

A Comparative Study of the Conservative and Operative Management of Midshaft Clavicle Fracture based on Functional Outcome and Post-Operative Complications

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ABSTRACT

Introduction: Clavicle fracture is a common condition mostly treated conservatively. Newer operative modalities have come up to obtain early fixation. Accurate reduction and fixation is important for complication-free management of clavicle fractures. However, there is still doubt amongst orthopaedic surgeons regarding the choice of management for clavicle fractures. Study aimed at analysis of the outcomes and complications of the operative management and its compare with conservative modality.

Material and Methods: Ethics committee permission was taken and 33 patients with middle-third clavicle fracture were included in this study. The affected limb was treated either conservatively ("Figure of 8" brace and sling) or operatively (OR+IF using recon plate or AO pre-contoured plate). Regular follow-up till 1 year post-treatment was done. The functional outcome were assessed by Constant and Murley score. Descriptive statistics and Chi-square test were applied for analysing the data.

Results: 17 patients were treated conservatively while 16 operatively. 23 (69.7%) had excellent or good functional outcome at 4 weeks irrespective of the treatment. The patients in the operative group who showed excellent results were significantly more than that in the conservative group ($p = 0.0324$). Average union time in the conservative group was 9.4 weeks, more than the 7.8 weeks seen in the operative group. Mal-union was present in 7 of 17 patients treated conservatively. Superficial infection, implant failure and keloid formation were seen in one patient of operated group.

Conclusion: Clavicle fractures managed operatively had better outcome with lesser post-operative complications.

Keywords: Conservative Management, Operative Management, Midshaft Clavicle Fracture, Functional Outcome and Post-Operative Complications

INTRODUCTION

Clavicle is the bony link between the thorax and the shoulder girdle contributing immensely to the shoulder movements. Clavicle fracture is a common traumatic injury due to its bilateral subcutaneous position which accounts to about 5-10% of all fractures and about 44% of shoulder injuries. Clavicle fractures involve the middle third of the bone in 70-80% cases while lateral third in 12-15% and medial third in 5-8% cases.¹ These fractures have been traditionally treated by conservative means. Although many methods of closed reduction have been described, it is recognized that reduction is practically impossible to maintain and a certain amount of deformity and disability is expected in adults. Conservative treatment in the form of sling, "figure of 8" bandage with sling and arm pouch have been used for long time but poor outcomes like mal-union and non-union (15%) have been observed after conservative treatment of displaced clavicle

fractures.^{2,3} In the past few years, newer modalities of treatment have come up to obtain an early fixation of fracture by using an intra-medullary device (nails, pins and wires) or an extra-medullary plate. However, complications like loosening and breakage of pins are common. Extra-medullary fixation with plate and screws like semi-tubular plate, dynamic compression plate and reconstruction plate are used to get rigid fixation.^{1,4} The proponents of early fixation of fresh clavicle fractures to prevent complications like mal-union and non-union emphasize the value of accurate reduction and rigid fixation with quicker pain relief and promoting early functional recovery.⁵

There is still doubt in minds of orthopaedic surgeons regarding the choice of management for clavicle fractures, i.e. whether to treat conservatively or to operate. In this study we analysed the outcomes of the operative management using plate and screw techniques and compared its results with older modality of conservative treatment considering it as standard treatment option in patients with clavicle fracture. We also tried to study the occurrence of post-operative complications, especially mal-union and non-union between the operative and the non-operative group in this study.

MATERIAL AND METHODS

The present study was carried out at Dr. D.Y. Patil Hospital and Research Centre from August 2011 to August 2013. All the patients with middle-third clavicle fractures were screened between August 2011 and August 2012 for the study, which makes it a period-based type of sample size. Patients above 18 years of age suffering from middle third clavicle fracture were included in this study. Inclusion in the study was complete only after the patients agreed and signed on the written informed consent document. Open fractures, fractures associated with complication like head injury, brachial plexus injury and with associated other bone injuries were included in this study. Patients with lateral third fracture of clavicle or medial end clavicle fracture were excluded from the study. A detailed history which included information about mode or type of injury was

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elicited. The site of pain and swelling over the affected clavicle were noted. Past medical history and family history was also recorded.

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

Local examination was done to check the presence of abnormal swelling over middle third for middle third clavicle fracture. The condition of the skin over the clavicle was noted for any abrasion, laceration and contusion. The entire length of the affected clavicle was palpated for tenderness, crepitus or any abnormal mobility.

