OUTCOME OF SURGICAL AND CONSERVATIVE MANAGEMENT OF FRACTURES OF THE MIDDLE-THIRD OF THE CLAVICLE

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ABSTRACT:

Introduction: *Clavicular fractures are common injuries, accounting for 2.6% of all fractures. Fractures. This study aims is to determine the rate of union in mid-third clavicular fractures treated by non-operative methods and by clavicular plating, to determine the complications involved in management of mid-third clavicular fractures and to compare the functional outcomes of mid-third clavicular fractures treated by non-operative methods and by clavicular plating.*

Methods: *In our study, for the operative group we used 3.5 mm reconstruction plates, 3.5 mm superior locking plates, 3.5 mm LC-DCP and 1/3 tubular plate . All plates were superior in position. Circlage was done where necessary. Lag screws were used in indicated cases for fracture compression. Nonoperative management was by treatment in a sling or a figure of eight harness. Functional results were evaluated by DASH scores. Independent student 'T' test was used for statistical analysis.*

Results: *In the non-operative group, 75% cases united, while 25% went on to non-union. A mean DASH score of 21 was obtained. In the Operative group, 90% union rate was found. A mean DASH score of 11 was obtained. Operative*

Conclusion: *From our study we conclude that further study is required to clearly delineate which method of treatment is better. Operative management is beneficial to the patient for early mobilization and early return to daily activities with better Functional outcome. But the complications may increase the reintervention rate.*

Keywords: *LC-DCP, Clavicular Brace, DASH, Reintervention Rates.*

INTRODUCTION

Clavicular fractures are common injuries, accounting for 2.6% of all fractures[1]. The fracture is more common in the males with the male-to-female ratio of 2.6:1 ratio of left- to right-sided fractures was 1.28:1[2]. Fractures of the middle third account for approximately 80% of all clavicular fractures. [1] Fractures were most common in males aged from 13 to 20 years with a subsequent fall in incidence with age until the seventh decade. In females, the incidence remained more constant with age. Sport is the commonest cause of fracture in the young.

There are three basic mechanisms- bending, torsion and compression. The freedom afforded by the sterno-clavicular joint makes pure bending an unlikely mechanism for fracture during clavicular impact loading. The primary mechanism of clavicular failure is compression with fall onto the shoulder being the most common history. It can also be fractured by a direct blow on the point of the shoulder or fall onto the outstretched hand[3].

Clavicle fractures are traditionally treated nonoperatively, even when substantially displaced. This treatment strategy is based on reports that suggested that clavicular nonunion was extremely rare. More recent studies of displaced midshaft clavicular fractures have shown a higher nonunion rate that previously reported in literature as well as a high rate of unsatisfactory patient-oriented outcome. Recent studies however, have also shown evidence of high rate of fracture union and low rates of complications with surgical fixation. . With improved implants, prophylactic antibiotics, and better soft-tissue handling, plate fixation has become a reliable and reproducible technique. The obvious advantages of operative treatment are: Quicker pain relief, early mobilization, accurate reduction and anatomical alignment.

This study aims to

1. Determine the rate of union in mid-third clavicular fractures treated by non-operative methods and by clavicular plating,
2. Determine the complications involved in management of mid-third clavicular fractures
3. Compare the functional outcomes of mid-third clavicular fractures treated by non-operative methods and by clavicular plating.

MATERIALS AND METHODS

The present study consists of prospective comparative study of 20 patients with acute mid-third clavicular fractures treated with conservative management and 20 patients with acute mid-third clavicular fractures treated with surgical management with open reduction with plating at Bowring and Lady Curzon Hospital and Victoria Hospital attached to Bangalore Medical College and Research Institute.

The fractures were classified according to Edinburgh classification. 20 patients managed conservatively and 20 patients managed surgically were followed. The Patients with Open fractures of the clavicle, Undisplaced fractures, Patients <18 yrs

and >60yrs, Patients medically unfit for surgery, Patients not willing for surgery, Severely comminuted and segmental fractures of the clavicle, Patients with neurovascular deficits, Associated significant ipsilateral fractures of the arm which would delay the functional recovery of the arm, Pathological fractures of the clavicle were excluded from the study.

