixed with Distal radius plate. Fixation with K wires and applying a tension band is an

age old technique for these fracture. Kalamaras et al. [24] described use of a low profile volar distal radius locking plate, in which all patients achieved union with a mean Constant-Murley score of 96 and this reported major complication in 10% of the patients. In our present study, there was 100% union and excellent to good outcome (By Constant-Murley score) in 72% in Group A and 60% in Group B. Qureshi et al. [25] for locking plates, which showed a union rate of 97.7% and Constant-Murley score excellent to good outcome in 73% patients. [26]

Conclusion

In conclusion, precontoured locking plates provide adequate stable fixation for the lateral end clavicle fractures and are not associated with any major complications. This low profile implant is easy to use and fits well to the contour of the lateral end of the clavicle and offers multi planar screw fixation in this small fragment providing stability. It may well be the answer to the fixation woes of the lateral clavicle fractures. Although, larger comparative studies between the various surgical treatment methods are required to confirm the same.

References

1. Robinson CM. Fractures of the clavicle in the adult: epidemiology and classification. The Journal of bone and joint surgery. British volume. 1998 May;80(3):476-84.
2. Robinson CM, Cairns DA. Primary nonoperative treatment of displaced lateral fractures of the clavicle. JBJS. 2004 Apr 1;86(4):778-82.
3. Khan LK, Bradnock TJ, Scott C, Robinson CM. Fractures of the clavicle. JBJS. 2009 Feb 1;91(2):447-60.
4. CHARLES S NEER II. 5 Fractures of the distal third of the clavicle. Clinical Orthopaedics and Related Research (1976-2007). 1968 May 1; 58:43-50.

5. Pandya NK, Namdari S, Hosalkar HS. Displaced clavicle fractures in adolescents: facts, controversies, and current trends. *J Am Acad. Or-thop Surg.* 2012;20(8):498-505.
6. Robinson CM. Fractures of the clavicle in the adult. *Epidemiology and classification.* *J Bone Joint Surg Br.* 1998;80(3):476-84.
7. Neer CS. Fracture of the distal clavicle with detachment of the coracoclavicular ligaments in adults. *J Trauma.* 1963; 3:99-110.
8. 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.
9. Largo RD, Rudin MA, Hotz TK, Valderrabano V, Käch KK. Anatomic reconstruction of unstable lateral clavicular fractures. *J Trauma.* 2011; 71:1348-51.
10. Klein SM, Badman BL, Keating CJ, Devinney DS, Frankle MA, Mighell MA. Results of surgical treatment for unstable distal clavicular fractures. *J Shoulder Elbow Surg.* 2010;19(7):1049-55.
11. Bosworth BM. Acromioclavicular separation. New method of repair. *Surg Gynecol Obstet.* 1941;73:866-71.
12. 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.
13. 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.
14. 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.
15. Largo RD, Rudin MA, Hotz TK, Valderrabano V, Käch KK. Anatomic reconstruction of unstable lateral clavicular fractures. *Journal of Trauma and Acute Care Surgery.* 2011 Nov 1; 71(5):1348-51.
16. Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. *Clinical orthopaedics and related research.* 1987 Jan 1(214):160-4.
17. Khan LK, Bradnock TJ, Scott C, Robinson CM. Fractures of the clavicle. *JBJS.* 2009 Feb 1;91(2):447-60.
18. Andersen JR, Willis MP, Nelson R, Mighell MA. Precontoured superior locked plating of distal clavicle fractures: a new strategy. *Clinical Orthopaedics and Related Research®.* 2011 Dec; 469:3344-50.
19. Oh JH, Kim SH, Lee JH, Shin SH, Gong HS. Treatment of distal clavicle fracture: a systematic review of treatment modalities in 425 fractures. *Archives of orthopaedic and trauma surgery.* 2011 Apr; 131:525-33.
20. 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.
21. 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.
22. Henkel T, Oetiker R, Hackenbruch W. Treatment of fresh Tossy III acromioclavicular joint dislocation by ligament suture and temporary fixation with the clavicular hooked plate. *Swiss surgery= Schweizer Chirurgie= Chirurgie suisse= Chirurgia svizzera.* 1997 Jan 1;3(4):160-6.
23. Sambandam B, Gupta R, Kumar S, Maini L. Fracture of distal end clavicle: a review. *Journal of clinical*

- Orthopaedics and Trauma. 2014 Jun 1;5(2):65-73.
24. Kalamaras M, Cutbush K, Robinson M. A method for internal fixation of unstable distal clavicle fractures: early observations using a new technique. *Journal of shoulder and elbow surgery*. 2008 Jan 1;17(1):60-2.
25. 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.
26. Lechheb, Khadija, Berdi, Fadoua, Ennafah, Wafaa, & Lamsaouru, Jamal. Analyse Des Risques a Priori En Unite De Retrocession Au Sein De L' unite De Gestion Des Produits a Statuts Particuliers a L'hmimv De Rabat: Processus De Dispensation. *Journal of Medical Research and Health Sciences*, 2022; 5(10): 2307–2316.