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Original Research Article

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

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Abstract

Background: Clavicle fractures are common injuries, particularly in young, active individuals, with midshaft fractures accounting for the majority. While many minimally displaced fractures can be treated conservatively, displaced and comminuted fractures pose a higher risk of nonunion and functional impairment. Recent studies highlight improved outcomes with surgical intervention, especially using locking compression plates. This study compares the functional outcomes and complications of conservative management versus surgical fixation in middle-third clavicle fractures.

Aims & Objective: The aim of this study was to assess the functional Outcomes of treating displaced middle 1/3rd clavicle fractures using Locking compression plate fixation and figure-of-eight clavicle brace.

Materials and Methods: A total of 32 patients, including both male and female individuals with displaced middle-third clavicle fractures (specifically Robinson type 2B1), were enrolled in our prospective Study. Patients were randomly assigned to either a conservative Treatment group or a surgical management group, each consisting of 16 patients. Follow-up evaluations were conducted weekly for the First 2 weeks post-treatment, followed by assessments at 6 weeks, 3 Months, 6 months, and 1 year. Functional outcomes were evaluated using the Constant and Murley scoring system.

Results: Our findings revealed a significant improvement in the Functional outcomes of patients who underwent surgical treatment. By the 12-month mark, 77% of patients in the surgical group Achieved excellent or good outcomes, compared to only 22% in the Conservative group. Complications observed in the surgical group Included 2 cases each of infection and implant failure, while the Conservative group experienced 3 cases of nonunion.

Conclusion: This study underscores that patients treated with locking compression plating through surgical intervention exhibited superior functional outcomes, characterized by early range of motion and reduced shoulder stiffness, leading to a quicker return to work compared to those managed conservatively.

Keywords: Locking compression plate fixation, Figure-of-eight brace, Constant and murley scoring.

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1. Introduction

Clavicle fractures are prevalent injuries among young, active individuals, constituting 2.6% of all fractures. The majority of clavicle fractures (80% to 85%) transpire in the midshaft region of the bone. Fractures of the distal third are the second most prevalent form, accounting for 15 to 20%.[1] Fractures in the medial third are the least common, occurring in 0 to 5% of cases. Most minimally displaced clavicle fractures can be effectively managed non-surgically with various forms of immobilization.

A vulnerable region is seen in the centre of the clavicle, which accounts for the majority of fractures in this area. A multitude of muscular and ligamentous forces exert influence on the clavicle; therefore, comprehending these various forces is essential for elucidating the mechanism of bone fracture displacement and for deriving inferences regarding the complications associated with specific fracture types that necessitate reduction and surgical fixation.[2]

Mid-clavicular fractures constitute 45% of shoulder injuries, predominantly occurring in individuals in their third decade of life, with a male to female ratio of 2:1. The occurrence of open clavicular fractures ranges from 0.1% to 1% of cases. The highest occurrence occurs in the third decade of life.[3] The incidence of nonunion in middle third clavicle fractures is often approximated at 0.1 to 0.8%; however, recent research indicates that the nonunion rate among people with displaced middle third clavicular fractures exhibiting comminution is between 10 and 15 percent.[4] This indicates that the incidence of nonunion or

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malunion is comparatively greater with conservative treatment than previously assumed.

Patients undergoing conservative treatment experience differing levels of discomfort and disability in the initial three to six weeks, a feature that is often underestimated. Following conservative therapy, pressure from misplaced pieces on the brachial plexus may induce discomfort. Patients undergoing conservative treatment experience differing levels of discomfort and disability throughout the initial three to six weeks, a feature that is often underestimated.

