



E-ISSN: 2395-1958  
P-ISSN: 2706-6630  
IJOS 2020; 6(4): 730-736  
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[www.orthopaper.com](http://www.orthopaper.com)  
Received: 16-08-2020  
Accepted: 15-11-2020

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## Functional outcome of conservative versus surgical management in mid shaft clavicle fractures at tertiary care centre

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**DOI:** <https://doi.org/10.22271/ortho.2020.v6.i4k.2410>

### Abstract

**Aim of the study:** To evaluate the functional outcome of locking compression plate fixation and figure of eight clavicle brace in the treatment of displaced middle 1/3rd clavicle fracture.

**Materials and Methods:** In our Prospective Study, we included 36 patients, both male and female patients with displaced middle-third clavicle fracture (Robinson type 2B1). Patients were randomly divided into two groups, based on treatment modalities as a conservative group and surgical management group, with 18 patients in each group. All patients will be followed up every week for 2 weeks after treatment, and then every 6 weeks, 3 months, 6 months and 1 year. Functional outcome were assessed with the help of Constant and Murley scoring system.

**Result:** In our study, we found that the functional outcome of surgical patients was significantly improved. At the end of 12 months, in surgical group excellent and good outcome was achieved in 12 patients (75%) whereas in conservative group excellent and good outcome was obtained only in 3 patients (18%). The complications seen in the surgical group were 2 cases each of infection implant failure and four cases of nonunion in the conservative group.

**Conclusion:** In this study, we observed that patients who were treated by surgical treatment with locking compression plating had a better functional outcome in terms of early range of movements and less shoulder stiffness and therefore early return to work when compared to the conservative group.

**Keywords:** Middle third clavicle, constant and murley score, Robinson classification

### 1. Introduction

Clavicle fractures are common injuries in young and active individuals, and they account for 2.6% of all fractures. Most clavicle fractures (80% to 85%) occur in the midshaft of the bone. Distal third fractures are the next most common type (15 to 20%). Medial third fractures are the rarest (0 to 5 %). Most of the least displaced clavicle fractures can be successfully treated non-surgically with some form of immobilization [1].

A weaker part can be seen in the middle of the clavicle, which is the cause of most fractures in this part. Many muscles and ligament forces act on the clavicle, so it is necessary to understand these different forces to understand the nature of bone fracture displacement and draw conclusions about why certain types of fractures are problematic without reduction and surgical fixation [2].

Mid-clavicular fracture accounts for 45% of shoulder injuries, mostly in the third decade of life, with male to female ratio is 2:1. The incidence of open clavicular fracture is only 0.1% to 1% of cases. The peak incidence occurs in the third decade of life [3]. In middle third clavicle fractures, the rate of nonunion is generally estimated as from 0.1 to 0.8%, however current data shows that the rate of non-union among adults is 10 to 15 percent, in displaced middle third clavicular fractures with comminution [4]. This shows that nonunion or malunion is relatively higher when treated conservatively than it was presumed earlier.

Patients treated conservatively have varying degrees of pain and disability during the first three to six weeks, and this factor is underestimated. After conservative treatment, pressure from displaced fragments on the brachial plexus can cause symptoms. Patients treated conservatively have varying degrees of pain and disability during the first three to six weeks, and this factor is underestimated.

After conservative treatment, pressure from displaced fragments on the clavicle behind the brachial plexus can cause symptoms. Similarly, extensive separation of fragments with soft tissue interposition may cause a closed reduction to fail. In extensively displaced middle-third clavicle fractures, there is 15% of nonunion with conservative treatment, and most of the patients with >2cm of shortening of clavicle suffered nonunion [5].

At present increasingly surgeons are more willing to perform surgery because non-surgical results are clinically and functionally poor. Numerous studies have shown the efficacy and safety of treating displaced midclavicular fractures with open reduction and internal fixation also established a higher rate of union with minimal complications [6]. In the majority of the patients with complex clavicle fractures, the locking compression plate provides a reasonable outcome, with fewer complications [7].