Surgrical Technique: In our study we used 3.5 mm reconstruction plates, 3.5 mm superior locking plates, 3.5 mm LC-DCP and 1/3 tubular plate . All plates were superior in position. Circlage was done where necessary. Lag screws were used in indicated cases for fracture compression. The patient was placed in supine in the beach-chair position. The table was broken and the head end was elevated 20^0. A sand bag was placed between the medial border of the scapula and the spine. . The entire length of the clavicle was palpated along the subcutaneous surface up to the acromio-clavicular joint. An incision was made beginning on the medial end following the 'S' shaped anatomy of the clavicle. The site and the length of the incision depended on the fracture.

After the fracture was exposed, the two main fragments were distracted, and the length of the clavicle, normal axis, angulations and rotation was restored. Any large fragments were temporarily reduced with clamps or K-wires. Lag screws were also used to maintain the reduction. A plate of appropriate length was selected. The plate was anatomically contoured to the patient's clavicle using the bending irons or the bending pliers. The plate was fixed with screws. Precaution was taken to prevent over penetration of the clavicle to protect the vital structures underneath. Minimum of 6 cortices in each fragment were fixed.

Nonoperative Management: Nonoperative management was by treatment in a sling or a figure of eight harness. The brace was adjusted frequently to keep proper tension. The advantage of the figure of eight harness was that it freed up both upper extremities for day-to-day activities. Patients are reviewed after 10 days, 6weeks and at 6 months. The skin is looked for any break down. Repeat x-rays are taken and looked for the status of the fracture union.

Follow Up: At 6 weeks x-rays were taken and if progress in union was evident, strengthening and resistive exercises were begun. At 3 months repeat x-rays were taken. If patient was pain free and union was obvious pt was allowed to resume routine activities. Contact sports and heavy lifting were avoided for 4-6 months. X-ray of the clavicle AP view was repeated after 6 months.

RESULTS

Our study comprised of 20 midshaft clavicular fractures treated non-operatively and 20 mid-shaft clavicular fractures treated by plate fixation.

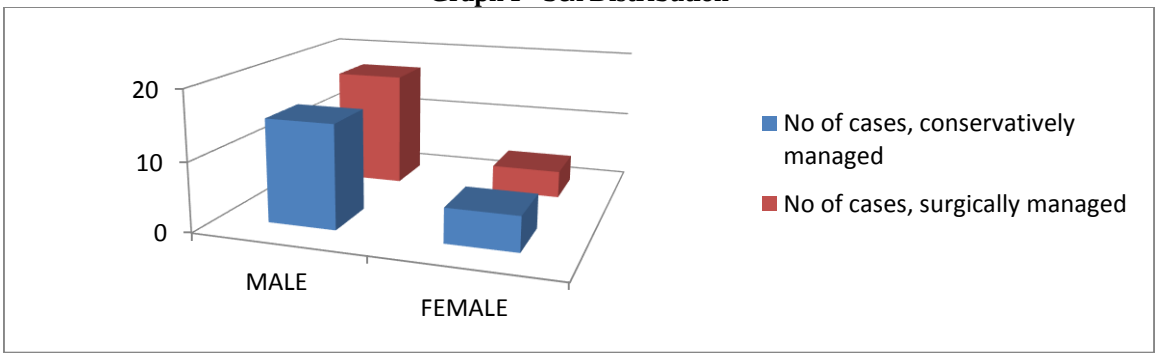
Nonoperatively Managed Group: There were 15 male patients and 5 female patients (Graph I) ranging from age 18 to 60 years (Table I) with a mean age of 38.6 years. Right to left ratio was 55% to 45%. Mode of injury of 80% had a direct fall on the shoulder, 15% sustained direct blow to the clavicle and 5 % had a fall on the outstretched hand (Table II).75% were classified as 2B1 and 25% were classified as 2B2 according to Edinburgh classification. They were managed with clavicular brace and monitored by serial x-rays. Union was noted in 75% cases while 25% went on to non-union.20% cases complained of pain on activity, 10% complained of transient paresthesia, 25 had symptoms of CPRS. Functional results were evaluated by Disabilities of the Arm Shoulder and Hand scores. A mean score of 21 was obtained.

