

*Research Article***Better Functional Outcomes in Plate Fixation of Midshaft Clavicle Fracture in Dr. Soetomo Hospital**Mouli Edward¹ , Steesy Benedicta², Teddy Heri Wardhana¹ ¹Department of Orthopaedic and Traumatology, Faculty of Medicine, Universitas Airlangga/Dr. Soetomo General Hospital, Surabaya, Indonesia²Department of Orthopaedic and Traumatology, EMC Pulomas, Jakarta Timur, Indonesia

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ABSTRACT

Background: Clavicle fracture is one of the common fractures worldwide, which trends moved from conservative to operative treatment. This study evaluates functional outcomes between patients treated with plating and conservative in Dr. Soetomo, Hospital, Surabaya.

Methods: We found 531 cases with midshaft clavicle fracture that came to our ER from 1st January 2014 to 31st December 2018. Patients with a head injury, multiple traumas associated with neurovascular injury, history of re-fracture, malunion or nonunion, open fracture, and pathological fracture were excluded in this study. The final data was 161 patients to evaluate. A conservative group total of 84 patients was treated using an arm sling or figure of eight bandages, and an operative group of 77 patients performed ORIF with S-plate. Clinical and functional scores were evaluated retrospectively with a minimum of 6 months after treatment. Shoulder function evaluated using Shoulder Constant Score and Manual Muscle Test.

Results: We found that 117 (72.7%) patients were male with a mean age of 35.4 ± 12.33 years old. The right side was dominantly injured. The manual muscle test on the operative group was five, and the conservative group was four. The constant Shoulder group on the operative group was 93.38 ± 7.529 , and the conservative group was 86.60 ± 7.560 ($P < 0.001$), and DASH score on the operative group was 10.05 ± 6.98 and the conservative group 23.67 ± 3.49 ($P < 0.001$).

Conclusion: In our study, surgery on clavicle midshaft fracture showed significant improvement and satisfaction in patients than conservative treatment. Patients gained better function in the outcome.

Keywords: Clavicle; Fracture; Operative procedure; Conservative treatment; Human and medicine

INTRODUCTION

Clavicle fracture had the highest incidence, accounting for 2.6-3% of all fractures. Cause of clavicle fracture mostly by a direct blow to the clavicle with the highest incidence in the second and third decade. A review by Cochrane comparing operative and conservative treatment in clavicle fracture by systematic review and meta-analysis found that operated patients with open reduction internal fixation (ORIF) gave union rate by 2.5% comparing an operative group. Malunion of clavicle gives little functional consequence. Many techniques showed a highhand injuries union rate and low complication rate in fixating clavicle fractures.^{1,2}

A clavicle fracture is also possible to treat non-operatively. Clinical research should be objective information directed to encourage each injury, such as function and patient's expectancy, fracture location, fracture type therapy based on this evaluation, and rational consideration of risk potency and benefit of the operation. Some recent studies showed the nonunion rate in midshaft clavicle ranges from 15-20%, loss of shoulder strength 18-33%, mild to moderate residual pain, and brachial plexus irritation.^{3,4} Some research also described functional and cosmetic deficits associated with malunion of the clavicle.^{5,6}

The therapy goal in clavicle fracture is fewer complications and better functional outcomes. It has not been proven superior and is

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not universally accepted. Return to function and avoidance of long-term complications are of socio-economic importance.⁶

Some modern concepts, validation, responsiveness, consistency in measurement, are now available in evaluated shoulder girdle injury. A clinical study based on the anatomical area used patient-oriented measurement states, such as SF-36, patients' extremity specific results, such as Disability of Arm, Shoulder, and Hand (DASH), Constant Shoulder Score (CSS), and radiologic measurement. This study evaluates union rate and functional improvement in a patient with clavicle fracture comparing conservative treatment and operative treatment in Dr. Soetomo Hospital from January 1, 2014 to July 31, 2018. In conservative treatment, patients were given an arm sling or modified figure of eight bandages. As in operative treatment, superior S-plate osteosynthesis was selected because it provides less muscular stripping and better biomechanically.⁴

MATERIAL AND METHODS

This retrospective study was performed at the Orthopaedic and Traumatology outpatient clinic, Dr. Soetomo Hospital, Surabaya. The ethical

committee has already approved this study of our hospital. Patients are all informed and given informed consent. The study design was retrospective analytic observational. Using the hospital database, we identified 531 cases. Inclusion criteria were (1) new case < 14 days between fracture and treatment (2) aged 18-60 years old. Exclusion criteria are (1) multiple trauma, (2) multiple fractures, (3) assisted neurological or vascular injury, (4) open fracture, (5) bilateral clavicle fracture, and (6) pathological fracture. After excluding those cases, 100 patients were unable to contact or refused to participate in research, and a total of 161 cases were included in this research. Along with those patients, 84 patients were treated operative and 77 patients treated conservatively (Figure 1).

