

Research Article

Functional outcome of open reduction and internal fixation of clavicle fracture

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ABSTRACT

Background: Clavicle fracture is one of common bony injury; which is more common in young active individual. It has been traditionally treated with non-operative method. This present study was undertaken to study the role of the surgical management in the fresh middle third clavicle fracture.

Methods: 30 adult patients (21 male and 9 female) of average age of 32 years presented with fresh middle third clavicle fracture and treated surgically with open reduction and internal fixation with plate and screws and followed. Study conducted between November 2011 to November 2012.

Results: In 27 patients fracture were united at end of 12 weeks, in 2 patients fracture were united at end of 24 weeks and 1 patient went for non-union. One patient had superficial infection. None had deep infection. One patient had plate loosening at 4week but fracture was united at the end of 24 weeks. 2 patients had persistent pain which is controlled with occasional analgesic but not effecting ordinary work. One patient had gross restriction of shoulder movement. Functional outcome assessed according to near shoulder scoring system. 24 patients had excellent result, 4 patients had satisfactory result, 1 patient had unsatisfactory result and 1 patients had failure.

Conclusions: The study showed rigid fixation with plate and screw for fresh middle third clavicle fracture especially displaced and comminuted give immediate pain relief and prevent the development of shoulder stiffness & non-union and give good functional outcome.

Keywords: Middle third clavicle fracture, Open reduction, Internal fixation

INTRODUCTION

Clavicle is the bony link between thorax and shoulder girdle which contributes movement at shoulder girdle. Clavicle fracture is one of the common bony injury around the shoulder joint due to their subcutaneous position. It is more common in young active individual, who participate in activities or sports where high speed fall (e.g. Bicycling, motorcycle) or violent collision (e.g. Football, hockey) are frequent, road traffic accident, fall from height, fall directly over the shoulder or fall on outstretched hand (indirect trauma). Fracture clavicle accounts for approximately 5% to 10% of all fracture and up to 44% of injuries of shoulder girdle. Majority of clavicle fracture occur in mid-shaft of the bone around

80% to 85% where the typical compressive forces applied to the shoulder and the narrow cross section of the bone combine and result in bony failure. Distal third accounts for 20% 14-18 and medial third fracture are rarest 5%.¹⁻³

Fracture clavicle have been traditionally treated conservatively with closed manipulation and various method of immobilization; figure of eight splint most commonly used. Older studies suggested that clavicle fracture, even when significantly displaced, was an essentially benign injury with inherently good prognosis when treated non operatively.^{4,5}

Proponent of early fixation of fresh clavicle fracture is to prevent complication, like non-union, malunion, shoulder

stiffness, cosmesis; emphasize the value of accurate reduction and rigid fixation in offering quick pain relief and promoting early functional recovery.⁶

The aim was to study the role of the surgical management in the fresh middle third clavicle fracture.

METHODS

The present study is carried out from November 2011 to November 2012 at orthopaedic department in Pushpagiri institute of medical science & research centre, Thriruvalla, Kerala. During this period 30 patients of middle third of clavicle fracture were treated with open reduction and internal fixation.

Inclusion criteria

All male and female patients age between 20 and 60 year having Allman Group 1 with informed consent.

Exclusion criteria

Open fracture, age <20 and >60, pathological fracture, parietic limb, neurological injury, patients not willing for surgery, patients medically unfit for surgery.

General information like name, age, sex, occupation and address were noted. Then a detailed history was elicited regarding mode of injury like fall on shoulder, road traffic accident, direct injury on 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 noted.

RESULTS

The present study consists of 30 patients of fresh middle third clavicle fracture which was treated surgically with open reduction and internal fixation with plate and screw between November 2011 to November 2012 in orthopaedic department of Pushpagiri institute of medical science & research centre.

All the patients were available for follow up and they were followed at regular interval. Results were analyzed both clinically and radiologically. Among 30 patients of middle third clavicle fracture direct injury occurred in 26 patients (87%) among them 15 patients (50%) were due to road traffic accident, 4 patients (13%) were due to simple fall on shoulder after slipping, 2 patients (7%) were due to sports (football) injury, 5 patients (17%) were due to fall from height. Indirect injury occurred in 4 patients (13%) due to fall on outstretched hand (Table 1).

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injury, 5 patients (17%) were due to fall from height. Indirect injury occurred in 4 patients (13%) due to fall on outstretched hand. Majority of patients i.e. 13 patients (44%) were in the age group of 20-29 year. Youngest patient was 20 year and oldest patient was 59 year with average age of 35 year. Majority of patients i.e. 13 patients (44%) were in the age group of 20-29 year.

