Original Article

Journal of Orthopaedic Education
Volume 3 Number 2, July - December 2017
DOI: http://dx.doi.org/10.21088/joe.2454.7956.3217.14

Study of Functional Outcome of Displaced Fractures of Middle Third of Clavicle Managed By Operative Treatment

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Received: 03 October 2017, **Accepted on:** 12 October 2017

Abstract

Introduction: The present consensus that great majority of clavicular fractures heal with non operative treatment is no longer valid. The amount of pain and disability during the first three weeks of conservative treatment has been underrated and the common view that nonunion does not occur is wrong. Pressure from a displaced fragment on the retroclavicular part of the brachial plexus may cause symptoms after conservative treatment. *Methodology:* General information like name, age, sex, occupation and address were noted. Then a detailed history was elicited regarding mode of injury like fall on the shoulder, Road traffic accident, direct injury to shoulder and fall on outstretched hand. Enquiry was made to note site of pain and swelling over the affected clavicle. *Results:* In this study 17 patients (85%) had excellent functional outcome, 2 patients (10%) had good functional outcome and fair in 1 patient (5%). *Conclusion:* In this study precontoured locking plates were used as it is contoured to the shape of the clavicle. It is necessary to put the plate superiorly and atleast three screws to be applied medially and three screws laterally.

Keywords: Functional Outcome; Displaced Fractures of Middle Third of Clavicle; Operative Treatment.

Introduction

Clavicular fracture is one of the most common bony injuries. They account for 2.6% to 4% of adult fractures and 35% of injuries to the shoulder girdle.The clavicle is an S-shaped bone that acts as a strut between the sternum and the glenohumeral joint. It also has a suspensory function to the shoulder girdle .The shoulder hangs from the clavicle by the coracoclavicular ligament [1].

The most commonly used system of classification of clavicular fractures isAllman classification. It is divided into three groups [1]:

- Group I: Middle third
- Group II: Lateral third
- Group III: Medial third.

A weak spot in the clavicle is present at the midclavicular region, which accounts for most fractures occurring in this region. Numerous muscular and ligamentous forces act on the clavicle, and knowledge of these differing forces is necessary to understand the nature of displacement of clavicle fractures and why certain fracture patterns tend to cause problems if not reduced and surgically stabilized [2].

While the overwhelming majority of clavicle fractures are benign, associated life-threatening intrathoracic injuries are possible. Complications vary based on location of fracture. Fracture of the clavicle is associated with delayed union or nonunion, brachial plexus compression resulting from hypertrophic callus formation, compression or laceration of the great vessels, trachea, or esophagus, injuries to the neurovascular bundle and the pleural

dome, poor cosmetic appearance, pneumothorax and intrathoracic injury.

The present consensus that great majority of clavicular fractures heal with non operative treatment is no longer valid. The amount of pain and disability during the first three weeks of conservative treatment has been underrated and the common view that nonunion does not occur is wrong. Pressure from a displaced fragment on the retroclavicular part of the brachial plexus may cause symptoms after conservative treatment. Recent studies have shown that higher rate of non union and specific deficits of shoulder function in subgroups of patients with these injuries. Hence they can be treated as a spectrum of injuries requiring careful assessment and individualized treatment. Nonunion after a clavicular fracture is an uncommon occurrence, although the prevalence is higher than previously reported. There are subgroups of individuals who appear to be predisposed to the development of this complication either from intrinsic factors such as age or gender, or from the type of injury sustained [3].

Also persistent wide separation of fragments with interposition of soft tissue may lead to failure of closed reduction. There is 15% nonunion rate in widely displaced fractures of middle-third of the clavicle treated without surgery. And all fractures with initial shortening of more than 2cm resulted in nonunion [2].

Methodology

General information like name, age, sex, occupation and address were noted. Then a detailed history was elicited regarding mode of injury like fall on the shoulder, Road traffic accident, direct injury to shoulder and fall on outstretched hand. Enquiry was made to note site of pain and swelling over the affected clavicle. Past medical illness and family history were also recorded.

General condition of the patients was examined for pallor, pulse rate and blood pressure. Respiratory and cardio vascular system were examined for any abnormalities.

1. On inspection the following points were noted. Patients with fracture clavicle often supports the flexed elbow of the injured side with the other hand. Abnormal swelling was present in the middle third for middle third clavicle fracture and in the lateral third for lateral third clavicle fracture. The condition of the skin over the clavicle was noted for any abrasion, laceration and contusion.
2. On palpation the following points were noted :

Palpation of the entire length of the affected clavicle for tenderness in the medial middle third or in the lateral third fracture. The fractured clavicle was also palpated for any abnormal mobility and crepitus.

3. *Movements:* The movements of the affected side shoulder was restricted due to pain .The distal neurovascular status of the affected upper limb was examined and also the associated injuries along with fractured clavicle were noted.