For all patients, we evaluated clinical examination along with standard anteroposterior and oblique clavicle radiograph and bilateral anteroposterior radiograph. Undisplaced midshaft clavicle fracture was prescribed for an arm sling. The displaced midshaft fracture was treated with modified eight bandages using stockinette and orthopedic padding wrapped across the shoulder and patient's back (Figure 2). The figure of eight bandages or arm sling was used for six weeks

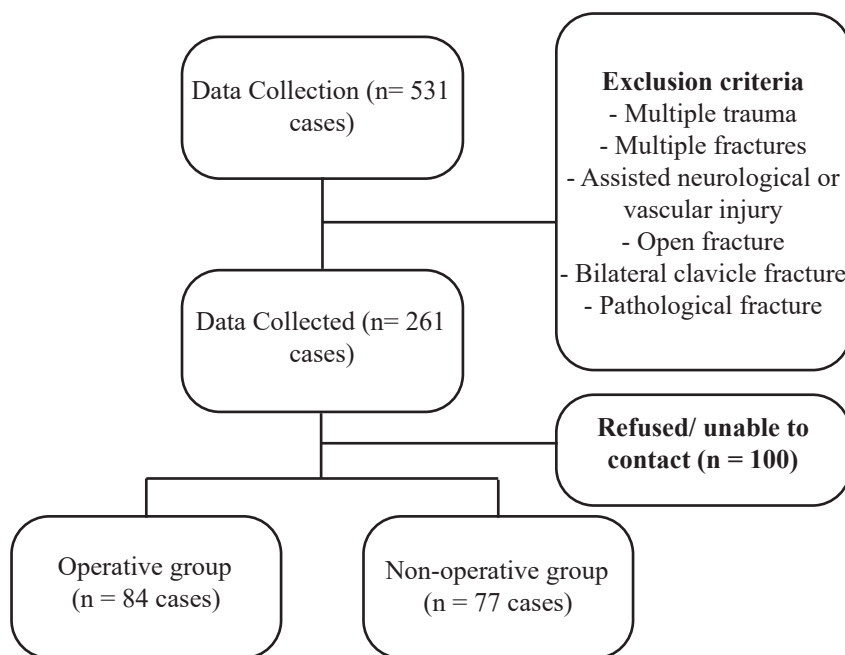


Figure 1. Flowchart of inclusion in study design





Figure 2. Conservative treatment in midshaft clavicle fracture. (A) Clinical appearance on clavicle midshaft fracture (B) Treated with the figure of eight bandages (C) Initial radiograph of the fracture.

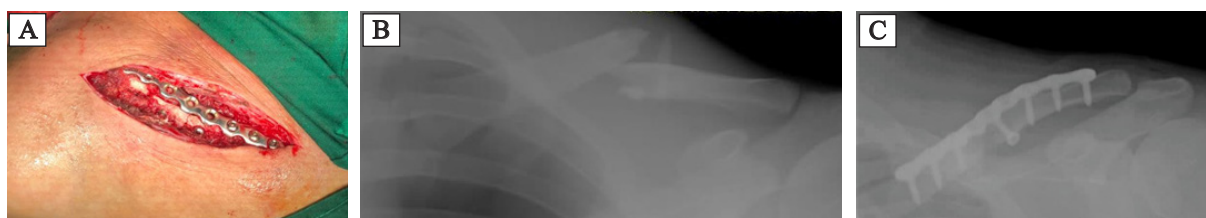


Figure 3. Operative treatment of midshaft clavicle. (A) Intraoperative reduction using 3.5mm – 9 holes reconstruction plate and lag screw fixation (B) Initial radiograph of the fracture (C) Radiograph after fracture fixation.

with assisted active range of motion exercise as the pain was tolerated. After three weeks, patients were asked to perform pendulum exercises. At week-8, patients are asked to remove the arm sling or figure-of-eight bandage and perform full weight-bearing.

In the operative group, the subject was done with general anesthesia. Patient in supine position with a pillow in the affected shoulder. Anterior approach was performed with the protection of the supraclavicular nerve. The fracture was reduced to gain a normal length. In comminuted fracture, we reduced as anatomical possible and fixed with a 3.5mm S-reconstruction plate in a superior clavicle with a minimum of six cortices in each fragment. If necessary, a lag screw is also added to stabilized fragments. The wound was sutured with an absorbable monofilament suture. The patient was given an arm sling for 10-14 days until the wound completely healed. Active range of motion exercise started in the second week (Figure 3).