Following conservative therapy, pressure from misplaced fragments on the clavicle posterior to the brachial plexus may induce discomfort. Likewise, significant fragmentation with interposed soft tissue may result in the failure of a closed reduction. In significantly displaced middle-third clavicle fractures, conservative therapy results in a 15% nonunion rate, with the majority of patients exhibiting over 2 cm of clavicular shortening experiencing nonunion.[5,6]

Surgeons are currently more inclined to undertake surgical procedures due to the suboptimal clinical and functional outcomes of non-surgical interventions. Multiple studies have demonstrated the effectiveness and safety of open reduction and internal fixation for displaced midclavicular fractures, resulting in a higher union rate with few sequelae.[7] In most patients with complicated clavicle fractures, the locking compression plate yields satisfactory results with reduced sequelae.[8]

The surgical intervention of open reduction and internal fixation for displaced comminuted mid-shaft clavicular fractures facilitates a prompt return to functionality.[9] Intramedullary K-wires or Steinmann pins fixation and plate fixation are several options for the surgical management of mid-shaft clavicle fractures.[10] Plates utilized for fixation can achieve stable anatomical reduction in cases of severely displaced or comminuted fractures. Numerous varieties of plates exist, such as the Sherman plate, dynamic compression plate, locking clavicle plate, and semitubular plate. The precontoured S-shaped locking compression plate (LCP) is the best suitable for the clavicle due to its curvature.[11] Various braces were created among conservatives to immobilize fractures of the middle portion of the clavicle, including the 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 most frequently utilized among other types of braces. This study aims to elucidate the outcomes and challenges associated with conservative and surgical interventions (ORIF clavicle LCP) for the treatment of middle third clavicle fractures, as well as to assess the functional results following each treatment modality.

2. Materials and Methods

32 patients, both male and female, with displaced middle-third fracture clavicle (Robinson type 2B1) who came to the orthopedics department Tezpur Medical College were included in our prospective study after providing written consent. Then, patients were divided into two groups of twelve in each—one for surgery and the other for conservative care. Patients in the conservative group received an arm sling and a Clavicle Brace right away. When deemed surgically fit, patients in the surgical group were posted for surgery. The demographic profile of the patient was taken note of, and a brief history and clinical examination were conducted to determine the site of discomfort and swelling over the clavicle that was afflicted. To assess the location and kind of fracture, a simple Anteroposterior x-ray of the shoulder and clavicle was obtained. Next, the fractures were categorized using Robinson's categorization. The study excluded patients who were younger than 18 years old or older than 60 years old, those who had open fractures, fractures in the medial or lateral third of the clavicle, pathological fractures, undisplaced fractures, patients who had proven nonunion from a prior fracture, patients who had polytrauma, patients who had any medical condition that would prevent them from undergoing surgery or general anesthesia (such as heart disease, renal failure, or active chemotherapy), and patients who had refused surgery (lack of consent).

After treatment, all patients were followed up on weekly for two weeks, and then every six weeks, three months, six months, and year. With the use of the Constant and Murley scoring system, radiographs are taken at the beginning and end of treatment, six weeks, three months, six months, and a year to track the healing of fractures and determine the functional outcome. Grading is done as Excellent (91-100), Good (81-90), Satisfactory (71-80), Adequate (61-70), and Poor (<60). Additionally, non-union, implant breakage, and infection were searched for and detected.

The institutional Human Ethics committee provided ethical clearance. The study commenced in 2023 December and ran until August of 2024. Every patient who was part of the trial signed a written informed consent form. Information about the patients was kept private and confidential both throughout and after the trial. Funding organizations from the governmental, private, or nonprofit sectors did not provide a specific grant for this study.

3. Results

The 32 patients in this study were divided into two groups: 16 underwent surgical treatment with clavicular locking compression plate and screws for a recent mid-third clavicle fracture, and 16 underwent conservative treatment with an arm pouch or sling and a figure of eight clavicle brace. A total of thirties patients were available for follow-up, and they had routine 12-month follow-up. Results were examined from a

radiological and clinical perspective.20 individuals (62.5%) out of the 32 patients who were included in the study had a fracture as a result of a traffic collision. A direct fall from height resulted in a fracture in 12 individuals (37.5%) (**Table 1**). The most prevalent fractures were to the right collarbone (59.625%) as opposed to the left side (40.625%). (**Figure 1**)

Table 1: Two groups of fractures

Mode of Injury	No of clavicle Fracture	Percentage
Road Traffic Accident	20	62.5
Fall from Height	12	37.5