Youngest patient was 20 year and oldest patient was 59 year with average age of 35 year. Majority of patients were male, 21 patients (70%), and female were 9 patients (30%). In this study for middle third clavicle fracture there were 18 patients (60%) of right side fracture and 12 patients (40%) of left side fracture.

Table 1: Demographic data.

Variables	No. of patients	Percentage (%)
Mode of injury		
Road traffic accident	15	50
Simple fall on shoulder	4	13.3
Fall on outstretched hand (indirect injury)	4	13.3
Sports injury	2	6.7
Fall from height	5	16.7
Age in year		
20-29	13	43.3
30-39	7	23.3
40-49	7	23.3
50-60	3	10
Sex		
Male	21	70
Female	9	30
Side affected		
Right	18	60
Left	12	40

Associated injury

9 patients (30%) had others associated injury. 2 patients had fracture both leg, among them one had contralateral closed both bone leg fracture also had ipsilateral rib fracture and other one had contralateral open both bone leg fracture. 2 patients had rib fracture, among them one had ipsilateral rib fracture with contralateral closed fracture both bone leg and Other one had ipsilateral rib fracture with ipsilateral scapula fracture. 1 patients had ipsilateral ilium fracture. 1 patients had ipsilateral anterior dislocation of shoulder. 3 patients had ipsilateral scapula fracture, among them one had ipsilateral rib fracture. 1 patients had ipsilateral subtrachanteric fracture of femur. 1 patients had ipsilateral distal end of radius fracture (Table 2). 9 patients (30%) had others associated injury. 2 patients had fracture both leg, among them one had contralateral closed both bone leg fracture also had

ipsilateral rib fracture and other one had contralateral open both bone leg fracture. 2 patients had rib fracture, among them one had ipsilateral rib fracture with contralateral closed fracture both bone leg and Other one had ipsilateral rib fracture with ipsilateral scapula fracture. 1 patients had ipsilateral ilium fracture.

Table 2: Associated injury.

Associated injury	No. of patients	Percentage (%)
Fracture both bone leg	1*+1	6.66
Rib fracture	1*+1#	6.66
Ilium fracture	1	3.33
Anterior dislocation of shoulder	1	3.33
Scapula fracture	1#+1+1	10
Subtrochanteric fracture of femur	1	3.33
Distal end of radius fracture	1	3.33

1 patients had ipsilateral anterior dislocation of shoulder. 3 patients had ipsilateral scapula fracture, among them one had ipsilateral rib fracture. 1 patients had ipsilateral subtrochanteric fracture of femur. 1 patients had ipsilateral distal end of radius fracture.

Classification

All fracture in study was Allman Group 1, which was further classified according to Robinson's classification. Group 1 Allman fracture of clavicle is Type-2 Robinsons, which is further classified into A1, A2, B1, and B2. There were 3 patients (10%) of type-2 A1, 3 patients (10%) of type2 A2, 18 patients (60%) of type2 B1, and 6 patients (20%) of type-2 B2 (Table 3).

Table 3: Robinson's classification.

Type	No. of cases	Percentage (%)
Type-1 Medial third	0	0
Type-2 Middle third	A1	3 10
	A2	3 10
	B1	18 60
	B2	6 20
Type-3 Lateral third	0	0

Table 6: Fracture type and type of plate used.

Type of fracture (Robinson type)	Precontoured plate	Reconstruction plate	One third tubular plate	Dynamic compression plate
Type2 A1	0	0	1 (3.33%)	2 (6.66%)
Type2 A2	2 (6.66%)		1 (3.33%)	0
Type2 B1	13 (43.33%)	5 (16.66%)	0	0
Type2B2	3 (10%)	3 (10%)	0	0

Time interval for surgery

All patients were operated as early as possible once the general condition of patients improved and stable.

Almost all patients (27 patients) operated within 1st week of injury except 3 patients operated in 2nd week due to patients was not stable (Table 4).

Table 4: Time interval for surgery.

Time of surgery	No. of patients	Percentage (%)
<7days	27	90
>7days	3	10

Type of implant

In 18 patients (60%) precontoured clavicular plates were used, in 8 patients (27%) reconstruction plates were used, in 2 patients (7%) one third tubular plates were used and dynamic compression plates were used in 2 patients (7%). Commonly precontoured and reconstruction plates were used (Table 5).

Table 5: Type of implant.

