

Outcomes of fractures of lateral end of clavicle using different modalities of management

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Abstract

Background: A fracture of lateral end of clavicle has been greatly under-rated in respect to pain and disability. The “usual or routine” treatment is perhaps far short of satisfying, relieving therapy.

Aims: Aims of this retrospective study were to study various aspects of patients with fracture of lateral end of clavicle like age, occupation, mode of injuries, type of fracture, etc. Study also aims to evaluate outcome of conservative versus operative treatment of Neer’s type II lateral end clavicle fractures and ultimately to determine which treatment modality is most suitable for such fractures.

Materials and Methods: Depending on fracture pattern, patients admitted for lateral end clavicle fractures, were either treated conservatively or operatively. Various surgical modalities like plate-screw fixation, K-wiring, tension band wires and coraco-clavicular screw fixation were used. Patients were assessed at admission, 3 months and 6 months post admission. Final outcome was judged in terms of union, range of movement, duration for fracture union, neurological status and ability to perform activities of daily life. The constant shoulder score was used to assess overall functional outcome.

Results and Conclusions: Most of the patients were young males having high functional demands who sustained injury due to fall from height or vehicular accident. Although non union was more common in conservative group, functional outcome was acceptable. We conclude that non surgical treatment should be considered as the first line treatment in type I and III and few type II cases. Operative treatment is preferred in type II unstable fractures. Coraco-clavicular fixation turned out to be the most preferred modality of surgical management for such fractures as compared to the plate-screw construct and k-wiring with or without TBW.

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

Introduction

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.

“A fracture of lateral end clavicle has been greatly underrated in respect to pain and disability. The usual or routine treatment is perhaps far short of satisfying, relieving therapy.”

Carter R. Rowe, 1968

Clavicle fractures constitute 44% of all shoulder girdle injuries. The fractures of the clavicle reportedly represent 2.6% of all fractures.^(1,2) 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.

Neer in 1968 suggested a new classification and proposed general treatment guidelines for fractures of lateral end of clavicle. Due to the unstable nature of Neer’s type II fractures, the risk of fracture non-union is high with an average of 30%. The high rate of non-union is secondary to excessive motion at the fracture site.

Neer’s classification of lateral end clavicle fractures:

- Type I – coracoclavicular ligaments intact.
- Type II – coracoclavicular ligaments detached from the medial segment but trapezoid intact to distal segment.
- Type III – intra-articular extension into the acromio-clavicular joint.

The **conservative treatment** includes pain medication, ice and compressive dressing to relieve pain and reduce swelling. Use of a shoulder immobilizer, figure of four strapping with arm sling is usually recommended.

Operative treatment includes coraco-clavicular (CC) stabilization, hook plate, intramedullary fixation, inter fragmentary fixation and K-wire plus tension band wiring (TBW).

Materials and Methods

This retrospective study includes patients having fracture of lateral end of clavicle treated either conservatively or operatively in our institute. Data was based on medical records of patients in the form of case sheets, discharge cards, x-rays, etc. Medical records of patients were assessed with respect to site of fracture, distribution according to age, occupation, mode of injury, closed/open, degree of comminution, treatment modalities, fixation techniques, etc. The type of fracture was determined by Neer's classification. Then according to the nature of the fracture, patient was either treated conservatively or surgically.

Patients were given information sheet informing the procedure and informed written consent was obtained prior to surgical intervention. Patients were assessed at admission, 3 months and 6 months post admission. Complications such as stiffness, infection, non-union, malunion, hardware impingement, etc. were noted. Final outcome was judged in terms of union, range of movement, duration for union of fracture, neurological status and ability to perform activities of daily life. The constant shoulder score was used to assess overall functional outcome.

Aims and Objectives

- 1) To systemically summarize outcomes of lateral end clavicle fractures in terms of :
 - Distribution according to age, occupation, mode of injury, type of fracture, local condition.
 - Clinical effects of displacement, fracture patterns, fracture location, fracture comminution, shortening of clavicle.
 - Comparison of the results of different treatment options (non operative versus various modalities of surgical management).
 - To evaluate the non union and other complication rate according to the treatment methods that had been employed.
 - Functional recovery – to measure the functional outcomes using constant shoulder score.
 - Cosmetic deformity.
- 2) To evaluate the outcome of conservative versus operative treatment of Neer's type II lateral end clavicle fractures.
- 3) To determine which treatment modality is most suitable.

