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Functional Outcome of Displaced Clavicular Fractures Managed Conservatively

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Abstract
Clavicle fracture is a common traumatic injury around the shoulder girdle due to its subcutaneous position. Clavicular fracture accounts for 5-10% of all fractures. The annual incidence varies from 29 to 64 per 100, 000 individuals. 80% of clavicle fractures occur in the middle third region. A Hospital-based observational prospective study was performed on all patients who came to the Department of Orthopaedics, Assam Medical College and Hospital, Dibrugarh with clavicle fracture and met the inclusion and exclusion criteria in the study period of 2021-2022. Non-operative treatment consisted of immobilization using Figure of 8 brace and arm sling and analgesic treatment followed by mobilization exercises. The figure of eight brace was removed after 6 weeks. Radiographs were taken during the immediate post bracing period, 6 weeks, 12 weeks, 16 weeks, and 24 weeks. The outcome for the study was patient-reported outcome in terms of-Functional outcome assessed by the Constant-Murley score. After a follow-up of 24 weeks (6 months) displaced (>2cm) mid shaft clavicular fractures treated non-operatively had higher rates of mal-union and two cases had non-union but functional outcome and union time were comparable to those treated with operative intervention as shown in literature. Conservative treatment gives good to excellent functional outcome without any significant complication as contrary to open reduction internal fixation where complications like infection, non-union rate are quite high along with need for reoperations for implant removal or hardware related complications.

INTRODUCTION

Clavicle fracture is a common traumatic injury around shoulder girdle due to its subcutaneous position[1]. Clavicular fracture accounts for 5-10% of all fractures. The annual incidence varies from 29 to 64 per 100, 000 individuals[2].About 70-80% of these fractures occur in middle third of the clavicle[1]. The midshaft is susceptible to fracture where there are no strong ligaments, muscle coverage is absent and the curved bone is weaker. These fractures are usually complete and show an oblique, transverse or multi fragmentary fracture pattern. In adults, clavicle fractures are common, comprising 2.6-4% of all fractures and 35% of all shoulder-area injuries[3,4,5]. 80% clavicle fractures occur in the middle third region, around 20% fractures occur in the lateral third region whereas only <2% fractures occur in the medial end[6,7]. Incidence is notably higher in men (68-71/100,000) than in women (23-31/100,000)[4,8]. Displaced midshaft fractures of the clavicle identified motor vehicle/motorcycle accidents, bicycle accidents, skiing/snow boarding falls or collisions, sports injuries and falls as the most commonly involved mechanisms[9].

Indications for primary fixation of Midshaft Clavicular Fractures are-Displacement>2cm, Shortening>2cm, Increasing comminution>3 fragments, Segmental Fractures, Open Fractures, Impending open fracture with soft tissue compromise, Scapular malposition and winging at initial examination. Since 2000, evidence has shown the contrary-operative treatment yields fewer non-unions (2.2 vs 15 %, respectively)[10,11] as well as mal-unions and earlier return to work and play[12,13]. Despite the success of plate fixation, complications related to their use are reported in the literature, such as plate loosening (4.8 %), plate breakage (1.9 %)[14],infection (0-18 %)[15,16], painful implants, refracture after removal (0.04 %)[17], and discomfort[14]. Some risk factors related to these complications include comminution, technical errors, use of cerclage wires for additional fixation[18] and fracture displacement[19]. Poor compliance postoperatively with restricted weight lifting has also been reported[20]. The incidence of surgical complications is estimated to be around 10–15.8% [21-23].

The aim of this study is to reduce the burden of complications and treat the displaced (>2cm) midshaft clavicle fractures conservatively and check the functional outcome of the patients. In this study we looked for what are the patient related outcomes in terms of physical functioning, return to work, sports, overall satisfaction and what are the clinical outcomes in terms of adverse effects.

MATERIALS AND METHODS

A prospective study was conducted in the Department of Orthopaedics, Assam Medical College and Hospital, Dibrugarh with clavicle fracture who were treated conservatively during the period of 2021 to 2022 and met the inclusion and exclusion criteria in the study period of 2021-2022. Displacement is measured radiologically.