Type of plate	No. of cases	Percentage(%)
Precontoured plate	18	60
Reconstruction plate	8	26.66
One third tubular plate	2	6.66
Dynamic compression plate	2	6.66

Fracture type and type of plate used

For type2 A1 dynamic compression plate used in 2 patients (6.66%) and one third tubular plate used in 1patients (3.33%). For type2 A2 precontoured plate used in 2 patients (6.66%) and one third tubular plate used in 1 patient (3.33%).

For type2 B1 precontoured plate is used in 13 patients (43.33%) and reconstruction plate used in 5 patients (16.66%). For type2 B2 precontoured plate used in 3 patients (10%) and reconstruction plate used in 3 patients (10%) (Table 6).

Type of plate and length of plate

The plates were intraoperatively bent to contour and curvature of the clavicle except precontoured plates.

Length of plate used was determined according to the extent of comminution at the fracture site. The aim was to place at three screws in the medial and three screws in lateral main fragment through both cortices of the bone.

Table 7: Type of plate and length of plate.

Type of plate	7 hole	8 hole
Precontoured plate (PCP)	15 (50%)	3 (10%)
Reconstruction plate (RC)	5 (16.66%)	3 (10%)
One third tubular plate (OTTP)	2 (6.66%)	0
Dynamic compression plate (DCP)	2 (6.66%)	0
Total	24 (80%)	6 (20%)

In 15 patients (50%) 7 hole precontoured plates, in 5 patients (16.66%) 7 hole reconstruction plates, in 2 patients (6.66%) 7 hole one third tubular plates and in 2 patients (6.66%) 7 hole dynamic compression plates were used. In 3 patients (10%) 8 hole precontoured plates and in 3 patients (10%) 8 hole reconstruction plates were used. Most commonly 7 hole plates were used in 24 patients (80%). Cortical screws were used of sizes from 12 to 18 mm (Table 7).

Duration of union

Fracture was considered united when clinically there was no tenderness, radiologically fracture line was not visible and full unprotected function of the limb was possible without any sign of instability and pain.

Most of fracture 27 patients (90%) united at end of 12 weeks. In 2 patients fracture united at the end of 24 weeks. 1 patient went to non-union, fracture not united even after 6 months (Table 8).

Table 8: Duration of union.

Time of union	No. of patients	Percentage (%)
8-12 week	27	90
>12 week	2+1	10

Implant removal

We advise the patients for removal of the plate at the end of 1 year. In this study only in 2 patients implant is removed. One is due to plate prominence due to losing of plate and plate is removed after 12week after union. In other patients plate is removed after 6 months as patients wants to implant removal, fracture was united.

Complications

In this study non-union occurred in 1 patient. In one patients plate loosening occurred after 4 week which

went for delayed union and fracture united in mal position after 20 weeks, latter due to plate prominence plate was removed after 9 month.

One patients developed superficial infection, which is controlled with dressing & antibiotics wound healed with hypertrophic scar, but there are no any sign of infection in latter follow-up. 2 patients complain pain even after 6 months, which is controlled with analgesic. One more patients went for delayed union and fracture was united at 24 week (Table 9).

Table 9: Complications.

Complication	No. of cases	Percentage (%)
Non-union	1	3.33
Delayed union	1* +1	6.66
Malunion	1*	3.33
Superficial infection	1#	3.33
Deep infection	0	0
Plate loosening	1*	3.33
Plate breakage	0	0
Plate prominence	1*	3.33
Hypertrophic scar	1#	3.33
Sign of nerve compression	0	0
Pain	2	6.66
Restriction of shoulder movement	1* +1	6.66

Functional outcome

Table 10: Functional outcome.

Functional outcome	No. of patients	Percentage (%)
Excellent	24	80
Satisfactory	4	13.33
Unsatisfactory	1	3.33
Failure	1	3.33

The functional score assessed by Neer shoulder score. 24 patients had excellent functional outcome, 4 patients had satisfactory result, 1 patients had unsatisfactory result and 1 had failure (Table 10).

DISCUSSION

Clavicle fracture are usually treated conservatively; but in the study conducted to analyse the result of conservative treatment by Hill et al.⁷ Robinson et al found poor result following conservative treatment of middle third clavicle fracture especially displaced one.⁸ They found higher rate of non-union and residual shoulder dysfunction.