We evaluated patients retrospectively, and minimal evaluation was six months after injury. We use telephone, texting, mail, and home visiting to contact patients to complete the DASH (Disability of Arm, Shoulder, and Elbow) score questionnaire and SCC (Shoulder Constant Score) and Manual Muscle Test. DASH Score consists of

30 questions to evaluate patients' functional activity. Scores ranging from 0 (no disabilities) to 100 (most severe disability). Constant Shoulder Score consists of two parts. The first part is a patient's function, while the second part consists of the patient's shoulder Range of Movement with a possible maximum score total of 100 points (best function). Manual Muscle test consists of 5 levels with level 0 is no contraction, and 5 showed full ROM.

Complications include nonunion, malunion, infection, and implant failure. Nonunion described if no evidence of healing three months after injury. Malunion described the presence of angular deformity and shortening > 2 cm with persistent pain three months after injury.

Samples are tested using an independent T-test form ROM, MMT, SCS, and DASH score. Values < 0.005 represent a significant difference—evaluation of union using Pearson Chi-square analysis. P-value < 0.05 represents a statically significant difference. Analysis was performed using SPSS v 23.0.

RESULTS

We evaluated 161 patients with a midshaft clavicle fracture, consisting of patients operated found 77 patients (47.8%), and the conservative group was

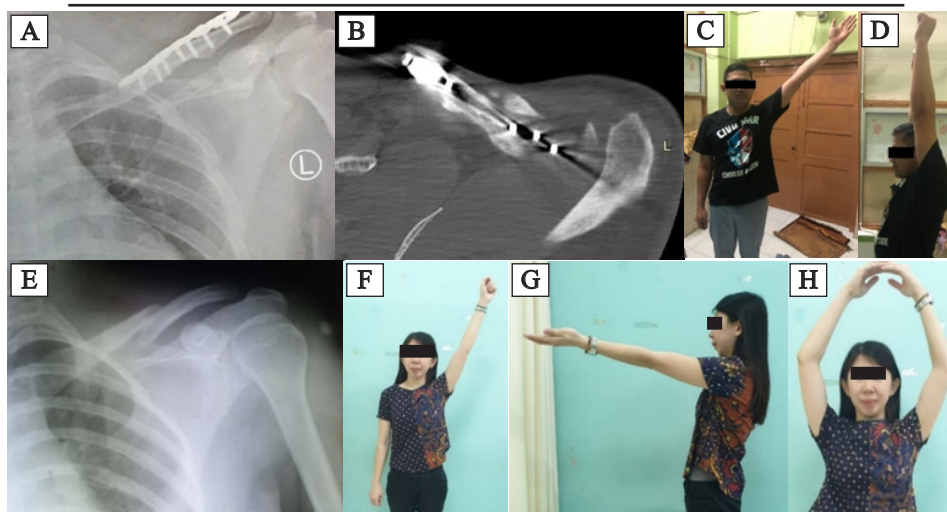


Table 1. Demographics of Patients

Demographic	Conservative	Operative	Total (%)
Sex			
Male	60 (71.4%)	57 (74%)	117 (72.7%)
Female	24 (28.6%)	20 (26%)	44 (27.3%)
Mean of Age	34.23 ± 13.07	36.69 ± 11.19	35.4 ± 12.23
Side			
Right	52 (61.9%)	48 (62.3%)	100 (62.61%)
Left	32 (38.1%)	29 (37.9%)	61 (37.9%)
Dominant Hand			
Right	77 (91.7%)	73 (94.8%)	159 (98.75%)
Left	7 (8.3%)	4 (5.2%)	2 (1.24%)

Table 2. DASH score, Constant Shoulder Score, and MMT for Operative and Conservative Group

	Conservative Group (n = 84)	Operative Group (n = 77)	P-value
DASH Score	23.67 ± 3.49	10.85 ± 6.98	<0.001
Constant Shoulder Score	86.60 ± 7.56	93.38 ± 7.529	<0.001

**Figure 4.** One year evaluation. (A-D) operative treatment radiologic, CT scan, and clinical evaluation. (E-H) conservative treatment radiological and clinical evaluation.