Surgical treatment by open reduction and internal fixation of displaced comminuted mid-shaft clavicular fractures helps in early return to function [8]. Intramedullary K-wires or Steinmann pins fixation and plate fixation are a few of many methods for surgical treatment of mid-shaft clavicle fractures. Plates when used for fixation can attain the firm anatomical reduction in severe displaced or comminuted fracture. There are many types of plates, including the Sherman plate, dynamic compression plate, locking clavicle plate, and semi-tubular plate. Precontoured clavicle locking compression plate (LCP), which is S-shaped resembling the curvature of the clavicle, is the most ideal. Among the conservatives, various braces were introduced to immobilize the fracture middle third clavicle, especially Parham support, Bohler's brace, Taylor's support, Velpeau wrap, Billington yoke, and commercial figure of eight brace. The commercial figure of eight brace is the one commonly used among various braces.

The purpose of this study is to gain a deeper understanding of the results and problems of conservative treatment and surgical treatment (ORIF clavicle LCP) in the treatment of the third middle clavicle and to evaluate the functional outcome after each treatment.

**2. Materials and Methods**

In our Prospective Study, we included 36 patients, both male and female patients who presented to the Department of Orthopedics and Out-Patient department, SreeMookambika Institute of Medical Sciences, with displaced middle-third clavicle fracture (Robinson type 2B1), after taking written consent from them. Patients were then allotted randomly into two groups (conservative and surgery) with 18 patients in each group. Patients in the conservative group were provided Clavicle Brace and arm sling immediately. Patients in the surgical group were posted for surgery when fit for surgery. Patients' demographic profile was noted and short history and clinical examination were performed to find out the location of pain and swelling over the affected clavicle. Plain Antero-posteriorroentgenogram shoulder with clavicle was taken to evaluate the site and type of fracture. The fractures were then classified by Robinson's classification. Patients aged < 18 years and >60 years, patients with open fractures, fracture in medial or lateral third of the clavicle, pathological fractures, undisplaced fractures, patients with established nonunion from a previous fracture, polytrauma patient, patients with any medical contraindication to surgery or general anaesthesia (heart diseases, renal failure or active chemotherapy) and patients refusing surgery (lack of consent) were excluded from the study.

All patients will be followed up every week for 2 weeks after treatment, and then every 6 weeks, 3 months, 6 months and 1 year. Radiographs are taken at immediate post-treatment period, 6 weeks, 3 months, 6 months, and one year for monitoring the progress of fracture healing and functional outcome was looked for with help of Constant and Murley scoring system and grading done as Excellent (91-100), Good (81-90), Satisfactory (71-80), Adequate (61-70) and Poor (<60) Also evidence of implant breakage, non-union, the infection was also looked for.

Ethical clearance was obtained from the institutional Human Ethics committee. This study was started on September 2016 and continued till April 2018. A signed, written informed consent was obtained from all the patients included in the study. Confidentiality and anonymity of the patient's information were maintained during and after the study. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**2.1 Data analysis**

All data were prepared using Microsoft excel 2010 version and was analyzed with the software SPSS for Windows (Statistical Presentation System Software, SPSS Inc.) version 20.0. A Chi-square test was used to find the significance of study parameters on a categorical scale between two or more groups.

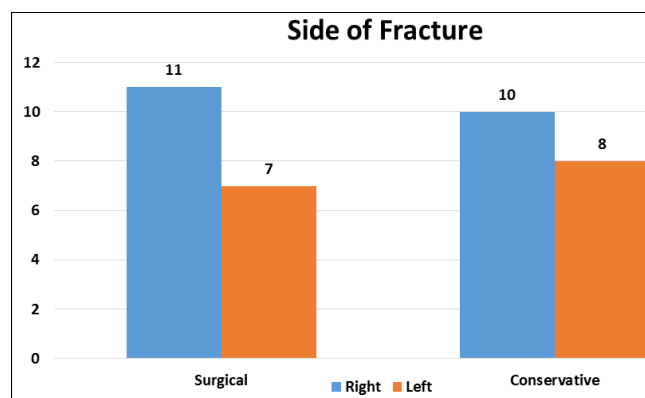
**3. Results**

The present study consists of 36 patients, among which 18 patients of fresh fracture of the mid-third clavicle treated surgically with clavicular locking compression plate & screws, and 18 patients were treated conservatively with a figure of eight clavicle brace and arm pouch/sling. 33 patients were available for follow-up and they were followed up for 12 months at regular intervals. Results were analyzed both clinically and radiologically.