The movements of the affected side shoulder were assessed, which were restricted in all patients 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.

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

The fractures were classified according to Robinson's classification.⁶

The affected upper limb was treated either conservatively ("Figure of 8" brace and sling) or operatively (OR+IF using recon plate or AO pre-contoured plate). Patient to be treated operatively were investigated for routine pre-operative investigations like haemoglobin, total cell and differential count, ESR, blood urea, blood sugar, serum creatinine, ECG and chest x-ray. HBsAg and HIV test were also done before surgery of all the patients.

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

Technique for conservative management with "figure of 8" brace and sling

Patient was made to sit on stool with the back facing the surgeon. Cotton was applied in axilla and a ready "figure of 8" brace was applied after reducing the fracture. The "figure of 8" brace was tightened to maintain position of clavicle. Radial pulses on both sides were checked after applying bandage. Patient was asked to report if he feels any tingling or burning sensation following bandage application. Patient's limb was immobilised in sling. Patients were followed up every week for 4 weeks. Further up, the follow up was done at 8 weeks, 12 weeks, 6 months and 1 year post-management.

Local examination of the affected clavicle was done for tenderness, instability deformity and shoulder movements. X-rays were taken at each follow-up visits to know about progressive fracture union and implant position. Rehabilitation of the affected extremity was done according to the stage of fracture union and time duration from day of surgery. *Constant and Murley score* was used to assess the functional outcome.⁷

Operative technique for management of clavicle fractures

Preoperative preparation of patients: Patients were kept fasting for 6 hours before surgery. A written informed consent for surgery was taken. The neck, chest, axilla, shoulder and arm were prepared and tranquilizers were given as advised by the anaesthetist. Systemic antibiotics were administered

intravenously 30 minutes before surgery to all patients. All patients were operated under general anaesthesia.

Operative technique for plate and screw fixation: Patient was kept in supine position with one towel in between the scapula. Entire upper limb was prepared and draped. Over the fracture site, a 7-9 centimetres incision was made in the anterior part. Division of the skin, subcutaneous tissue and platysma was done without undermining the edges. The overlying fascia and periosteum were divided next. The osseous ends were freed from surrounding tissue. Minimal soft tissue and periosteal dissection was done. Reduction of the fracture fragments was followed by plate application over the superior clavicular part. The inferior surface was exposed at the junction of the medial and middle third of the clavicle, so that a protective instrument can be inserted during drilling to prevent injury to neurovascular structure below it. The plate was fixed to the medial and lateral fragment with a 3.5 millimetres cortical screw and a minimum of three screws were applied in medial and lateral fragments. Wound closure was layered after ensuring proper haemostasis and sterile dressing was applied.^{5,8}

Post-Operative care: X-rays were taken to study the alignment of fracture fragments. Suture removal was done on 10th postoperative day. Patients were discharged with the arm pouch. Rehabilitation of the affected arm was started on first post-operative day. Gentle pendulum exercises to the shoulder were allowed. At 3 to 4 days gentle active assisted range of motion of the shoulder was allowed but abduction in limited to 80 degrees. At 6 to 8 days active range of motion in all planes were allowed.

Follow up: Regular follow up for every week for 4 weeks, then at 8 weeks, 12 weeks, 6 months and 1 year was done. Local examination of the fractured clavicle was done to check for tenderness, instability and movements at shoulder joint. At each follow up visits, X-ray was done to know about the union of fracture as well as the position of implant. The stage of the fracture as well as the duration from the surgery decided the rehabilitation of the affected extremity. The functional outcome were assessed by *Constant and Murley score*.⁷

The functional outcome was assessed by subjective (maximum 35 points) and objective (maximum 65 points) evaluations, with the total scores being allotted out of the maximum 100. (table 1 and table 2) Based on the total scores, the functional outcomes was graded as the following: 91- 100 as excellent, 81-89 as good, 71-80 as satisfactory, 61-70 as adequate and 0-60 as poor.

STATISTICAL ANALYSIS

Descriptive statistics was applied for analysis by using proportions and percentages. Chi-square test was done to check the association or independence of variables.