Operated Group: There were 17 males and 3 females (Graph I) ranging from 18 to 60 years (Table I) with a mean age of 33.9 years. Right to left ratio was 55%-45%. Mode of Injury of 90% had a direct fall on the shoulder, 5 % had a direct blow on the clavicle and 5% had a fall on the outstretched arm (Table II). 70% were classified as 2B1 and 30% were classified as 2B2 according to Edinburgh classification. 2 patients were treated with 1/3 tubular plate, 1 patient was treated with LC-DCP, 1 patient with LCP and 16 patients with reconstruction plates.90% union rate was found. Patients were monitored with serial x-rays. 10% went on for non-union. 15% had pain during activity, 10% had symptoms of CRPS, 15% had wound infection which subsided with antibiotics, 5% complained of hardware irritation and 5% had early mechanical failure which resulted in non-union. Functional results were evaluated by DASH scores. A mean score of 11 was obtained.

Table I: Age Distribution

Age group (years)	No of cases, conservatively managed	Percentage	No of cases, surgically managed	Percentage
18-30	6	30	7	35
30-40	5	25	5	25
40-50	6	30	7	35
50-60	3	15	1	5
Total	20	100	20	100

Graph I - Sex Distribution

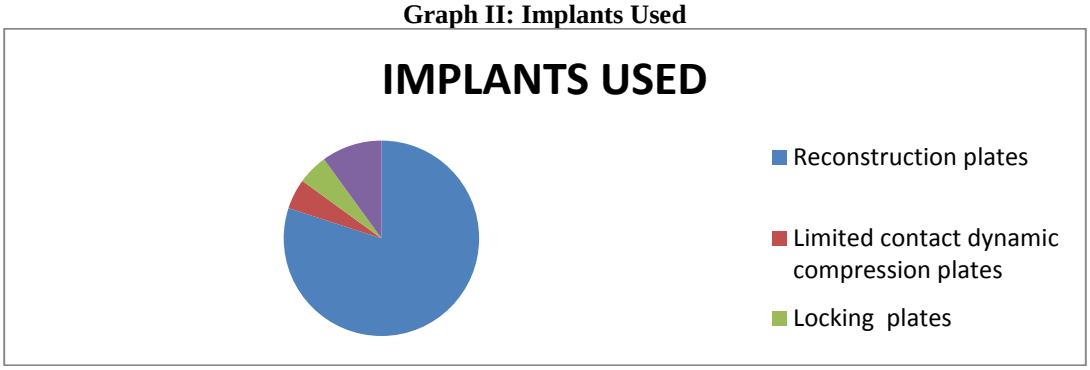


Case 1: (Conservtive) XRays at presentation and at 24 weeks with Movements at 24 weeks