Out of the 36 patients that were included in the study, 26 patients (72.2%) sustained a fracture as a part of road traffic accident. 10 patients sustained a fracture due to a direct fall from height (27.8%) (Table- 1). The right clavicle (58%) was most commonly fractured compared to the left side (42%)(Fig 1)

**Table 1:** Mode of Injury.

| Mode of Injury        | No. of Middle Third Clavicle fracture | %    |
|-----------------------|---------------------------------------|------|
| Road traffic Accident | 26                                    | 72.2 |
| Fall from Height      | 10                                    | 27.8 |
| Total                 | 36                                    | 100  |



**Fig 1:** Side of Fracture

The distribution of age in the surgical group ranges from 25 to 59 years. The mean age in the surgical group was 45.11 years and an SD of 8.123 years. The distribution of age in the

conservative group ranges from 18 to 64 years. The mean age in the conservative group was 45.33 years and an SD of 13.578 years (Table 2).

**Table 2:** Distribution according to age of participants

| Age characteristics (years) | Surgical group (N=18) | Conservative group (N=18) |
|-----------------------------|-----------------------|---------------------------|
| Minimum                     | 25                    | 18                        |
| Maximum                     | 59                    | 64                        |
| Mean                        | 45.11                 | 45.33                     |
| Standard deviation          | 8.123                 | 13.578                    |

Constant & Murley score at 6 weeks, at 3 months, at 6 months, and at 12 months was significantly higher in the surgical

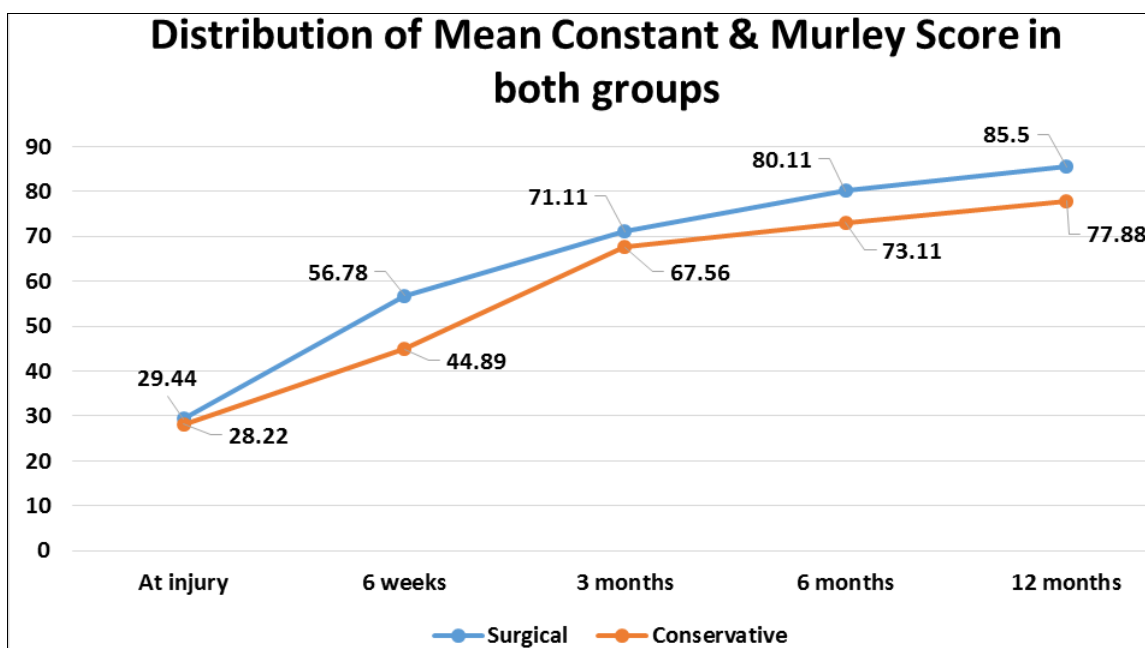
group than the conservative group (Table 3).