The present study of 30 patients with middle third clavicle fracture treated by open reduction and internal fixation with plate and screw is compared with Bostman et al which treated 103 patients of middle third clavicle fracture by open reduction and internal fixation with plate and screw.²

Mechanism of injury

In this study, in 87% patients most common mechanism of injury was direct injury to shoulder whereas Bostman et al also showed direct injury is most common mechanism of injury i.e. in 77% patients.²

Age incidence

In this present study middle third fracture of clavicle commonly occurred in the age group 20 to 29 year. The youngest patient's age was 20 year and an oldest patient was 58 year. The average patient's age was 35 year. In Bostman et al studies show an average patient's age was 33.4 year and youngest patient's age was 19 year and oldest patient's age was 62 year.²

Sex incidence

In this study there were 21 male (70%) patients and 9 female (30%) patients. In Bostman et al series also commonly male are affected 76 patients (74%) compared to female 27 patients (26%).²

Associated injuries

In this study 9 patients (30%) had associated injuries. 2 patients had fracture both bone leg, 3 patients had rib fracture, 1 patients had ilium fracture, 1 patients had anterior dislocation of shoulder, 3 patients had scapula fracture, 1 patients had subtrochanteric fracture of femur and 1 patients had distal end radius fracture. In Bostman et al series there was no associated injuries.²

Type of fracture

In this present study all patients of middle third clavicle fracture were closed type. In Bostman et al study also all their patients were closed type.²

Fracture classification

In this study Robinson type-2 A1 was in 3 patients (10%), Robinson type-2 A2 was in 3 patients (10%), Robinson type-2 B1 was most common in 18 patients (60%) and Robinson type-2 B2 was in 6 patients (20%). In Bostman et al study also Robinson type-2 B1 was common in 81 patients (79%) and Robinson type-2 B2 was in 22 patients (21%).²

Time interval for surgery

In present study most of the patients 27 (90%) were operated in the first week and 3 patients (10%) operated in second week. In Bostman et al study all patients were operated in first week.²

Type of implant

In this study fracture fixed with precontoured plate in 18 patients (60%), reconstruction plate in 8 patients (26.66%), dynamic compression plate in 2 patients (6.66%) and semitubular plate in 2 patients (6.66%). This in comparison with Bostman et al. study were reconstruction plate were used in 46 patients (45%), dynamic compression plate used in 55 patients (53%) and semitubular plate were used in 2 patients (2%).

Plate length

In this study 7 hole plate were used in 24 patients (80%) and in 6 patients (20%) 8 hole plate were used depending upon fracture type. In Bostman et al study also plate length was above 6 hole to place at least three screw in each fragment. Plate length also depends upon the amount of comminution.

Duration union

In this study majority of the fracture united between 8 to 12 weeks. In 27 patients (90%) fracture were united at the end of 12 weeks. 2 patients for delayed union fracture united at end of 24 week. 1 patients went for non-union. In Bostman et al study also more 90% fracture united at end of 12 weeks.²

Complications

This present study was uneventful in 24 patients (80%) and overall 12 complication developed in 6 patients (20%). In Bostman et al study the course was uneventful in 79 patients (77%). In the remaining 24 patients (23%), a total of 44 individual complication occurred. In this study non-union occurred in 1 patients, malunion in 1 patients, delayed union in 2 patients, plate loosening & plate prominence in 1 patients, superficial infection in 1 patients, hypertrophic scar in 1 patients, restriction on shoulder movement in 1 patients and pain around shoulder during activity for which they need analgesic in 2 patients. In Bostman et al. study non-union occurred in

3 patients, delayed union in 3 patients, malunion in 12 patients, plate loosening in 10 patients, plate angulation in 3 patients, plate breakage in 2 patients, deep infection in 5 patients, superficial infection in 3 patients and irritation of brachial plexus occurred in 2 patients.

Functional outcome

The functional outcome according to Neer in this study of total 30 patients of middle third fracture of clavicle fixed with plate and screws showed excellent result in 24 patients (80%), satisfactory result in 4 patients (13.33%), unsatisfactory in 1 patients (3.33%) and failure in 1 patients (3.33%).⁹ The advantage of rigid internal fixation and early mobilisation of fresh displaced clavicle fracture is that it gives immediate pain relief and prevents the development of shoulder stiffness and non-union.

CONCLUSION

The use of benzydamine hydrochloride gargles can be helpful in reducing the incidence of POST. There was no evidence of any side effects to the use of this drug in the present study. Thus a simple technique of gargling with benzydamine hydrochloride can help reduce the incidence of post-operative sore throat, emergence phenomenon in the form of coughing and hoarseness of voice.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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