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The surgical outcome of management of the middle one third clavicle fractures

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Abstract
Clavicle is the most commonly associated fractures of childhood. It is estimated that one in every twenty fractures is a clavicle fracture. In fact 44% of all shoulder girdle fractures are clavicle fractures. The importance of proximity to vital structures in the neck and thorax necessitates the early and proper management of these fractures. The present study was carried out at Orthopedics Department in General Hospital. During this period 20 patients of clavicle middle one third clavicle fractures were treated surgically. Direct injury occurred in 17 patients (85%) among them 8 patients (40%) were due to fall on shoulder from two wheeler, 5 patients (25%) were due to road traffic accident, 4 patients (20%) were due to fall on the shoulder after slipping. Indirect injury occurred in 3 patients (15%) due to fall on outstretched hand. In this study 1 (5%) patient had superficial infection for which we have treated with antibiotics and 1 (5%) patient had implant failure due to screw proud for which implant removal was done and after fracture got union. No cases with non-union are reported as only middle one third clavicle fracture with minimal comminution are taken in this study.

Keywords: Clavicle, Surgical Outcome, Management

Introduction
Clavicle receives its name from Latin word clavicula because the bone rotates along its axis like a key when the shoulder is abducted and it is roughly the same shape as roman door lock keys. It is also called collar bone; it serves as a strut between scapula and sternum. It makes up part of the shoulder and the pectoral girdle and is palpable in all the people. Clavicle fractures are recognized easily and readily. They unite uneventfully with proper treatment. They are also associated with early and late complications. Clavicle is the most commonly associated fractures of childhood. It is estimated that one in every twenty fractures is a clavicle fracture. In fact 44% of all shoulder girdle fractures are clavicle fractures. The importance of proximity to vital structures in the neck and thorax necessitates the early and proper management of these fractures. Clavicular fracture was observed as early as 400 B.C by Hippocrates. [1] It is difficult to reduce fracture fragments and maintain its alignment by closed reduction. [2] Weight of the arm and pull of pectoralis major produces inferior pull of lateral fragment while sternocleidomastoid muscle pulls the medial fragment superiorly. [3] King William III of England had clavicle fracture sustained while riding a horse. He died after 3 days due to diffuse false aneurysm that was complicated by clavicle fracture. [4] Lucas Championniere was the first to advocate FIGURE OF EIGHT BANDING in 1860 A.D. [5] Sagre, 1871 A.D advocated ambulatory treatment with rigid dressing to maintain reduction and support the extremity. [6]

In INJURY 1992, PIOGENFURST *et al.* published their results concluding that plating for acute mid-third fractures is a reliable procedure. They also advised to retain the plate for a minimum of six months. They also advocated not to remove interfragmentary screws while removing the plate. [7]

In JBJS July 1993, (A) Leung *et al.* stated that clavicular fractures associated with ipsilateral scapular neck fractures should be treated operatively because shoulder suspensory mechanism is affected and also normal lever arm, the rotator cuff is also lost. Their study noted that operative treatment is safe with good functional recovery. [8]

In JBJS July 1997 (B), Hill *et al.* published their study of conservatively treated displaced mid-third fractures and recommended surgical treatment for displaced mid-third fractures. [9]

In Journal of Trauma 1999, Davids *et al.* concluded that operative treatment of delayed and non-union with plating, bone grafting and early mobilization yields good results. [10]

In Journal of Trauma 2000, Bostman *et al.* concluded that the patient's non-compliance with post-operative regimen could be a major cause of treatment failure. [11]

In Injury 2001, Jupiter *et al.* stated in their study that plate and screw fixation is better than other modes of fixation as they excellent control over their rotations , restore normal length of the clavicle as it is fixed to the apex of the deformity. But he also stated that disadvantages of plate fixation like osteoporosis below the plate acting as stress raisers and wide periosteal stripping. [12]

In 2009, Ayman Khalil the technique is simple, affordable and it does not require special instrumentation or implants. It allows intramedullary compression, stability, stress sharing, little periosteal stripping and early recovery after surgery. Hardware removal is done through a small incision, without obvious complications. [13]

In clinics and elbow 2016, Young Girl Rhee *et al.* in their study they have compared the outcomes of retrograde intramedullary screw fixation and of anterograde intramedullary screw fixation for clavicle shaft fractures and made a comparative analysis of the two approaches using the radiological and clinical outcomes. [14]

In J Trauma 2001, Grassi *et al.* in a comparative study reported a 25% unsatisfactory rate in both the nonoperative group and operative group. The major factors resulting in poor satisfaction were unaesthetic deformity in the non operative group and unsightly scars in the operative group. [15]

