Original Article

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Study on Surgical Management of Midshaft Clavicle Fractures

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Abstract

Introduction: Fractures of the clavicle constitute 2.6% of all fractures, account for 44% of the injuries around the shoulder girdle, approximately 70-80% of which occur in the middle third. Even when significantly displaced traditionally these fractures are treated without surgery. Conservative treatments either by sling/figure of 8 bandage/clavicular brace is favored by patients, but the results are much inferior to what reported previously. Present study conducted to operate fresh fracture with displacement >2cm, non-union by ORIF with locking plate with or without bone grafting. Objective is relief from pain, restoration of activities as far as possible & better cosmetic appearance. *Material & methods*: 28 cases of clavicle in healthy active individuals between 16-65 yrs. of age operated between Dec. 2012 to September 2016 in Hi-Tech Medical College, Rourkela, Odisha. Fracture classified by Allman in to three groups as middle 1/3rd, distal 1/3rd, medial 1/3rd. Indications for surgery either opens, vascular injuries, initial displacement >2cm, nonunion, cosmetically conscious patients. *Results:* 15 cases of fresh, 6 cases of symptomatic delayed union and 7 cases of nonunion operated with precontoured plate with or without bone grafting. The average hospital stay was 3-7 days. The average time of fracture union was 10 weeks (8-12 weeks). Patients were followed weekly up to 4 weeks and then after 2 and 6 months. The functional outcome according to Constant and Murley score is excellent in 17 patients (60.7%), good in 10 patients (35.7%) and satisfactory in 01 case (3.6%). There was no major complication, 1 patient had superficial infection, deep infection in 1 case, nonunion in 1 case and plate breakage in 1 patient. Results were compared with cases treated conservatively. *Conclusion:* In present era of competition, cosmesis and advancement with least morbidity & excellent results is required. ORIF in selected cases is a very good option in comparison to accept morbidity, cosmetic disfigurement and below average functional results.

Keywords: Osteosynthesis; Symptomatic; Non-Union; Fracture; Clavicle.

Introduction

Displaced fractures of the middle third of the clavicle are common in young, athletic populations and following road traffic accidents. Fractures of the clavicle constitute 2.6% of all fractures, account for 44% of the injuries around the shoulder girdle, approximately 70-80% of which occur in the middle third [1]. Fracture classified by Allman in to three groups as middle 1/3rd, distal 1/3rd, medial 1/3rd (Table 1). Clavicle fractures typically produce an obvious painful deformity, with tenderness localized over the site of fracture. There is often downward displacement of the lateral fragment under the weight of the shoulder and elevation of the medial fragment from the unopposed pull of the sternocleidomastoid muscle. Even when significantly displaced, traditionally these fractures are treated without surgery. Conservative treatments either by sling/figure of 8 bandage/ clavicular brace is favored by patients, but the results are much inferior to what reported previously. This has shown a greater prevalence of symptomatic

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malunion, nonunion and poor functional outcomes following inadequate reduction or failure to maintain reduction of displaced midshaft clavicle fracture. Malunion can cause a bony deformity that may be cosmetically unacceptable. In some cases, the malunion can compress adjacent blood vessels or nerves resulting in thoracic outlet syndrome. In 1960, Neer [2] reported an astonishingly low rate of nonunion in conservatively treated middle third clavicle fracture. In 1977, Hill et al. [3] reported a 15% nonunion rate in nonoperatively treated clavicle fractures and a relationship between shortening and the risk of nonunion. Several techniques of fixation have been described in literature, including the use of plates, Kirschner wires, steinmann pins, intramedullary nail and external fixators [4]. It lacks a well defined medullary cavity. The use of a precontoured superiorly placed locking plate and screws for the midshaft fracture clavicle is a very good option [5].

Material and Methods

28 patients of midshaft clavicular fractures were treated by open reduction and internal fixation between February 2012 and September 2016 in Hi–Tech Medical College, Rourkela, Odisha. During this period of four years, twenty eight patients of midshaft clavicle fractures were treated surgically with precontoured plate and screws with or without bone grafting. Twenty two patients were males while six patients were females. 16 cases were following road traffic accident, 10 patients were due to fall on shoulder and 2 cases were due to direct violence. Age incidence and mode of injury are shown in Tables 2 and 3.