Observation and Discussion

Out of the 30 patients having fracture of lateral end of clavicle, 15 were managed non-operatively and 15 were operated using different modalities. In operative modalities, 6 (40%) cases were operated in the form of tension band wiring, 5 (33%) patients using plates and screws, 4 (27%) using coraco-clavicular screw fixation. It was chosen according to fractures configuration.

The Nordqvist study concluded that fracture of the lateral end of clavicle does not require surgery. In the

Robinson CM, Cairns DA study, non-operative treatment of most displaced lateral fractures of the clavicle in middle-aged and elderly patients achieved a good medium-term functional result. But several authors (Neer 1960, 1963), Neviasser (1963), Zenni et al (1981), Jager and Rreitner (1984), Eskola et al (1987) and Post (1989) have recommended open reduction and internal fixation in type II fractures of the distal end clavicle because of their tendency of slow healing and residual shoulder disability.

Majority of the patients in our study were young patients (44% patients below the age of 35, 34% of the patients between 35-50 yrs old). This group represents the working class of the society who are involved maximally in outdoor activities and manual labour. Mean age in the Nordqvist study was also 36 years.

Males out-numbered the females by approximately 3.3 times. This can be due to the fact that in our society, men are the main bread-winners and are more commonly involved in outdoor activities; so chances of their being involved in vehicular and occupational accidents are more.

In our study, 75% cases were either service-men or labourers, which can be explained by their chances of being involved in occupational and vehicular accidents. Also 6 (86%) out of 7 household (low demand people) preferred non-operative management and most business class and younger patients with higher functional demands preferred operative treatment.

Mode of injury of 50% patients in our study was fall from height and 40% patients had road traffic accident. This is in accordance with the Nordqvist study. Right side was affected in 67% of cases and dominant side was right in 83% of cases. Perhaps handedness plays a role in higher incidence of fractures seen on the right side due to the tendency of the falling patient to support himself with his dominant hand. Importance of side of injury lies in the future functional outcome requirements and the rehabilitation of patients.

A total of 8 (26%) cases had associated injuries like chest injury, lower limb or other upper limb injury. Most of these cases had high velocity trauma and were Neer's type II fractures. These systemic injury were responsible for delayed surgical intervention and preference to non-operative treatment. 87% of the patients treated surgically were operated within the first 4 days of admission. Indication of surgery was taken to be Neer's type II unstable fractures.

In our study, 20% patients were Neer's type I fracture pattern, 10% patients were Neer's type III, and the remaining 70% patients had Neer's type II fractures. All the patients of type I and III and 20% patients of type II were treated conservatively. All the patients that required surgery were Neer's type II variety. Results were similar in the Nordqvist study.

67% cases had clean local skin condition and the remaining 33% had local abrasion, in which most of the fractures were Neer's type II (70%). It can be explained

by high association of Neer's type II fractures with vehicular accidents and high energy trauma. Open fractures were excluded from our study.

In our study, 27 patients (90%) were immobilized in an arm sling for an average of 4-6 weeks. Only 3 patients (10%) were immobilized for >6 weeks because they did not show union at 6 weeks. They were kept immobilized until they showed clinic-radiological signs of bony union. Neer's type I and III fractures needed shorter period of immobilization compared to type II fractures.



Coraco-clavicular screw fixation

In our series, all type I and III were well united with conservative treatment. No case of non-union was noted. Similar findings were observed in the Webber MC and Haines JF study. Among Neer's type II fractures, 3 (50%) cases out of 6 had nonunion when managed conservatively and 1 (6.66%) case out of 15 had nonunion when managed operatively. Thus operative treatment is preferred over non-operative in type II unstable lateral end clavicle fractures. The Neer's original report and the studies by Sylvia A Stegeman and Hakan Nacak showed the same type of results except that they had a few non unions in conservatively managed patients also, probably because of wrong patient selection.