**Table 3:** Distribution of mean Constant & Murley score in surgical group

| Constant & Murley Score | Surgical group |       | Conservative group |       | t value | p value  |
|-------------------------|----------------|-------|--------------------|-------|---------|----------|
|                         | Mean           | SD    | Mean               | SD    |         |          |
| At time of Injury       | 29.44          | 2.812 | 28.22              | 1.801 | 1.553   | 0.130    |
| At 6 weeks              | 56.78          | 5.537 | 44.89              | 4.296 | 7.198   | 0.000*** |
| At 3 months             | 71.11          | 5.910 | 67.56              | 3.729 | 2.159   | 0.038*   |
| At 6 months             | 80.11          | 7.684 | 73.11              | 4.51  | 3.33    | 0.002**  |
| At 12 months            | 85.5           | 6.792 | 77.88              | 3.903 | 3.981   | 0.000*** |

There was a statistically significant difference in Constant & Murley score at 6 weeks, at 3 months, at 6 months, and 12 months between the surgical group and conservative group. At 6 weeks the mean Constant & Murley score was 56.78 in the surgical group and 44.89 in the conservative group which

is statistically significant (p-value 0.000\*\*\*) and at the end of 12 months the mean Constant & Murley score was 85.5 in the surgical group and 77.88 in the conservative group which is also statistically significant (p-value 0.000\*\*\*) (Fig 2)



**Fig 2:** Distribution of Mean Constant & Murley Score in both groups

At the end of 12 months, in the surgical group excellent and good outcome was achieved in 12 patients (75%) and satisfactory was seen in 3 patients (19%), whereas in the

conservative group excellent and good outcome was obtained only in 3 patients (18%) and rest of the 14 patients had satisfactory outcome (82%) (Fig 3).

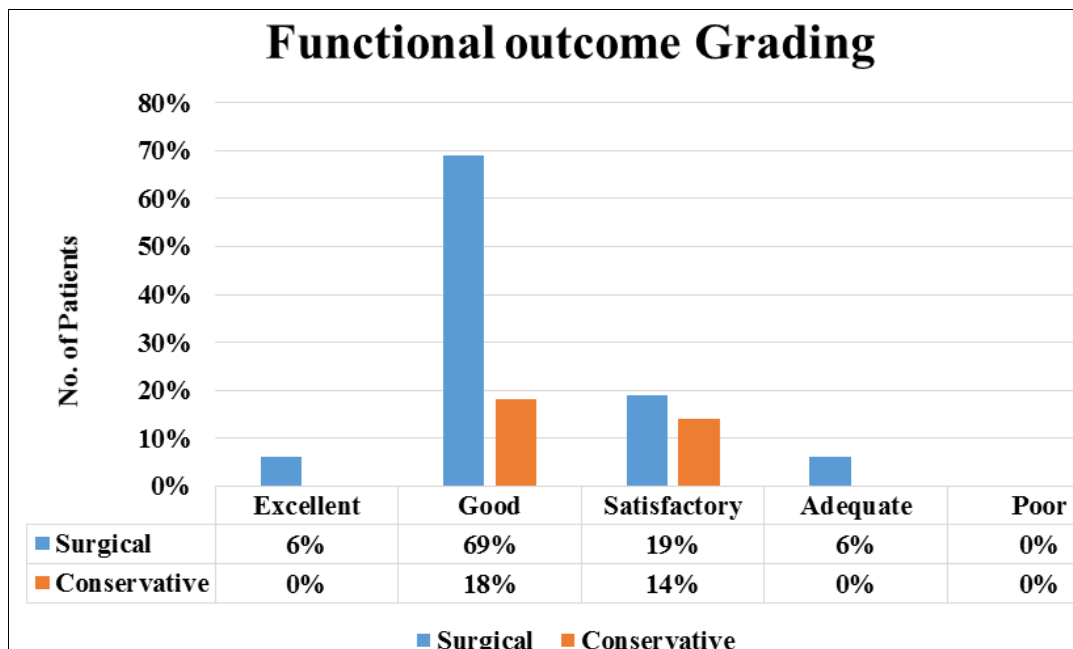


Fig 3: Functional outcome grading based on Constant and Murley Score

Complications like shoulder stiffness were observed in 1 patient (5.4%) in the surgical group compared to 4 patients (22.2%) in the conservative group. There was no delayed union or nonunion seen in surgical management whereas 3

patients (16.7%) had delayed union and 4 patients (22.2%) had nonunion in conservative management. However, no complication was seen in 12(66.6%) and 7(38.9%) patients in surgical and conservative management respectively (Fig 4).