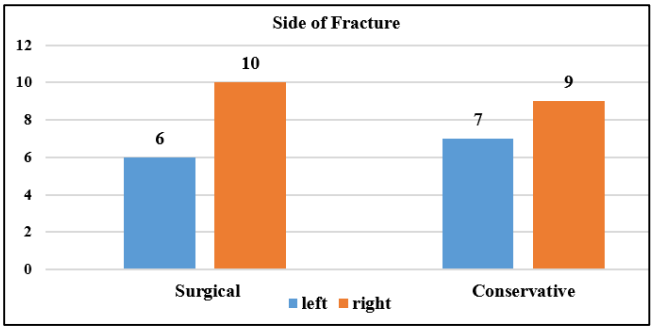

Figure 1: Side of fracture

The surgical group's age distribution is from 22 to 58 years old. In the surgical group, the mean age was 41.5 years with a standard deviation of 11 years. The conservative group's age distribution spans from 18 to 64 years old. **Table 2** shows that the conservative group's mean age was 41.688 years with a standard deviation of 14.653 years.

Table 2: Distribution according to the age of the participants

Age (Years)	Surgical Group (N=16)	Conservative Group (N=16)
Minimum	22	19
Maximum	58	64
Mean	41.5	41.688
Standard Deviation	11	14.653

The surgical group's Constant & Murley score was considerably greater than the conservative group's at 6 weeks, 3 months, 6 months, and 12 months (**Table 3**).

Table 3: Mean Constant & Murley score distribution in both groups

Constant & Murley Score	Surgical Group		Conservative Group		P value
	Mean	SD	Mean	SD	
At the time of injury	27.94	5.26	28.56	4.01	0.667
At 6 weeks	52.33	6.01	42.23	6.07	.016**
At 3months	70.12	6.21	65.5	3.34	.163
At 6 months	81.27	7.05	75.64	4.56	0.045**
At 12 months	86.73	5.96	78.55	3.22	.013**

At the 12-month mark, 11 patients (68.75%) in the surgical group had excellent and good outcomes, and 4 patients (25%) had satisfactory results; in contrast, only 2 patients (12.5%) in the conservative group had excellent and good outcomes, and the remaining 14 patients (77.5%), had satisfactory results (**Figure 2**).

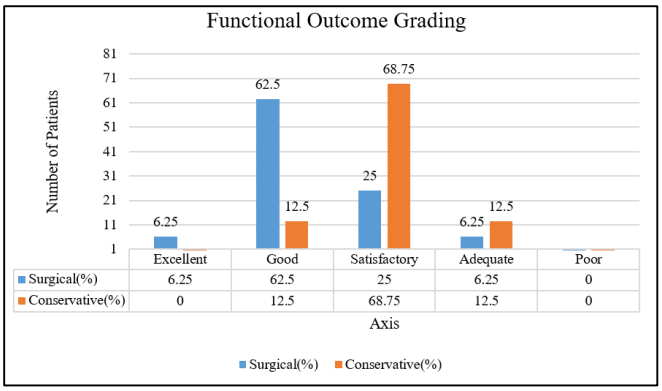

Figure 2: Functional outcome grading based on Constant and Murley Score

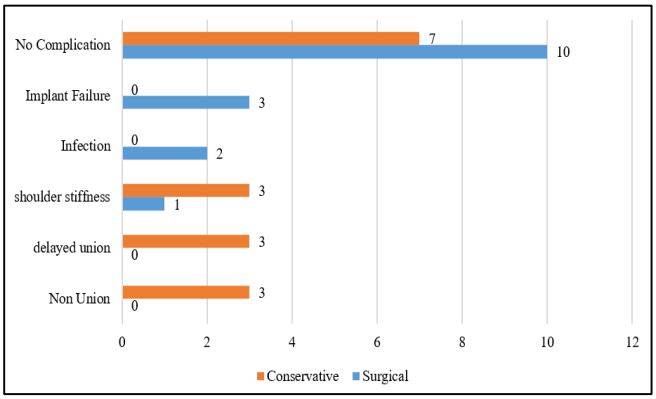

Figure 3: Complications in conservative and operative Group

One patient (6.25%) in the surgical group and three patients (18.75%) in the conservative group experienced complications such as shoulder discomfort. In contrast, 3 patients (18.75%) experienced nonunion and 3 patients (18.75%) experienced delayed union under conservative care. No delayed union or nonunion was observed under surgical management. However, with conservative therapy, no complications was observed in 7 (43.75%) and 10(62.5%) of the surgical group. (**Figure 3**)