In Strategies Trauma Limb Reconstr 2017, Nowak*et al.* reported that 46 % of patients with clavicle fracture in his study complained of persistent symptoms until to 10 years after fracture despite the fact that only 7 % of patients developed nonunion. [16]

In In J Ortho Trauma 2005, Zlowodski *et al.* reported an 87% relative risk reduction for displaced midshaft clavicular fractures treated with intramedullary fixation compared with non operative management. [17]

Postacchini *et al.*, therefore considering the distance between the inferior border of one bone fragment and that of the corresponding border of the other fragment at the fracture site if exceeding 3 mm on radiographs with a 1:1 magnification. Identified fracture was then classified according to Allman's radiographic classification system. [18]

Methodology

The present study was carried out at Orthopedics Department in General Hospital. During this period 20 patients of clavicle middle one third clavicle fractures were treated surgically.

Inclusion Criteria

- Middle one third clavicular fracture
- Age 20 - 60 years
- Bilateral clavicle fractures

Exclusion Criteria

- Open fractures involved in middle one third of clavicle
- Lateral end clavicle fractures.
- Clavicle fracture with acromial joint subluxation.
- Pathological fractures.
- Patients managed conservatively due to comorbidities and associated chest injuries.
- Associated with neurological injuries.
- Previous clavicle fractures with malunion.
- Grossly comminuted fractures.

Demographic information such as name, age, sex, occupation and address were noted. Then a detailed clinical history such as mode of injury like fall on the shoulder, road traffic accident, direct injury to shoulder and fall on outstretched hand was noted. 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 cardiovascular system were examined for any abnormalities.

Local examination was done in the following step

1. On inspection the following points were noted :
   Patients with fracture clavicle often support the flexed elbow of the injured side with the other hand. Abnormal swelling was present in the middle 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 at the fracture site, abnormal mobility and crepitus.

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. Plain radiograph of clavicle with shoulder in anteroposterior view was taken to asses the site of fracture and the fracture type (displacement and comminution). The fractures were classified according to Robinson's classification.

The affected upper limb was initially immobilized in shoulder immobilizer.

Patient was thoroughly investigated and evaluated by all necessary haematological investigations.

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.

Pre- operative preparation of patients:

Patients were kept fasting for 6 hours before surgery. A written informed consent for surgery was taken.

The neck, chest, axilla, shoulders and arm were prepared.

An antibiotic intravenously were administered 30 minutes before surgery to all patients.

Results

The present study consists of 20 patients of fresh fracture of the clavicle which were treated with open reduction internal fixation with intramedullary screw for middle one third clavicle fracture between November 2016 to August 2018. All the patients were available for follow up and they were followed every 4 weeks till 6 months.

Table 1: Mode of Injury

Mode of injury	No. of Patients	Percent
Fall on shoulder from two wheeler	8	40 %
Road traffic accident	5	25 %
Simple fall on shoulder	4	20 %
Fall on out stretched hand	3	15 %
Total	20	100 %

Direct injury occurred in 17 patients (85%) among them 8 patients (40%) were due to fall on shoulder from two wheeler, 5 patients (25%) were due to road traffic accident, 4 patients (20%) were due to fall on the shoulder after slipping. Indirect injury occurred in 3 patients (15%) due to fall on outstretched hand.

Table 2: Type of fracture

Side	Frequency	Percent
TYPE 2B1	16	80 %
TYPE 2B2	4	20 %
Total	20	100 %

In this study type-2 B1 (displaced with simple or single butterfly fragment) occurred in 16 (80%) patients and type-2 B2 (displaced with comminuted or segmental) fracture occurred in 4 (20%) patients.

Table 3: Functional Outcome

Grade	Patients
Excellent	16
Good	3
Fair	0
Poor	1

In this study 16 (80%) patients had excellent functional outcome, good functional outcome in 3 (15%) patients and poor functional outcome in 1 (5%) patient.

Table 4: Complications

Complications	Patients
Non union	0
Mal union	0
Shoulder restriction	0
Implant failure	1
Superficial Infection	1

In this study 1 (5%) patient had superficial infection for which we have treated with antibiotics and 1 (5%) patient had implant failure due to screw proud for which implant removal was done and after fracture got union. No cases with non-union are reported as only middle one third clavicle fracture with minimal comminution are taken in this study.

Discussion

Majority of the clavicle fractures occur at middle one third region with over all rates reported as 82%. Intramedullary fixation with cancellous screw for middle one third fractures has achieved best results and patient satisfaction. Because of the minimally invasive technique, small incisions are enough, cosmetically better, less hospital stay, faster wound healing. According to my study total number of patients are 20 are evaluated all underwent open intramedullary screw fixation with 6.5mm cannulated screw.