84 patients (52.2%). The patients' characteristics were a male total of 117 patients (72.7%), and female 44 patients (27.3%). Patients' ages range from 18-60 years old, with a mean age of was 35.4 ± 12.23 years old (Table 1). Mode of injury divided into Motor vehicle collisions (MVC) 25 patients (14.28%), motorcycle crash (MCC) for 34 patients (21.11%), single motorcycle injury for 66 patients (41%), pedestrian vs. motorcycle 7 patients (4.36%), fall from height 17 patients (10.56%), and direct hit 12 patients (7.45%).

Significant differences showed in primary outcomes showed in DASH score, constant

shoulder score, and Manual Muscle Test between two groups ($p < 0.001$). DASH score in the operative group was 10.85 ± 6.98 , compared to the conservative group 23.67 ± 3.49 , which showed better shoulder function in the operative group. Constant Shoulder Score in the operative group in operative group 93.38 ± 7.529 while in conservative group 86.60 ± 7.56 . Both groups showed good results in shoulder function but with better results in the operative group (Table 2).

Even though both function between operative and conservative, shortening showed in nonoperative cases (Figure 4). Patient satisfaction



was also higher in the operative group and earlier return to activity time. Some patients complain of the lump at the anterior shoulder in the conservative group.

DISCUSSION

Clavicle midshaft fracture is one of the commonest fractures, and with good treatment will give good function because of its fast healing rate. The previous study reported 29-58 cases per 100.000 populations.^{7,8} In our study, we found 531 cases, around 130-150 cases per year. Based on several studies, we found the mechanism of injury mostly by a motor vehicle crash. Our study also found that single motorcycle injury is the most caused of injury by 41%. Since the motorcycle is one of the easiest modes of transportation in our country than the car, the incidence of motorcycle injury put the highest rank. Cases of males also had a higher incidence than females. According to our study, this is confirmed by male cases 72.7% and mostly in young adults.⁹⁻¹¹

The tendency of management therapy for midshaft clavicle fracture had moved from conservative to the operative. The nonoperative group has mostly complained about the risk of nonunion, shortening, shoulder malposition, and bony prominence.⁹ Patient satisfaction and union time are higher in the operative group. Faster union time and better function related to faster back to work time. Some complications like malunion and nonunion are also higher in the conservative group. Most complained symptoms in surgical groups are implant prominence and scar-related cosmetic.¹²

Using the DASH score, the operative group showed better outcomes than the nonoperative group in our evaluation. According to a previous study by Patel, who evaluated the DASH score between operative and conservative, also showed better scores in the operative group.¹³ According to Tamaoki et al., a one-year evaluation of the DASH score showed no significant

difference. Canadian orthopedic trauma society by 2007 showed the operative group had a better score.¹⁴ Mean Constant score was also higher in the operative group than in the conservative group.

This study showed that operative treatment gives superior functional outcomes to the conservative group. The operation can be performed using a plate and screw or TENS (Titanium Elastic Nail System), which gives smaller scar. Newer meta-analysis research showed a nonunion risk was higher in the nonoperative group (15%) than operative (2.2%), especially with good fixation technique.¹⁵ Some patients also complain of constant pain, nonunion, malunion, and lowered shoulder function.¹⁴

It is better for patients who underwent surgery in the acute phase (less than 14 days), giving a higher union rate than performing >14 days. By performing operative, we gave rigid fixation and correct lengthening for better union and function while giving less pain and better function due to early rehabilitation and movement. Early mobilization gives faster recovery for shoulder movement and muscle strength. In longer evaluation, if there are no complaints around the shoulder, such as tingling sensation or implant prominence, removal of the implant was unnecessary, except in patients doing body contact sports. A shorter return to preinjury activity was also found in the operative group with a difference of 4 weeks faster. Some research has already compared superior and anteroinferior plating to increase patients satisfaction and less complication.^{4,14-16}

Some conservative group complications include shoulder dysfunction, mostly caused by shortening of the bone segment, residual bone deformity, loss of force, and persistent pain. Shortening 1.5-2 cm could give result in decreased shoulder function. However, conservative treatment remains a gold standard in simple undisplaced mid-shaft fracture. However, the gold standard for treatment in midshaft displaced



and comminuted for young active adult patients must be considered a regiment of therapy related to better shoulder function.^{12,14,16}

CONCLUSION

Operative treatment of midshaft clavicle fracture has been accepted as the gold standard worldwide for displaced or comminuted fractured inactive young adults. It has better bone healing, less healing time, and superior shoulder function than conservative treatment. Patient satisfaction is also higher in the operative group. Indonesian population was mostly filled with active young adults, and a motorcycle was commonly used as main transportation, so the incidence of clavicle fracture was common. We need a multi-centered prospective randomized trial to make a better result, and objective measurement for radiologic can be added for future research.

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