Among the 4 non-unions, 2 (50%) cases were asymptomatic and both were managed conservatively. Among operative treatment modalities, coracoclavicular screw fixation/stabilization and plate and screw fixation were found to have 100% union rates. The 1 case of non union was initially treated with tension band wiring. In Ballmer FT, Gerber C study and Fazal MA, Saksena J, Haddad FS study, 100% union was seen in coracoclavicular fixation. In Joo Han Oh, Sae Hoon Kim study, 1.9% nonunion rate associated with coracoclavicular stabilization, 1% associated with hook plate and 5% associated with tension band wiring.



Distal clavicle locking plate fixation

Among the 26 fractures which united, time taken by 80% of fractures for union was less than 8 weeks, rest 20% took more than 8 weeks to unite. Overall average time for union was 7.8 weeks. Average time taken for union in Yu-Chuan Tsuei study was 8.62 weeks, 9 weeks in Ballmer FT, Gerber C study, 7 weeks in Macheras G study and 6 weeks in the Herrmann S study.

Out of the patients who were operated, 74% patients had no complications. Among the 6 cases operated with TBW, 2 (33.33%) cases had complications, while out of the 5 cases operated with plate and screw fixation, 2 patients developed complications. There was no complication in any patient treated with coracoclavicular fixation. Thus, coracoclavicular screw fixation having the highest union rates and no complications (in our study) proves to be the best option among all operative modalities. Although plate and screw fixation has high union rate, it was associated with high complication rate.



Hook plate fixation

Among the complications that were encountered, 2 patients developed pin migration and skin erosion, 1 patient developed acromio-clavicular arthrosis, 1 developed infection and 2 patients had hardware impingement. Out of the total 30 cases, 7 (23%) developed shoulder stiffness, out of which 6 patients

had type II fracture and 1 had type III fracture. Out of the 6 patients of type II fractures that developed shoulder stiffness, 3 (50%) were from the conservatively treated group and 3 (50%) were from the surgically treated group. Shoulder stiffness is highly associated with type II fractures due to longer requirement of immobilization, nonunion and complications.

In our study, 16 patients (54%) had full range of motion of the affected shoulder, 10 (33%) cases had good range of motion and 4 (13%) cases had abduction and external rotation limitation of >30 degrees. Only 1 case of non-operatively managed type II fractures had full range of motion while 10 cases of operatively managed type II fractures were associated with full range of motion. Thus operative management was found to be better in type II fractures in terms of gaining shoulder movement.

In our study, 6 (20%) cases had moderate pain and only 1 (3%) patient had severe pain at 2 months follow-up. All were associated with Neer's type II fractures. One case of type III fracture had no pain initially but later developed pain due to acromioclavicular arthrosis. Only 4 (13%) patients had moderate pain at final follow-up (at 6 months post injury). In Nordqvist study, incidence of pain was 8%.



Tension band fixation of distal clavicle fracture

Constant shoulder score of 23 (80%) cases had excellent to good outcome and 6 (17%) cases had satisfactory to adequate outcome and only 1 (3%) case had poor outcome. Mean constant shoulder score was 88.5 (good). The 1 case with poor outcome was surgically treated for type II fracture and had infection and nonunion. In C. Michael Robinson and David A. Cairns study, the mean constant shoulder score was 93.

Most of the patients i.e. 94% in our study did not require hospital stay for more than 7 days. Only 2 patients had prolonged hospital stay due to associated injuries. 73% of patients were fully satisfied with their results, while 20% were only partially satisfied and 7% were unsatisfied mainly because of pain while lifting weight and decreased motion at shoulder joint and cosmetic deformity.

All the patients who were treated conservatively, returned to their same profession. And among the operated patients, one had to change his occupation

mostly due to symptomatic nonunion and associated pain.

In our study, 6 (40%) cases managed conservatively had cosmetic deformity. Only 1 (6.66%) of all the operated patients had cosmetic deformity which was due to infection and partial loss of reduction after tension band wiring.



Fig. Showing a case with poor cosmetic outcome following conservative treatment



Fig. Showing patient with poor outcome following surgical treatment



Fig. Showing excellent functional outcome in a patient who underwent surgical treatment

Conclusion and Summary

From our study, after studying various parameters about patients with fracture of the lateral end of clavicle, we conclude that these fractures are very tricky and may mislead the surgeon to take it lightly enough to generate complications. We suggest that the distal clavicle fracture should be treated individually after sufficient discussion with the patients regarding high non-union rate and cosmetic problem after non-union in patients treated conservatively.