According to Ayman Khalil *et al.* there were 28 males and 7 females with a mean age of 38 years (range 18–65). All fractures were closed and scoring system for functional outcome Disability of Arm, Shoulder and Hand score was used. In my study they are 13 males and 7 females with mean age of 40 years (range 20-60) and all are closed fractures which shows majority of the patients are males and constant and murley scoring system was used for functional outcome. Hence have correlation with study. [13]

According to Young Girl Rhee *et al.* the study total of 22 patients were enrolled to investigate and compare the outcomes of retrograde intramedullary screw fixation and of anterograde intramedullary screw fixation for clavicle shaft fractures and made a comparative analysis of the two approaches using the radiological and clinical outcomes. In which 12 patients were treated with retrograde intramedullary screw and 10 patients with anterograde intramedullary screw clavicle shaft fractures and its radiological and clinical outcome is described .The study is classified by robinson's Classification in which type2B1 are 20 patients and tybe2B2 are 2 patients. For clinical assessment they analyzed pain at final follow up using the visual analogue scale score for subjective pain and American shoulder and elbow score for range of motion were assed. In my study total 20 patients are included and only one approach all the patients underwent retrograde intramedullary screw fixation for clavicle shaft fractures and its radiological and clinical outcome is described. The study is classified by Robinson AO Classification in which type2B1 are 16 patients and tybe2B2 are 4 patients. But in my study clinical and functional outcome is assessed by Constant and Murley score. hence have correlation with study. [14]

According to Pei Yu Chen *et al.* study the procedure was not applied for patients above 7 days old fractures and all the patients were operated with closed reduction technique. In my study similarly as pei yu chen *et al.* the procedure was not applied above 7 days old fractures but in my study all the patients were operated with open reduction technique. Hence have correlation with study.

According to Grassi FA *et al.* study was to compare the results achieved in two groups of in a total of 80 patients, 40 patients each group. The patients in which Group 1 (mean age, 37.2 years) 40 patients underwent non operative treatment with a figure of 8 bandage, and whereas group 2 (mean age, 30.2 years) 40 patients underwent open reduction and intramedullary fixation with a threaded pin for uncomplicated midclavicular fractures. In my study only one group of 20 patients with (mean age of 40 years) have been included and all the 20 patients are treated with open reduction intramedullary fixation with cannulated cancellous screw for uncomplicated midclavicular fractures. Hence, have correlation with study

According to Dr. S. P. Rai *et al.* study there were 28 patients and All the patients in middle third clavicle fracture were closed type and displaced fractures. .In middle third clavicle fracture majority were males, 18 (64%) patients and10 (36%).females. In this study for middle third clavicle fractures there were 16 patients (57%) of right sided and 10 patients (36%) of left sided and 2 (7%) patients has fracture of both clavicles. The functional outcome is assessed by Constant and Murley score. In this study on 22 patients (79%) with middle third clavicle fracture treated with Lag screws had excellent functional outcome, good functional outcome in 4 patients (14%) and fair functional outcome in 2(7%) patient. They followed Robinson's classification, in type-2 middle third fracture type-2 B1 occurred in 20patients (78%) and type -2 B2 fracture occurred in 8 (32%) patients. All the patients were fixed with single Cannulated Lag

screw. In this study primary open reduction and internal fixation with Cannulated screw fixed with Lag effect in fresh middle third clavicle fractures. In my study there are 20 patients and all the patients are of middle third fracture closed type and displaced fractures similarly of Dr. S.P.Rai *et al.* study. In which majority are males 13 (65%) patients and 7 are females (35%) and majority are left sided 12 (60%) patients and right sided 8 (40%) and no bilateral clavicle were include in my study. similarly we have same scoring system of functional outcome is assessed by Constant and Murley score . In this study on 16 patients (80%) with middle third clavicle fracture treated with Lag screws had excellent functional outcome, good functional outcome in 3 patients (15%) and poor outcome in 1(5%) patient. Similarly we have also followed Robinson's classification, In type-2B1 occurred in 16 patients (80%) and type -2 B2 fracture occurred in 4 (20%) patients. All the patients are fixed with single Cannulated Lag screw and primary open reduction and internal fixation with single Cannulated screw fixed with Lag effect in fresh middle third clavicle fractures. Hence have correlation with study.

Conclusion

Hence we concluded, from this study, we recommend the use of minimally invasive intramedullary screw fixation with 6.5 cannulated cancellous screw for displaced middle third clavicle fractures. It allows intramedullary compression by lag effect, stability, stress sharing, less periosteal stripping and early recovery after surgery, faster fracture union, easier implant removal and less complications.

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