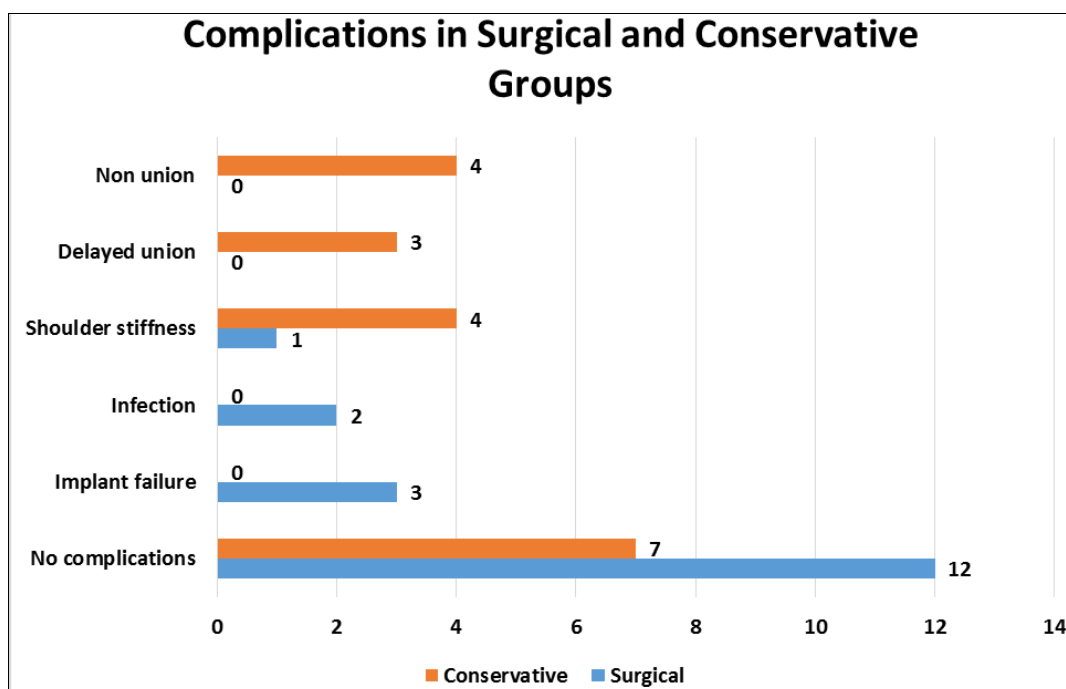
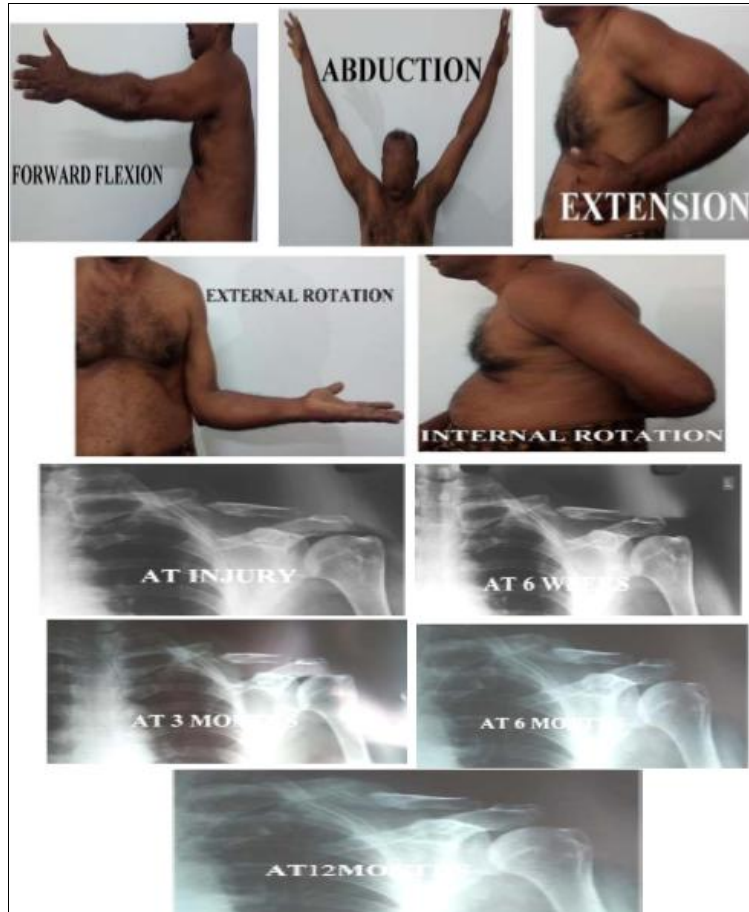
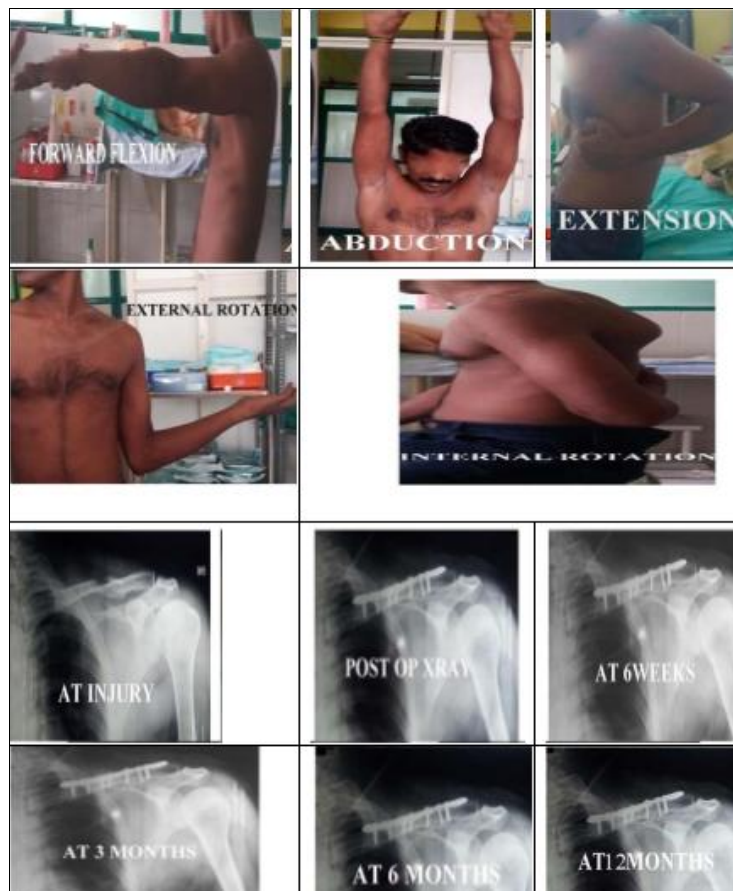