Routine Radiological Examination.

Plain radiograph of clavicle with shoulder in anteroposterior view was taken to assess the site of fracture and the fracture type (displacement and comminution).

Baseline Investigations and Others

Routine investigation like Hb%, Total count, Differential count, ESR, Blood urea, Sugar, Serum creatinine and ECG were done. HBsAg and HIV test were done beforesurgery on all patients .

- Fracture anatomy assessed with X-rays.
- Diagnosis – Clinical and Radiological .
- Written informed consent will be taken for surgical procedure.

All patients were operated as early as possible once the general condition of the patients were stable and the patients were fit for surgery as assessed by the physician

- Surgery – Open reduction and internal fixation with plating.

Surgical Procedure

1. Patient in supine on OT table in beach chair position with one towel in between the scapula.
2. Entire upper limb from base of neck to hand were prepared and draped.
3. About 7-9 cms, incision was made in the anterior aspect centering of clavicle over the fracture site.
4. The skin subcutaneous tissue and platysma were divided without undermining the edges.
5. The overlying fascia and periosteum were next divided. The osseous ends was freed from surrounding tissue.
6. Minimal soft tissue and periosteum dissection was done.

7. Fracture fragments were reduced and precontoured locking compression plate was applied over the superior aspect of the clavicle.
8. At the junction of the medial and middle third of the clavicle, the inferior surface is exposed so that a protective instrument can be inserted during drilling to prevent injury to neurovascular structure underneath it .
9. The precontoured locking compression plate was fixed to the medial and lateral fragment with 4.0 mm locking screw and at least three screws in medial and lateral fragment were applied.
10. Wound was closed in layers after ensuring meticulous hemostasis and sterile dressing was applied.

Results

In this study 15 patients (75%) were operated with in 7days and 5 patients (25%) were operated after 7 to 10 days. Average time for surgery was 4.70 days.

Plate length of patients studied

The length of plate to be used was determined according to the extent of comminution at the fracture. The aim was to place at least three screws in the medial and lateral main fragments.

In 14 patients (70%) 7 hole locking compression plates were used. In 5 patients (25%) 6 hole locking compression plate were used and in another 1 patients (5%) 8 hole locking compression plates were used.

Table 1: Time interval

Interval-injury to operation (days)	No. of patients	%
<7	15	75.0
>7	5	25.0
Total	20	100.0

Table 2: Plate Length

Plate Length	No. of Patients	%
6 hole	5	25.0
7 hole	14	70.0
8 hole	1	5.0
Total	20	100.0

Table 3: Operation time (hrs) of patients studied

Operation time (hrs)	No. of Patients	%
50	6	30.0
60	10	50.0
70	3	15.0
80	1	5.0
Total	**20**	**100.0**

Average operation time was 59.50 minutes.

Table 4: Blood Loss of patients studied

Blood Loss(ml)	No. of patients	%
80	6	30.0
90	9	45.0
100	4	20.0
110	1	5.0
Total	**20**	100.0

Average blood loss during surgery was 90 ml.

Table 5: Time to union (weeks) of patients studied

Time to union (weeks)	No. of patients	%
<12 weeks	18	90.0
>12 weeks	2	10.0
Total	20	100.0

The fracture was considered to be united when clinically there was no tenderness, radiologically the fracture line was not visible and full unprotected function of the limb was possible.

In this study 18 patients (90%) united by 12 weeks. In 2 patients (10%) union occurred at the end of 14 weeks.

There were no major complications like plate breakage. Minor complications like plate loosening, hypertrophic scar, plate prominence, delayed union and malunion are listed in table

In our study 1 patient (5%) had plate loosening, 2 patients (10%) had plate prominence,1 patient (5%) had delayed union

In this study 17 patients (85%) had excellent functional outcome, 2 patients (10%) had good functional outcome and fair in 1 patient (5%).

Table 6: Complications

Complications	No. of patients (n=20)	%
Plate loosening	1	5.0
Plate prominence	2	10.0
Delayed union	1	5.0
Hypertrophic scar	0	0.0

Table 7: Functional outcome-Constant Murley Score

Constant Score Murley	No. of Patients	%
<70	0	0.0
70-79	1	5.0
80-89	2	10.0
>90	17	85.0
Total	**20**	100.0

Table 8: Outcome

Result	No. of Patients	%
Fair	1	5.0
Good	2	10.0
Excellent	17	85.0
Total	**20**	100.0

Discussion

Most of the middle third clavicle fractures were treated conservatively in past. The results of conservative treatment by Hill et al [4] in 1997, Nordqvist et al [5] in1998 and Robinson et al [6] in 2004 found poor results following conservative treatment of displaced middle third clavicle fracture. So operative treatment is needed for displaced middle third clavicle fractures.