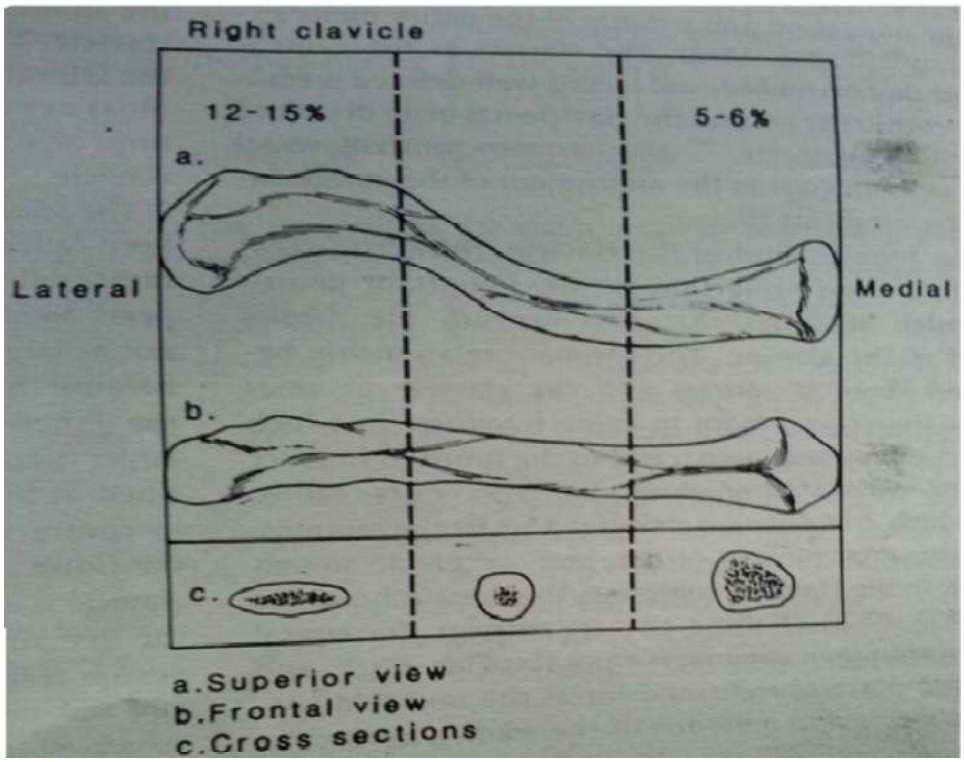
Table 2: Age-wise distribution of patients according to the incidence of middle clavicle fractures (n= 28)

Age(in years)	Number of midshaft clavicle fracture
15-25	3
26-35	13
36-45	10
46-55	1
56-65	1

Table 3: Distribution of the patients according to the mode of injury

Age(in years)	Number of midshaft clavicle fracture
Road traffic accident	16
Fall on shoulder	10
Direct Violence	2

Table 1:



Indications for surgery are open fractures, vascular injuries, initial displacement >2cm, symptomatic delayed union, no union and cosmetically conscious patients. In our study, the inclusion criteria were healthy active individuals between 15-65 years of age which required surgical intervention for displaced and comminuted middle third fracture clavicle. Out of the 28 patients, fifteen cases were of fresh fractures, six cases were delayed union (no evidence of union > six weeks) and seven cases were of nonunion (No union > three months). Six patients in this study showed clinical mobility at the fracture site and inadequate callus formation on radiographic examination at the end of six weeks with significant morbidity due to pain and inability to use their limb to normal function. Such patients were labeled as symptomatic patients with delayed union. Nonunion has been labeled after three months to sixteen weeks in various studies [5]. Exclusion criteria in this study were paediatric patients, patients with undisplaced fracture, proximal/distal third of clavicle fracture, pathological fractures and any medical contraindication to surgery or general anaesthesia.

Surgical technique: Surgery was done under general anaesthesia with patient in beach-chair semi-sitting position. A curvilinear 5-8 cm long incision was given on the anterior aspect of the clavicle centering over the fracture site. The skin, subcutaneous tissue, and platysma were divided. Carefully identify and preserve 3-5 branches of supraclavicular Nerves running obliquely or perpendicular to clavicle. The overlying fascia and periosteum were divided. Extreme care was taken while elevating the periosteum. The osseous ends were mobilized with careful sharp dissection, freshened and fracture ends were reduced with care not to damage the adjacent structures. After reduction, precontoured plate was applied with locking screws over the superior aspect *(Figures* 1 and 2) of the clavicle. Cancellous bone graft was used where there was inadequate callus formation. In fresh cases, bone graft was not used. Four of delayed cases had callus at fracture site, hence it was used as bone graft, while 2 cases were 6 weeks old fracture and introperatively it was felt that good stability at fracture site will be good enough to achieve fracture union. Iliac crest strut graft was used in 3 patients where a significant defect existed at the site of nonunion after freshening bone ends [6]. Stability of the fixation was checked clinically. The average hospital stay was 3-7 days. From the fourth postoperative day, pendulum exercises were started and collar-cuff sling was given thereafter. Stitch removal was done on 12th day and further follow-up was done after 4 weeks. Full ROM was allowed once the pain subsided. Patients were then reviewed at 6 weeks, 12 weeks and subsequently at 6 months to assess the fracture healing. On each visit, X-ray examination was done to assess fracture healing. In all patients, the functional outcomes were assessed by Constant and Murley Score [7].