High demand patients should be treated surgically with anatomical reduction and stable fixation especially in Neer's type II fractures. The non-union rate is high with conservative treatment, however, the functional outcome including pain is acceptable in most of the cases with non-unions.

We believe that the prolonged period of immobilization required in conservative management is certainly a disadvantage. Also, given the high rate of non-union in conservatively treated type II fracture cases, operative fixation for displaced type II unstable fractures of distal clavicle should be recommended.

If surgical treatment of a distal clavicle fracture is indicated, then the fixation method with the least complication rate and the maximum union rate should be selected. Hence coraco-clavicular stabilization should be preferred modality of surgical management. K-wiring and tension band principle is sometimes preferred because of the simplicity of the procedure, low cost, simple hardware, high union rate and easy availability of the implant..

Though associated with higher rate of union, the number and severity of plate-related complications seems to disqualify this implant. Plating is associated with stress-shielding and the potential for re-fracture after implant removal. Plate removal requires another general anaesthesia to the patient while the coraco-clavicular screw can be removed under local anaesthesia. However, due to the limited quantity of

patients treated with plating, no definite conclusion can be drawn regarding plating as a modality of surgical management of lateral end of clavicle fractures.

Based on the current results from our study, we would conclude that there is no clear evidence, but nonsurgical treatment should be considered as the first line of treatment in Neer's type I and III and few stable cases of type II fractures of lateral end of clavicle. But operative treatment is preferred over conservative management for unstable, displaced type II fractures in terms of functional outcome, shoulder movement and deformity, particularly in younger population with high functional demand.

References

1. Nordqvist A, Petersson C (1994). The incidence of fractures of the clavicle. *Clin Orthop Relat Res* 300:127-132.
2. Postacchini F, Gumina S, De Santis P, Albo F (2002). Epidemiology of clavicle fractures. *J Shoulder Elbow Surg* 11(5):452-456.
3. Neer CS, Fractures of the clavicle, in Rockwood CA and Green DP – Fractures in adults. Vol.1, 2nd Edition, Philadelphia: JB Lippincott Co., 1984.
4. Meda PV, Machani B, Sinopidis C, Braithwaite I, Brownson P, Frostick SP (2006) – Clavicular hook place for lateral end fractures: a prospective study. *Injury* 37(3):277-283.
5. Neer CS II – Nonunion of the clavicle. *JAMA* 172:1006-1011,1960.
6. Yates DW. Complications of fractures of the clavicle. *Injury* 7:189-193,1976.
7. Charles A. Rockwood, Fredrick A. Matsen, Michael A. Wirth, Steven B. Lippitt, Edward V. Fehring and John W. Sperling. The Shoulder, Fourth edition, chapter 11, Fractures of the clavicle, 381-452.
8. Neer CS. Fractures of the distal clavicle. *Clin Orthop Relat Res* 1968;58:43-50.
9. Jupiter JB. Paper presented at the first open meeting of the American Shoulder and elbow surgeons, Miami, 2000.
10. Robinson CM, Cairns DA (2004) Primary non operative management of displaced lateral fractures of the clavicle. *J Bone Joint Surg Am* 86-A(4):778-782.
11. Nuber GW, Bowen MK. Acromioclavicular joint injuries and distal clavicle fractures. *J Am Acad Orthop Surg* 1997;5:11-18.
12. Edwards DJ, Kavanagh TG, flannery MC (1992). Fractures of the distal clavicle: a case of fixation. *Injury* 23:44-46.
13. Fann CY, Chiu FY, Chuang TY, Chen CM, Chen TH (2004). Transacromial Knowles pins in the treatment of Neer type 2 displaced clavicle fractures. A prospective evaluation of 32 cases. *J Trauma* 56:1102-1106.
14. Fuchs M, Losch A, Sturmer KM. (surgical treatment of fractures of the clavicle – indications, surgical technique and results) (in Germany). *Zentralbl Chir* 2002;127:479-484.
15. Ballmer FT, Gerber C (1991) Coracoclavicular screw fixation for unstable fractures of the distal clavicle. *J Bone Joint Surg Br* 73:291-294.
16. Yamaguchi H, Arakawa H, Kobayashi M (1998). Results of the Bosworth method for unstable fractures of the distal clavicle. *Int Orthop* 22:366-368.