Our study is compared with Bostmanet al [7] study which treated only middle third clavicle fractures, in this totally 103 patients were treated by early open reduction and internal fixation with plate and screws. It was also compared with Cho et al [8] study where 41 patients with a clavicle mid shaft fracture were treated by internal fixation with a reconstruction plate (19 patients) or reconstruction LCP (22 patients). It was also compared with VanBeek et al [9] study, where they compared outcomes after precontoured and non contoured superior plating of acute displaced midshaft clavicle fractures, in this they retrospectively reviewed 52 patients with 52 acute, displaced midshaft clavicle fractures treated with either noncontoured or precontoured superior clavicle plate fixation. Noncontoured (14) in which DCP (4), LCP (2), LCDCP (4), reconstruction plate (4) and precontoured (28); locking clavicle plate (28). Fourteen patients with noncontoured plates and 28 with precontoured plates were available for followup at a minimum of 1 year postoperatively.

In this present study, Robinson Type-2B1 (displaced with simple or butterfly fragment) were common and there were 16 patients (80%), Type- 2B2 (displaced with comminution) occurred in 4 patients (20%).

In Bostmanet al [7] study also Robinson Type- 2B1 was common in 81 patients (78.64%). Robinson Type-2B2 occurred only in 22 patients (21.36%).

In Cho et al [8] study, in reconstruction plate group there were 7 patients with Robinson Type-2B1 and 12 patients with Robinson Type-2B2 and that of

locking compression plate group had 9 patients with Robinson Type-2B1 and 13 patients with

Robinson Type-2B2 fractures

In Van Beeket al [9] study 20 patients had Robinson Type-2B1 and 25 patients had Robinson Type-2B2 fractures

Time Interval for Surgery

In this study 15 patients (75%) were operated with in 7days and 5 patients (25%) were operated after 7 to 10 days. Average time for surgery was 4.70 days.

In Bostmanet al [7] study, all patients were operated within 3 days of injury.

In Cho et al [8] study, the reconstruction plate group was operated by 4 days and the locking compression plate group by 9 days.

In Vann Beeket al [9] study, mean time for surgery was 8 days in non contoured group and 12 days in precontoured group.

Plate Length

In 14 patients (70%) 7 hole locking compression plates were used. In 5patients (25%) 6 hole locking compression plate were used and in another 1 patients (5%) 8 hole locking compression plates were used.

In Bostmanet al [7] study, plate length was above 6 holes to place atleast three screws in each fragment. Plate also depends upon the amount of comminution.

Duration of Union

In this study 18 patients (90%) united by 12 weeks. In 2 patients (10%) union occurred at the end of 14 weeks .

Lazarus MD stated radiological union occurred approximately between 6 to 12 weeks.

In Cho et al [8] study, bony union for reconstruction plate was 14.6 weeks and that for locking compression plate was 13.2 weeks.

Complications

There were no major complications in this study. In our study 1 patient (5%) had plate loosening,2 patients (10%) had plate prominence,1 patient(5%) had delayed union Both Bostmanet al [7] and Cho et al [8] studies didn't have any major complications Either.

In Bostman et al [7] study 7 patients (6.80%) had implant loosening. In all the patients loosening occurred at 6 postoperative weeks. Malunion of varying degree followed in all of these patients and no reoperations were performed. In Cho et al [8] study, only the reconstruction group that plate loosening occurred in 3 patients (15.8%).

Plate Prominence

In Van Beeket al [9] study, plate prominence was reported postoperatively in nine of 14 patients (64.3%) of the noncontoured group and nine of 28 patients (32.1%) of the precontoured group. Three of 14 (21.4%) of the noncontoured patients and three of 28 (10.7%) of the precontoured patients ultimately underwent elective removal of hardware for plate prominence.

Delayed Union

In Bostmanet al [7] study delayed union occurred in 3 patients (2.91%). In Van Beeket al [8] study, non-union occurred in 1 patient for with revision surgery with bone grafting was done.

Skin complications

The total complication rate in Bostman et al study was 23%.The total complication rate in Van Beek et al study was 64.3% in non contoured group and 39.3% in precontoured group.

Functional outcome

The functional outcome according to Constant Murley Scoring in this study 17 patients (85%) had excellent functional outcome, 2 patients (10%) had good functional outcome and fair in 1 patient (5%) of total 20 patients of middle third clavicle fracture fixed with locking compression plate and screws.

The advantage of rigid internal fixation and early mobilization of fresh displaced clavicle fracture is that it (displaced comminuted middle third and displaced lateral third clavicle fracture) gives immediate pain relief and prevents the development of shoulder stiffness and non-union.

Conclusion

In conclusion, bony union could be achieved with

precontoured locking clavicle plate by reducing the complication rates in midshaft comminuted displaced clavicle fractures and functional outcome were good to excellent.

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