Results

The fracture was considered to be united when clinically there was no tenderness, radiologically the fracture line was not visible (Figure 3) and full unprotected function of the limb was possible. All the fractures united well within 3 months (Figure 3,4), 80% in 10 weeks and 20% in 10-12 weeks. The average time of fracture union was 10 weeks (8-12 weeks) Average time for iliac crest strut grafting also showed satisfactory incorporation of the graft. There were no major complications in our study. Only one

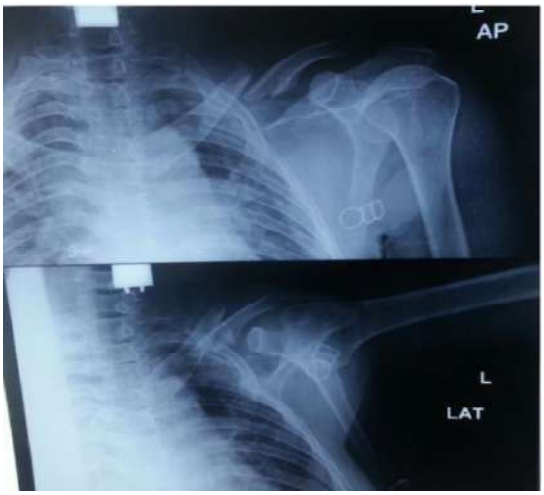


Fig. 1: Pre op X Ray

Fig. 2: Post op X Ray

Fig. 3: Showing Operative scar

Fig. 4: Follow up

Fig. 5: Showing superficial infection

Fig. 6: Showing late deep infection

Table 4: Distribution of the patients according to the complications

Complications	n
Skin Infection	1
Deep Infection	1
Delayed union	0
Non union	1
Plate breakage	1

Table 5: Distribution of the patients according to the functional outcome

Functional Outcome	n (%)
Excellent	17 (60.7)
Good	10 (35.7)
Satisfactory	1 (3.6)
Adequate	0
Poor	0

(3.6%) patients have superficial infection (Figure 5), one (3.6%) had nonunion and one case had plate breakage and one patient had late deep infection for which the implant removal was performed (Figure 6). Complications are shown in Table 4.

The functional outcome according to Constant and Murley score is excellent in 18 patient, good in 10 patients and satisfactory in 01 patient. This is shown in Table 5.

Discussion

The clavicle has an integral role not only in the mechanics of the pectoral girdle but also in the function of the upper extremity. About 80% clavicle fractures occur in the middle third. In our series, road traffic accident followed by fall on the outstretched hand is the most common cause. Maximum patients were of the middle age group. Clavicle fractures rarely need operative fixation. Rowe suggested that the usual healing periods for fractures of the middle third of the clavicle were two weeks for infants ,three weeks for children, four to six weeks for young adults and six weeks or more for older adults [1]. Adults don't possess same remodeling potential as younger children and most midshaft clavicle fractures heal with some degree of malunion. Hence we have taken absence of union at six weeks to define as symptomatic delayed union. We have considered nonunion in patients with clinical mobility at the fracture site and no radiological union after three months, double the time required for union as suggested by Rowe. Nonunion has been labeled after three months to 16 weeks in various studies [8]. Hill et al reported a 15% nonunion rate and 31% patient dissatisfaction rate in conservatively treated displaced middle third fractures of the clavicle [3]. Recent study has

shown that rate of malunion and nonunion is higher in the nonoperative group. Fractures of midshaft clavicle with 100% displacement and more than 2 cm shortening require surgical fixation

Open reduction and plate osteosynthesis along with autogenous bone graft when required is the standard method for the surgical management of displaced clavicular fractures. Subclavian vessels and the brachial plexus lie beneath the middle third of the clavicle. Extreme care and meticulous dissection is required to prevent damage to these structures [9]. Also care must be taken to avoid damage to the pleura in the apical region of the lung. No force should be applied while drilling the holes. Power drills, preferably oscillating drill with sharp drill-bits should be used for the purpose. Locking compression plate, which is shaped to match the shape of the clavicle, is very effective. In our study, precontoured locking plates were used instead of recon plate. The advantages with these plates include strong fixation due to locking between screw and the plate and the blood supply preservation due to minimal contact between plate and cortical bone [10]. Restoration of the length is necessary for good functional outcome.

Neer's original report recommended operative fixation based on a 67% rate of delayed union and a 33% incidence of nonunion with nonoperative management compared with 100% union within 6 weeks after operative fixation [11]. Bostman et al studied 103 patients treated with open reduction and internal fixation using plates, the wound infection rate in their study was 4.8%(3/62) and they were managed with antibiotics and local wound care and subsequently underwent implant removal once the fracture had healed [12]. In Canadian study, no patient in the operative group presented with symptomatic malunion [13]. We could achieve good functional outcome in most of our patients. The results of the current series compare favorably with the previous reports, with fracture union achieved in 95.4% of cases. The functional outcome (Figure 4) according to Constant and Murley was found to be significantly higher in the operative group [7]. In this study, average constant score in the operative group was found to be 96.1 and 85.9 in nonoperative group. The results depended on the stability of the fixation, biological environment to achieve bone healing and careful surgical technique.

Conclusion

Clavicle fractures are treated conservatively, but open reduction and internal fixation with a precontoured locking plate in conjunction with an autologous graft, in selected cases, is a successful procedure with good outcome. It was observed that primary fixation of mid shaft clavicular fractures provide a more rigid fixation and yielded better functional outcome and resulted in high union rates. With careful technique the complication rate is low and most patients can return to a near normal level of function. The high rate of success of osteosynthesis in this series and other series strongly support this statement.

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