Fig 4: Complications in Surgical Group



**Case 1:** Patient treated conservatively at 12 month follow up. Ranges of motion noted are Forward Flexion, Abduction, Extension, External rotation and internal rotation.



**Case 2:** Patient treated surgically at 12 month follow up. Range of motion noted is Forward Flexion, Abduction, Extension, External rotation and internal rotation

#### 4. Discussion

The results of the present study of patients with middle third clavicle fractures are compared with the results of standard literature. The commonly compared studies are the Bostman *et al.* [9] study which treated 103 patients with only middle third clavicle fractures, by early open reduction and internal fixation with plate and screws Cesare Faldini [10] *et al.* study was also used to compare the results, where 100 patients with a clavicle midshaft fracture were treated by the figure of eight clavicle brace.

We compare two acknowledged treatment methods in our study for the mid-third clavicle fracture called an open reduction and fixation with locking compression plate and conservative treatment with the figure of eight clavicle brace in terms of effect. In our study, out of 36 patients, 16 were male (44%) and 20 were female (56%). Number of male patients in surgical group was 7 while in conservative group it was 9. The number of female patients were 11 and 9 in surgical and conservative group respectively. In Bostman *et al.* [9] study 76 Patients (73.79%) were males compared to 27 females Patients (26.21%). In Cesare Faldini [10] *et al.* study, out of 100 patients 78 were males and 22 were females. All these studies show a female predominance in fracture mid-third clavicle occurrence.