Case Illustrations

Case 1: Patient treated conservatively at 12 month follow up (**Figure 4**)

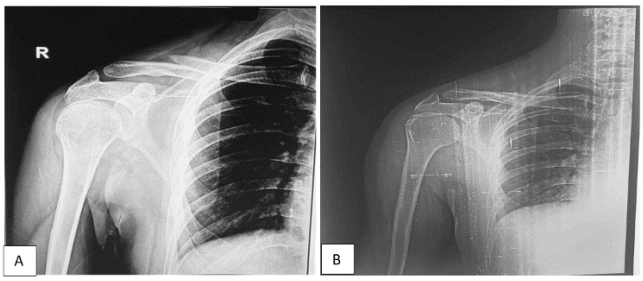

Figure 4: A): X-ray at injury; **B):** Follow up at 12 months

Case 2: Patient treated operatively at 6 month follow up **Figure 5**.

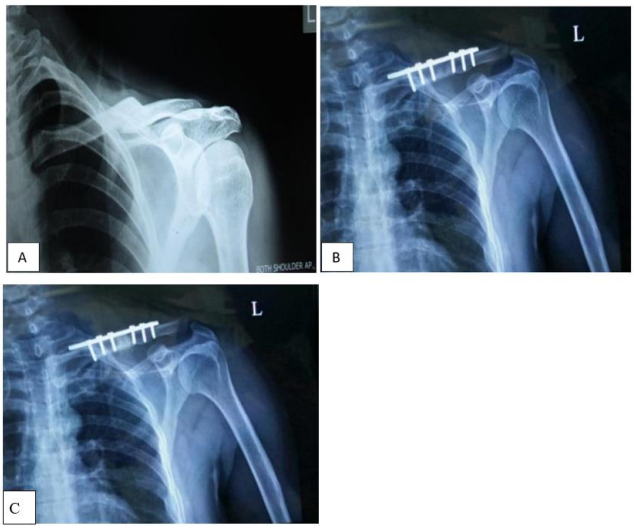

Figure 5: **A**: Pre-op x-ray; **B:** Immediate post op x-ray; **C**: Follow-up at 6 months

4. Discussion

This study compares the results of individuals with middle third clavicle fractures to those from conventional literature. Bostman et al. treated 103 patients with only middle third clavicle fractures using early open reduction and internal fixation with plate and screws.[9] The study by Cesare Faldini et al. compared the results of treating 100 patients with a clavicle midshaft fracture with a figure of eight clavicle brace.[12]

Our study compares the effectiveness of two treatment approaches for mid-third clavicle fractures: open reduction and fixation with locking compression plate and conservative treatment with a figure of eight clavicle brace. In our study, 14 of the 32 patients were male (44%), whereas 18 were female (56%). The number of male patients in the surgical group was seven, whereas the conservative group had nine. In the surgical group, there were 9 female patients, whereas the conservative group included seven. In the study by Bostman et al. there were 76 male patients (73.79%) and 27 female patients (26.21%).[9] Cesare Faldini et al. found that out of 100 patients, 78 were male and 22 were female. Studies indicate that fractures of the mid-third clavicle are more common in women.[12]

Out of the 32 patients in our study who had a mid-third clavicle fracture, 20 patients (62.5%) suffered a fracture as a consequence of RTA, and 12 patients (37.5%) suffered a fracture as a direct fall onto their shoulder. 100% of the injuries were direct. In the study by Bostman et al. the mechanism of injury was sports injuring 22 patients (21.36%), self-fall by slip in 24 patients (23.30%), road traffic accident in 19 patients (18.45%), and self-fall from a motor cycle in 38 patients (36.8%). The most frequent cause of clavicle fractures was found to be direct injuries to the shoulder.[9] According to Cesare Faldini et al.'s study, all fractures resulted from high-energy trauma, which in 48 cases (48%) was a car accident. an accident at work in 18 cases (18%), a home accident in 12 cases (12%), and a sporting accident in 22 cases (22%).100% of them were direct injuries.[12]