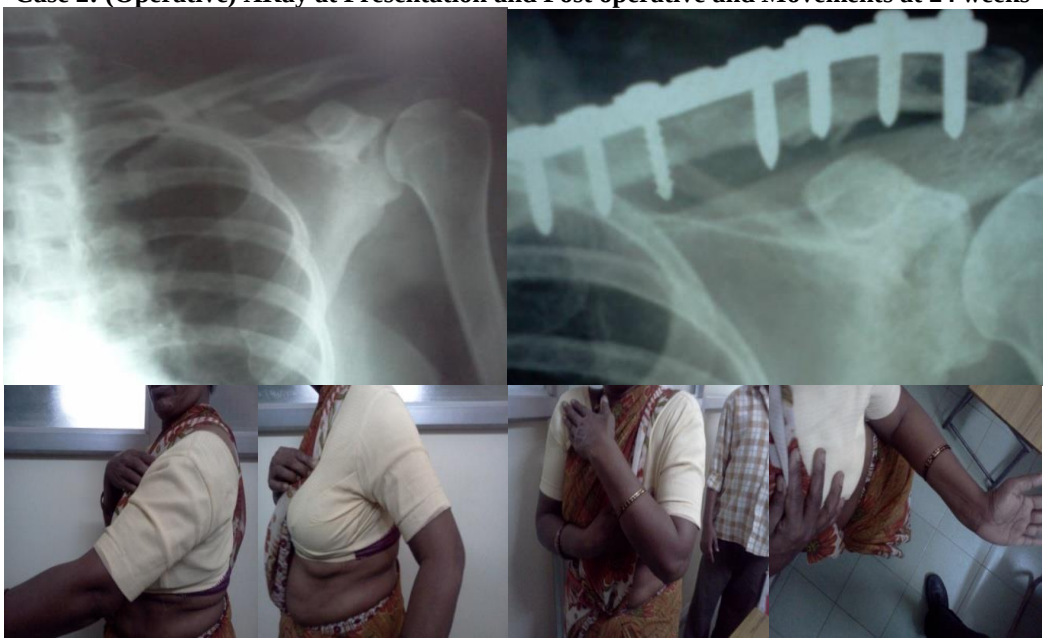
Table II: Mode of Injury

Mode of injury	No of cases, conservatively managed	Percentage	No of cases, surgically managed	Percentage
Direct fall on the shoulder	16	80	18	90
Direct blow on the clavicle	3	15	1	5
Fall on the outstretched arm	1	5	1	5
Total	20	100	20	100

Graph II: Implants Used



Case 2: (Operative) XRay at Presentation and Post operative and Movements at 24 weeks



DISCUSSION

In our study the mean age in conservatively treated patients was 38.6 years and in the operatively treated patients was 33.9 years. In Allman's study[4] the mean age was 22 years. In the Canadian Orthopaedic Trauma Society study[5] the mean age was 33.5 years.

In our study, there were 15 males and 5 females in the conservatively managed group and 17 males and 3 females in the operative group.

In our study, 85% of the patients had a direct fall on the shoulder, 10% had a direct blow on the clavicle, and 5% had a fall on the outstretched hand. This pattern confirms to the study on the mechanism of clavicular fractures by Stanley et al. in 1988.[3]

Edinburgh classification of clavicular fractures was used in the study. Only type 2B1 and 2B2 fractures were included for the study. In the conservatively managed group, 15 fractures were type 2B1 and 5 fractures were type 2B2. In the operative group, 14 patients were of type 2B1 and 6 patients were type 2B2.

Traditionally, clavicular fractures have been considered better treated nonoperatively. Neer [6] in 1960 reported non-union in only three of 2235 patients with middle third fractures treated by closed methods, while Rowe[7] in 1968 reported non-union in four of 566 clavicular fractures. This information formed the basis for the clinical approach to the treatment of clavicular fractures for next several decades. These studies also suggested a higher non-union rate with operative care.

More recently, Robinson et al[8]. in 2004 described a consecutive series of 868 patients with clavicular fractures, 581 of whom had a midshaft diaphyseal fracture. They found 21% non-union rate for the displaced, comminuted midshaft fractures.

Hill et al[9]. in 1997 studied fifty-two displaced midshaft clavicular fractures and reported that eight patients had a non-union and sixteen patients had an unsatisfactory outcome on the basis

of patient oriented measures. They concluded that displacement of the fracture fragments by >2 cm was associated with an unsatisfactory result.