RESULTS

The present study was carried out on 33 patients of fresh fracture of the clavicle, out of which 17 were treated conservatively and 16 operatively at our hospital. 31 (93.9%) of the patients suffered from clavicle fractures due to road traffic accidents while 2 of them fractured their clavicle due to fall on the outstretched hand. Mean age of the patients in the study was 38.7 years. Out of the 33 patients enrolled in the study, 24 (83.3%) were males while 9 (16.7%) were females. All patients were available for

follow up and were evaluated clinically in form of tenderness over fracture site and radiographic union. There were associated injuries in few patients with clavicle fracture who suffered road traffic accident. The associated injuries were scapulae fracture (2), mandible fracture (1), proximal tibia fracture (1), skull fracture (1), superior and inferior pubic rami fracture (1). In our study, clavicle fracture on right side was seen in total 23 (69.7%) patients and 10 (30.3%) patients had left sided fractures. Based on the Robinson classification of mid-shaft clavicle fractures, majority of patients were in B1 (14 i.e. 42.4%) group followed by A2 (08 i.e. 24.2%), B2 (06 i.e.18.2%), A1 (5 i.e. 15.2%). Functional outcome of each patient was noted at 1 month. From the total of 33 patients, 23 (69.7%) had excellent or good

functional outcome at 4 weeks irrespective of the treatment. 7 of the 17 patients who were managed conservatively had satisfactory to poor scores as compared to 3 patients out of 16 who were managed operatively. The functional outcome results, assessed by the *Constant and Murley Score*, is expressed in table 3. The number of patients in the operative group who showed excellent results were significantly more than that in the conservative group (p = 0.0324).

A total of 23 patients in the study suffered from un-displaced fractures, 10 of which were managed conservatively while 13 were managed operatively. In this group with un-displaced clavicle fracture, 11 patients showed good to excellent outcome based on *Constant and Murley Score*, of which 7 were treated conservatively (70% of conservatively managed patients) and 4 were operatively managed (30.77% of the operated patients). Out of the 16 operated patients, 12 (75%) of them were treated with the help of a reconstruction plate while 4 (25%) of the patients were operated using pre-contoured locking plate.

In our study, the 16 patients who were operated upon had an average union time of 7.8 weeks; 1 patient had delayed fracture union by 12 wks. 16 patients in conservative group had normal union of fractures with 1 patient going into non-union. Average union time in the conservative group was 9.4 weeks, which was more than the 7.8 weeks seen in the group treated operatively. Mal-union was present in 7 of the 17 patients treated conservatively, and 5 of these 7 had a visible deformity. Out of these patients with mal-union 1 had poor functional outcome, 3 had good to excellent outcome and 3 had satisfactory functional outcome. 4 of these had restricted movements terminally and 2

Pain (Maximum = 15 Points) No pain- 15 Mild- 10 Moderate - 5 Severe – 0
Activities of daily living (Maximum = 20 Points) Ability to perform full work - 04 Ability to perform Leisure activities/Sports - 04 Unaffected sleep - 02 Level at which work can be done: Up to Waist - 02 Up to Xyphoid - 04 Up to Neck -06 Up to Head -08 Above head – 10
Table-1: Subjective Assessment of Participants:

Range of Motion (Maximum = 40 points)				Strength of Abduction (Maximum = 25 points)
Active flexion without pain:	Functional external rotation:	Active abduction without pain:	Functional internal rotation:	A normal shoulder resists 25 pounds without difficulty. The score given for normal power is 25 points, with proportionately less for less power.
00-30°: 00	Hand behind head with elbow forwards – 2	00-30°: 00	With dorsum of hand on back reaches –	
31-60°: 2		31-60°: 2	Ipsilateral buttock: 2	
61-90°: 4	Hand behind head with elbow backwards - 4	61-90°: 4	S1 spinous process: 4	
91-120°: 6	Hand above head with elbow forwards – 6	91-120°: 6	L3 spinous process: 6	
121-150°: 8	Hand above head with elbow backwards – 8	121-150°: 8	T12 spinous process: 8	
> 151°: 10	Full elevation from on top of head - 10	> 151°: 10	T7 spinous process: 10	
Table-2: Objective Assessment of Participants:				

Conservative Treatment (n=17)	Operative Treatment (N=16)	Total (33 patients)
Excellent = 3 (17.6%)	Excellent = 9* (56.3%)	Excellent = 12 (56.3%)
Good = 7 (41.1 %)	Good = 4 (25%)	Good = 11 (33.3%)
Adequate = 3 (17.6%)	Adequate = 2 (12.5%)	Adequate = 5 (15.15%)
Poor = 4 (23.52%)	Poor = 1 (6.2%)	Poor = 5 (15.15%)
* P < 0.05 compared to the particular outcome grade of the conservative group. Fisher's exact test was used to analyse the contingency table.		
Table-3: Functional Outcomes of Patients with Clavicle Fractures Treated Conservatively or Operatively (Total number of patients = 33)		

had pain on movement

In surgically treated group, 1 patient suffered from superficial infection while another 1 experienced implant failure in forms of loss of reduction and implant separation from distal fragment. Skin related complication included keloid formation over scar for open reduction and plating was seen in one patient.