Patients with a fracture of the mid-third clavicle in our study had an average age of 41.5 in the surgical group and 41.68 in the conservative group; the youngest patient was 19 years old in the conservative group and 22 years old in the surgical group; the oldest patient in the surgical group was 58 years old, and the oldest patient in the conservative group was 64 years old (**Table 2**). In the Bostman et al. study, patients had an average age of 33.4 years, with the youngest patient being 19 years old and the oldest patient being 62 years old.[9] In the Cesare Faldini et al. study, patients had an average age of 32 years, ranging from 18 to 67 years old.[12]

The 32 patients (100%) in our current study had all fractures of Robinson Type-2 B1 (displaced with simple or butterfly fragment). 81 patients (78.64%) in the Bostman et al.[9] investigation also had Robinson type-2Bl. Only 22 patients (21.36%) had Robinson type-2 B2. In our study, 4 patients (22.2%) in the conservative group and 1 patient (open reduction with a clavicular plate and bone grafting) experienced non-union. (**Table 4**) No patient in the operational group had non-union. Just 3% of participants in the Bostman et al. research experienced nonunion after plate fixation.[9] One study that Hill et al the reported nonunion rate in a clavicle fracture treated non-operatively was 15%.[13] Poigenfurts J et al. reported that 2.2% of patients undergoing operational management had nonunion.[14] In the surgical group of our study, 3 patients also had implant failure. One patient had a history of falls and implant failures. Similar to our study's findings, Zlowodzki M et al. found that nonunion in displaced midshaft clavicle fractures following operative procedure was 2.2% only, while it was 15.1% in the conservative group.[15] This indicates that operative treatment has a lower chance of nonunion than conservative management.

Table 4: Comparison of rates of non-union

Non union	Operative %	Non Operative %
Bostman et al.[9]	3	-
Hill et al.[13]	15	-

Poigenfurts J et al.[14]	2.2	-
Zlowodzki M et al.[15]	2.2	15.1
Our Study	0	18.75

5. Summary

In summary, our paper comprehensively reviewed the functional outcomes of treating displaced middle 1/3rd clavicle fractures using locking fixation plates versus conservative management with clavicle braces.

Locking fixation plates offer potential advantages in terms of anatomical reduction, stability, and accelerated recovery, particularly in highly active patients or those with significant displacement.

Conservative management with clavicle braces provides a non-surgical option, promoting natural healing and gradual rehabilitation, which may be preferable in certain patient demographics. The choice between these approaches should be guided by careful consideration of factors such as fracture displacement, patient age, activity level, associated injuries, and patient preferences. Further research and long-term follow-up studies are needed to evaluate the durability of outcomes, complication rates, and patient satisfaction to refine treatment guidelines and optimize patient care.

6. Conclusion

The treatment of displaced middle 1/3rd clavicle fractures using locking fixation plates versus conservative management with clavicle braces presents a nuanced clinical decision-making dilemma. Our analysis of functional outcomes indicates that both approaches have their merits and limitations, with no clear superiority of one over the other in all cases. Locking fixation plates offer the advantage of anatomical reduction, improved stability, and potentially faster return to function, particularly in patients with high activity levels or significant fracture displacement. However concerns regarding implant-related complications and the need for surgical intervention must be carefully considered. Conversely, conservative management with clavicle braces avoids surgical risks and complications, promoting natural healing and gradual rehabilitation. This approach may be preferable in certain patient populations, such as older individuals or those with lower activity demands, where the goal is functional restoration with minimal intervention.

7. Ethical approval

2024/100/TMC&H.

8. Source of Funding

No funding sources.

9. Conflict of Interest

None declared.

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