In our study, out of 36 patients with fracture mid-third clavicle, 26 patients (72.2%) sustained fracture as a result of fall from bike due to road traffic accident and 10 patients (27.8%) sustained fracture due to direct fall on shoulder. All were direct injuries (100%). In Bostman *et al.* [9] study the mechanism of injury was self-fall from motor cycle in 38 Patients (36.8%), self-fall by slip in 24 Patients (23.30%), road traffic accident in 19 patients (18.45%) and sports injury 22 patients (21.36%). Direct injury to shoulder was found to be the most common cause of fracture clavicle. In Cesare Faldini [10] *et al.* study, all fractures were due to a high-energy trauma: a road accident in 48 cases(48%), a sporting accident in 22 cases(22%), an accident at work in 18 cases(18%), and a domestic accident in 12 cases(12%). All were direct injuries(100%)

In our study, the average age of patients with fracture mid third clavicle was found to be 45.11 in surgical group and 45.33 in conservative group. The youngest patient was of 18 year for conservative and 25 year for surgical group. The oldest patient in surgical group was 59 years old and conservative group it was 64 years. In Bostman *et al.* [9] study patients average age was 33.4 years and the youngest patient age was 19 years and oldest patient age was 62 years. In Cesare Faldini [10] *et al.* study, patient's average age was found to be 32 years ranging from 18 to 67 years old.

In our present study, all fractures (36 patients-100%) were of Robinson Type-2 B1 (Displaced with simple or butterfly fragment). In Bostman *et al.* [9] study also Robinson type-2B1 was common in 81 patients (78.64%). Robinson type-2 B2 occurred only in 22 patients (21.36%). In our study, no patient had non-union among the operative group and 4 patients (22.2%) had non-union among the conservative group, among these 1 patients underwent open reduction with a clavicular plate and bone grafting for nonunion. In Bostman *et al.* [9] study, only 3% patients went for nonunion following plate fixation. A study by Hill *et al.* [11] in a non-operatively treated fracture clavicle nonunion rate reported was 15%. According to Poigenfurts J *et al.* [12], the nonunion rate in patients who underwent operative management was 2.2%. Also in our study 3 patients had implant failure in the surgical group. Among them, one patient had a history of fall and implant

failures (5.6%). One patient came with implant failure associated with RTA (5.6%) and one patient came with implant failure and nonunion (5.6%). Similarly in Zlowodzki M *et al.* [13] in a systematic review of 2144 fractures, found that nonunion in displaced midshaft clavicle fractures following operative procedure was 2.2% only and in conservative group it was 15.1%, shows that operative treatment has less chance of non union compared to conservative management which is similar to the findings of our study.

**Table 4:** Comparison of Rates of Non union

| Non union                        | Operative (%) | Non operative (%) |
|----------------------------------|---------------|-------------------|
| Bostman <i>et al.</i> [9]        | 3             | -                 |
| Hill <i>et al.</i> [11]          | 15            | -                 |
| Poigenfurts J <i>et al.</i> [12] | 2.2           | -                 |
| Zlowodzki M <i>et al.</i> [13]   | 2.2           | 15.1              |
| In our study                     | 0             | 22.2              |

In our study, 2 patients (11%) in the surgery group had superficial skin infections and received oral antibiotics for 5 days and were cured. In Bostman *et al.* study [9], the infection rate was found to be 7.8%. The Constant and Murley score at 6 weeks, 3 months, 6 months, and 12 months were significantly better in the surgical group than the conservative group. In a randomized control study [14] by the Canadian orthopaedic trauma society, it was found that Constant score and DASH Scores are significantly better in the surgical group at 6 weeks, 12, and 24 weeks than the conservative group. The main advantage of surgical treatment of displaced mid-third fractured clavicle with plate is that it gives immediate pain relief, early shoulder movements less chance of non-union, and early return to work compared to conservative treatment.

#### 5. Conclusion

This study aimed at comparing two accepted treatment options, open reduction and internal fixation with clavicular locking compression plate and conservative treatment with the figure of eight clavicle brace and sling application for mid-third clavicle fracture and to find out which treatment option gives better functional outcome. It was observed that patients who were operated had better functional outcomes in terms of early range of movements and less shoulder stiffness and therefore early return to work when compared to the conservative group. According to the present study, surgery is recommended over conservative treatment in patients with a displaced mid-third fractured clavicle.

**Source of Funding:** None.

**Conflict of Interest:** None.

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