Inclusion Criteria:

- Clavicle fracture Robinson's type 2B1 and 2B2, b) Duration <3 weeks, c) Age 18-65 years,d)Patients giving informed consent

Exclusion Criteria:

- Open fractures, b) Pathological fractures, c) Segmental fractures, d) Bilateral clavicle fractures, e) Established nonunion from a previous fracture, f) Refracture, g) Associated ipsilateral upper limb fractures, i) Any shoulder joint pathology, j) Fractures >3 weeks duration

Treatment and Outcome: Nonoperative treatment consisted of immobilization using Figure of 8 brace and arm sling and analgesic treatment followed by mobilization exercises. Stepwise tightening of the brace is recommended to counteract the shortening forces. Patients and relatives of patients were also taught on how to tighten the brace when needed. Broad arm sling was added to provide analgesia and support during the initial weeks, when there is significant pain. After bracing, patients radial pulse was checked to rule out any axillary artery compression and for nerve injury if any. The figure-of-eight brace was encouraged to be used all day (including bed-time). Patients were also advised to keep a rolled up towel between their shoulder on the bed during night to maintain shoulder in the correct position during sleep. The figure of eight brace was removed after 6 weeks. Radiographs were taken during immediate post bracing period of 6 weeks, 12 weeks, 16 weeks and 24 weeks. Once radiological signs of union are seen no further radiographs are taken. Day one to 6 weeks: Patient will be put on a clavicle brace and the limb is immobilized in a sling/arm pouch. Elbow is maintained at 90 degrees flexion with no range of motion at shoulder. At six to eight weeks: Gentle pendulum exercises to the shoulder in the sling as pain permit is allowed. Active range of motion exercises of elbow, wrist and hand were started with pendulum movements of shoulder. After eight weeks: Active – assisted to active range of motion in all planes is allowed. Isometric and isotonic exercises are prescribed to the shoulder girdle muscles[24].

Outcome for the study was patient reported outcome in terms of -Functional outcome assessed by the Constant-Murley score[25].

It comprises of clinician- assessed physical examination findings and subjective patient- reported

assessments. It consists of 14 items with a total score of 0-100. The questionnaire consists of two parts: the subjective part measures pain during various activities: pain, activity level sleep affected, recreations/ sport limitation, daily living limitation and arm positioning. The objective part is completed by surgeon and includes the following components: Range of motion, strength of abduction, external rotation and internal rotation. A Handheld dynamometer was found to be reliable in assessing the shoulder strength in subjects with shoulder disease. In our study we used a handheld dynamometer to assess the shoulder strength in follow up of our cases and compared them with the normal side of the patient. Manual muscle tests are also recognized as being a subjective measurement of strength, dependent on the experience, strength, and judgment of the examiner[26-31].

Physical functioning, health reated quality of life, pain return to work, sports, overall satisfaction. The Disability of the Arm, Shoulder and Hand (DASH) quotionnaire was used to measure physical functioning with score 0 (no disability) and 100 (most severe disability).

Statistical Analysis: The statistical analysis of data was performed using the computer program, Statistical Package for Social Sciences (SPSS for Windows, version 20.0. Chicago, SPSS Inc.) and Microsoft Excel 2010. Results on continuous measurements are presented as mean ± standard deviation are compared using student t test. Discrete data are expressed as number (%) and are analysed using Chi square test and Fischer's exact test (where the cell counts were <5 or 0). Pearson's correlation coefficient (r) was used to measure the associations among continuous variables. For all analyses, the statistical significance was fixed at 5% level ($p<0.05$).

RESULTS AND DISCUSSIONS

Our study aims to evaluate the results of the functional outcome of displaced midshaft clavicular fractures managed conservatively with figure of eight brace and arm pouch. A total of 70 displaced midshaft clavicular fractures were studied and followed up during the study period, following observations were made:

In our study, 24(34.29%) of the cases were in the age group of 18-29 years, 22(31.43%) cases were in the age group of 30-39 years, 16(22.86%) cases were in 40-49 years group and 8(11.43%) cases were in 50-60 years group. The mean age was 35.6±4.5 years. 56 males (80%) and 14 females (20%) with male to female ratio of 4:1. 33 patients (47.14%) were manual labourer, 16 patients (22.86%) were skilled labour, 11 patients (15.71%) were students, 10 patients (14.29%) were athletes. fracture occurred in 50 patients (71.43%) due to Road Traffic Injuries, 12 patients (17.14%) due to self fall, and 8 patients (11.43%) due to sports injury. , mechanism of injury for 48 patients (68.57%) was fall on an outstretched hand, 12 patients (17.14%) was fall on lateral end of the shoulder and 10 patients (14.29%) was a direct blow on the clavicle. the dominant side was involved in 38 patients (54%) and non-dominant side involvement in 32 patients(46%). 32 fractures (45.71%) were transverse and the remaining 38 fractures (54.29%) were oblique in pattern. there were 60 patients(85.71%) in 2B1 and 10 patients (14.29%) in 2B2. in our study, 2 patients (2.86%) had associated head injury, 2 patients (2.86%) had blunt chest injury and 3 patients (4.29%) had other extremity fracture. Constant Murley Score of the cases were poor (less than 56) at the time of presentation. 38(54.29%) patients (54.29%) cases had fair functional outcomes, and 32 patients (45.71%) had poor functional outcomes at 3 weeks following the intervention of figure of eight bandage and arm pouch application. 15 patients (21.43%) had excellent

Fig 1: Fracture at the time of injury

Fig 2: Fracture at 18 weeks followup

Fig 3: Clinical pictures at 24 weeks follow up

Table 1: Mean Constant Murley Score at specific time intervals.

Time Interval	Constant- Murley Score	
	Mean	S.D.
At time of injury	20	5.5
At 3 weeks	35.5	3.1
At 6 weeks	49.7	4.3
At 12 weeks	60.5	5.6
At 16 weeks	81.5	7.5
At 24 weeks	91.5	7.5

Table 2: Union time

Duration (weeks)	Number (n)	Percentage (n=70) %
<12	23	32.85
12-16	35	50.00
>16	12	17.15
Total	70	100.00

Table 3: Complications

Complications	Number(n)	Percentage %
Non Union	2	2.86
Delayed Union	10	14.29
Mal Union	45	64.28
Total	57	81.43

functional outcome, 27 patients (38.57%) had good functional outcome, 25 patients (35.71%) had fair functional outcome, 3 patients (4.29%) have poor functional outcome at 12 weeks of follow-up. 56 patients (80%) have excellent functional outcome, 10 patients (14.29%) have good functional outcome, 4 patients (5.71%) have fair functional outcome at 24 weeks of follow-up. The mean Constant Murley Score of our study population at the time of injury, was found to be 28 ± 2.7; at 3 weeks as 43.7 ± 3.1; at 6 weeks as 58.6 ± 4.3; at 12 weeks as 79.5 ± 5.6; and at 24 weeks as 91.5 ± 7.5. 23 fractures (32.85%) united within 12 weeks of duration, 35 fractures (50%) united in 12- 16 weeks of duration and the remaining 12 fractures (17.15%) united in > 16 weeks of duration. In our study, 2 patients (2.86%) complicated with asymptomatic non-union, 10 patients (14.29%) complicated with delayed union and 45 patients (64.28%) complicated with mal-union. 13 patients (18.57%) underwent treatment without any complications.

Middle third fracture of the clavicle is one of the most common fractures of the body, clavicle fractures account for approximately 4% of all fractures[32]. It frequently results in short-term disability and pain, eventually causing longer-term deformity and disability if treated inadequately. Fractures occur most commonly in the middle third of the bone (76-82%) and less often in the distal (12-21%) and medial (3-6%) third[33,34]. Traditionally most of these fractures have been treated with slings, or figure- of-eight harnesses. Historically it was considered that, "All clavicle fractures do well with non operative treatment". Such treatment were usually successful and till recently most of the available literature showed that more than 95% of clavicle fractures achieve union with acceptable cosmetic and functional results[35].

Virtanen KJ *et al.,* who reported no significant difference between the functional outcome of the conservative and operative group in their series. Virtanen KJ *et al.,* in their series of 60 patients of whom 32 patients were managed conservatively and 28 patients underwent open reduction and plate fixation, they concluded that the rate of non-union was higher with the conservative group but the outcome of shoulder function was same as the operated group[36].