A meta-analysis by Zlowodzki et al[10]. in 2005 of recent studies revealed that the rate of nonunion for displaced midshaft clavicular fractures was 2.2% after plate fixation compared with 15.1% after nonoperative care, a relative risk reduction for nonunion of 86%. That meta-analysis also showed that primary plate fixation was, contrary to prevailing opinion, a safe and reliable procedure.

In a 2007 Canadian multi-centric study[5], a non-union rate of 14.2% and 3.2% was reported for nonoperative and surgical management respectively. In the forty-nine patients in their study who were treated nonoperatively and had a healed fracture, 18% had symptoms of malunion and they elected corrective osteotomy.

Difference between the outcome of clavicular fractures in previous reports and those in contemporary studies are thought to be due to the data included on clavicular fractures in children, who have inherent healing abilities and re-modelling potential. Secondly the use of patient-oriented outcome measures, as in the studies by Hill et al.[9] and McKee et al[11], has been shown to reveal functional deficits in the upper extremity that are not detected by traditional surgeon-based scores. Thirdly, the injury patterns may be changing. The high energy fractures with concomitant chest injuries who might not have survived to be included in the earlier reports may be included in the contemporary studies. The high energy may impart a poorer prognosis and persisting long term sequelae.

In our study, there were 5 cases of non-union in the conservative group (25%). In 2 of the cases there was displacement of >2cm. In 2 cases there was fracture comminution .In the surgically managed group, there were 2 cases of non-union (10%). The average rate of union was 25.7 weeks.

5 out of 15 cases treated by conservative methods which went for malunion were symptomatic with 2 patients complaining of shoulder stiffness, 1 patient complaining of pain on activity, 1 case of paresthesia, 2 cases of complex regional pain syndrome. Among the 5 cases of non-union, 3 patients complained of pain on activity and there were 3 cases of CRPS.

In the study of sequelae from clavicular fractures by Novak[12] in 2005, he found 86 and 23 out of 219 patients to have pain during activity and paresthesia respectively. He also evaluated various risk factors for development of sequelae in patients with clavicular fractures. Displacement, comminuted fractures, advanced age and shortening were found to be reliable risk factors for residual symptoms at the end of 6 months.

In our study we used recon plate in 16 cases, 1/3 tubular plate in 2 cases, limited contact dynamic compression plates in 1 case, locking plate in 1 case. Average rate of union was 16 weeks.

There were 2 cases with nonunion among the operatively managed group. One case of early mechanical failure was noted (5%). 3 patients complained of pain on activity, 2 patients had Complex regional pain syndrome, 3 patients had wound infection which resolved with administration of antibiotics.1 patient (5%) complained of hardware irritation.

In the Multicenter Study in Canada[5] there was 1.6% incidence of non-union in the plated group, 8% incidence of hardware irritation, and 1.6% incidence of early mechanical failure.

In contrast to earlier case series, modern studies on primary plate fixation of acute midshaft clavicular fractures have described high rates of successful results with rates of union and low rates of infection and surgical complications. A recent meta-analysis[10] of plate fixation for 460 displaced fractures revealed a nonunion rate of only 2.2%. With improved implants, prophylactic antibiotics, and better soft-tissue handling, plate fixation has been a reliable and reproducible technique.

The functional results were graded according to DASH score. The mean DASH score among the non-operative group was 21 and among the operative group was 11. Independent student 'T' test was used for statistical analysis. There was a significant difference in the mean DASH scores between the two groups ($p<0.01$). Operative group is found to have a lower DASH score and a better outcome.

CONCLUSION

In view of the listed results, it is not clear if there is a distinct functional benefit is gained by surgery compared to a united fracture in non-operated cases. Also it is unclear the number of plate fixations required to prevent one case of non-union due to conservative management.

Recent advances in plate technology, availability of low profile contoured clavicular plates, refinements in approaches, advances in surgical techniques are likely to improve the results and reduce complications in the future.

From our study we conclude that further study is required to clearly delineate which method of treatment is better. Operative management is beneficial to the patient for early mobilization and early return to daily activities with better Functional outcome.

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