DISCUSSION

For a long time, clavicle fractures have been treated by conservative means using measures like sling, “figure of 8 bandage” and plaster. However, the interest in operative treatment has increased and it has progressed from open reduction and fixation to closed reduction with fixation. Extramedullary fixation have been performed by using dynamic compression plate, reconstruction plate, pre-contoured plates, locking plates and now 3-D contoured plates. According to various studies, conservative therapy of displaced middle third clavicle fracture has been associated with poor outcomes.^{3,9,10}

Few participants of our study had associated injuries in addition to the clavicle fracture. These injuries were scapulae glenoid fracture (2), proximal tibia fracture (1), mandible fracture (1), skull fracture (1) and superior plus inferior pubic rami fracture (1). Previous studies assessing clavicle fractures have shown patients associated with other fractures or injuries too.¹¹

In this study we have classified fracture of mid-shaft clavicle according to Robinson classification. Majority of patients in this study were in B1 (14 i.e. 42.4%) group followed by A2 (08 i.e. 24.2%), B2 (06 i.e. 18.2%) and A1 (5 i.e. 15.2%). Not even a single patient belonged to the 2A1 class in the operative group. Previous studies have also used the Robinson classification to classify clavicle fractures. However, they do not show any particular preponderance of any specific type of mid-shaft clavicle fractures in the participants.¹²

Functional outcome was assessed using the objective and subjective parameters of the *Constant and Murley score*. In our study, the functional outcome was excellent in 12 cases (36.4%), good in 11 patients (33.3%), satisfactory in 4 cases (12.1%), adequate in 1 participant (3%) and poor in 5 patients (15.2%). Out of all the excellent outcomes, 3 cases (17.6%) were from conservative group while 9 patients (56.3%) in operative group. On Fisher’s exact test, it was found that the difference between the number of excellent outcomes between the two groups was significant ($p < 0.05$). A previous study states that though the non-operative group did approach the functional outcome of the operative group at 18 months, a significant difference was still evident.¹²

In our study, the 16 patients who were operated upon showed an average union time of 7.8 weeks. Only 1 patient had union delayed by 12 weeks. In the conservatively managed group, 16 patients reported normal fracture union but 1 patient had a non-union. Average union time in conservative group was 9.4 weeks. It was noteworthy that malunion was a major concern in the conservatively managed group, with 7 out of 17 patients (41.1%) suffering from it. In a previous study, all fractures in the operative group showed normal union, whereas eight fracture patients in the non-operative group reported non-union (29%) ($P = 0.002$). In addition, 10 patients (35.7%) in the non-operative group experienced a symptomatic malunion compare with two (4.4%) surgically treated patients.¹²

In the operative group of our study, one patient suffered from superficial infection at the operative site which was treated successfully with debridement and oral antibiotics. One patient suffered from implant failure in the form of reduction loss and implant separation from the distal fragment. Another single patient experienced a keloid formation over the operative scar. In a previous study, 2 patients in the operative group (4.5%) had implant deformation associated with a delayed union. Both fractures united in that study but with angulation.¹²

This study did not assess the individual modalities of treatment (like ‘figure of 8’ management or plate fixation). There is a need to study the various individual treatment options, especially the outcomes between the various newer operative modalities like plate fixation and titanium elastic intramedullary nail fixation.

CONCLUSION

From our study based on patients of mid-shaft clavicle fractures, it can be concluded that the operative group had significantly higher excellent outcomes as compared to the conservatively-managed group, based on the *Constant and Murley score*. The number of mal-union reported in the conservatively treated group was significantly more with that in the operative group. The average union time observed in the non-operative group was more as compared to that in the operative group. Thus, clavicle fractures managed with operative modalities had a better outcome with much lesser post-operative complications.

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