In the prospective clinical trial conducted by Jha GK *et. al*[37] the average union time in the conservative group was 16.04±4.229 weeks and that in the operative group was 14.57 ± 4.150 weeks, the reduction in time was not found statistically significant and mean Constant Murley Score was found to be 94.47±7.514 in the conservative group and 96±7.909 in the operative group at a follow-up period of 24 weeks. Complications included-2 cases (6.67%) of asymptomatic non-union, 3 cases (10%) of delayed union, 70% of asymptomatic mal-union in the conservative group and 4 cases (13.3%) of delayed union, 3.3% of malunion in the operative group along with infection (3.3%), hardware complications like screw loosening (13.3%), implant failure (6.7%).

Shetty SK *et. al*[38] reported that the mean DASH score at the end of 24 weeks was noted to be 8.57±6.073 among the conservative group while that in the operative group was noted to be 7.74±16.422.

Persico F *et. al*[39]. studied the complications of operatively treated clavicle fractures at Level 1 trauma centre and found 12 patients (21.4 %) had complications, there were overall 16 individual complications: 4 nonunions (3 cases with no augmentation during the index procedure), 2 refractures, 3 superficial infections, 2 plate angulations, 1 deep infection, 2 plate loosening, 1 painful prominent implant, and 1 patient complaining of pain without prominence of the implant. In 5 patients (8.9 %), the complications needed operative treatment: 2 for refracture of the plated clavicle, 2 for nonunion, and 1 case for pain.

In our study, the mean union time for the fractures were 16.10 ± 4.3 weeks. The mean Constant Murley Score at 24 weeks of follow up was found to be 91.5 ± 7.5. In our study, 2 patients (2.86%) complicated with asymptomatic non-union, 10 patients (14.29%) complicated with delayed union and 45 patients (64.28%) complicated with mal-union. 13 patients (18.57%) underwent treatment without any complications. However, all the mal-union and delayed union cases were asymptomatic with good functional outcome.

Limitation: This study does not provide longitudinal data about short-term patient outcomes. This information could be an important consideration for

active, high-demanding patients. Moreover, due to the limited number of patients in the different treatment groups comparison between the different operative treatment strategies was not feasible. Lastly, we acknowledge that missing data about adverse events or complications might occur. However,the risk of missing data concerning adverse events and complications was considered low, because it was acquired from patient files as well as from additional questions in the follow-up questionnaires.

CONCLUSION

Fractures of clavicle constitute approximately 4% of all fractures in an urban population, and constitute 35% of all fractures of the shoulder region. The mid-shaft area being the thinnest zone along the shaft of clavicle and devoid of soft tissue coverage being more prone to fracture. According to literature, 70-80% of clavicular fractures are midshaft and more than half of them are displaced. Traditionally, all clavicular fractures were treated conservatively but studies have shown the emergence of operative intervention for displaced clavicular fractures. However, the post operative complications like infection, non-union, hardware-related complications and the need for implant removal increases the rate of reoperation. The main aim of the study is to reduce the burden of operative intervention, hence reduce the postoperative complications arising if all the displaced clavicular fractures had been treated with operative intervention, without compromising the functional outcome through conservative management. In a developing country like ours, this would reduce the financial burden of surgical intervention in the patients which can be managed conservatively.

This study throws light on the union time, functional outcome of patients, with displaced midshaft clavicular fractures, mostly being manual labourers in whom shoulder function is utmost important. Unexpectedly, the functional outcome is comparable to that following operative intervention according to many literatures. However, a non-union rate of 2.86% is also seen in our study which is mostly asymptomatic as those two patients had fair functional outcome. After a follow-up of 24 weeks (6 months) displaced midshaft clavicular fractures treated non-operatively had higher rates of malunion and two cases of non-union but functional outcome and union time is comparable to those treated with operative intervention as shown in literature. Hence we conclude that conservative management can still be accepted as a recommended method of treatment for displaced mid-shaft clavicular fractures without the post-operative complications and the need for reoperations as conservative treatment still gives good to excellent functional outcome without any significant complication as contrary to open reduction internal fixation where complications like infection, non-union rate are quite high alongwith need for reoperations for implant removal or hardware related complications. Therefore, there is a need to individualize the treatment as per the need and functional demand of the patient to give the optimum outcome.

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