

Figure of Eight Bandage Versus Arm Sling for Treating Middle third Clavicle Fractures in Adults

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Clavicle fractures make 2 to 5 % of skeletal injuries; in adult age group. While treating fractures of clavicle, primary aim is to restore the shoulder activity to status before the injury; and guide towards healing with minimal residual deformity; with minimal pain and near normal shoulder range of movements. The study was conducted at Krishna Institute of Medical Sciences, Karad, over a period of 40 months; in 100 patients.

Keywords: Middle 1/3rd shaft clavicle fractures; figure of eight bandage; arm sling.

1. INTRODUCTION

Clavicle fractures make 2 to 5 % of skeletal injuries; in adult age group. According to Mario Lenz et al., Clavicle fractures have incidence of 36.5 to 64 per 100,000 [1,2,3]. The most common cause of Clavicle Fracture is Moderate

to High energy trauma from Road Traffic accidents, Sports trauma, etc. in young individuals. Fracture of clavicle are uncommon with pathological conditions [4].

For management of Clavicle fractures, the main aim is to restore the shoulder activity to status

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before the injury status; and guide towards healing with minimal residual deformity; with minimal pain and near normal shoulder range of movements [5]. Historically, non-operative management of middle third shaft fracture of Clavicle was most accepted management of fracture. The debate of Gold standard of care for middle third shaft fracture of clavicle is still going on.

While considering the best conservative treatment for middle 1/3rd clavicle fractures, a lot of literature is present worldwide. The answer is still a controversy. Considering USA surgeons, a simple sling is preferred by 94% of surgeons; whereas among German surgeons 88% would prefer figure of 8 bandage. [6,7,8]

There is no regularity present amongst conservative treatment. Being the one of the most common fractures, there is a need to investigate the better intervention with a better functional outcome and less adverse effects. This study also aims to compare and evaluate the functional outcomes and complications associated with figure of eight bandage versus arm sling for treatment of middle third clavicular fracture in adults.

2. MATERIALS AND METHODS

This is a prospective study, conducted at Krishna Institute of Medical Sciences, Karad. It is a study of 100 patients admitted between September 2017 to December 2020. The patients who satisfy the Inclusion criteria are included in the study.

2.1 Inclusion Criteria

- i. Patients diagnosed with Midshaft Clavicle Fracture.
- ii. Age > 18 years.
- iii. Patient must be willing for participation in the study.
- iv. No medical contraindication to proposed methods of immobilization.

2.2 Exclusion Criteria

- i. Pathological Fractures.
- ii. Open Fractures.
- iii. Neurovascular Injury on physical examination.
- iv. Associated Head injury (Glasgow Coma Score < 12)
- v. Ipsilateral upper limb fractures and/or dislocation- shoulder, humerus, scapula.

- vi. History of frozen shoulder
- vii. Previous disease in the limb that could influence the results (e.g., rheumatoid arthritis)
- viii. Inability to comply with follow up (inability to read or complete forms)

The study size will be 100 patients, which will be randomly divided among 2 groups of 50 patients each.

2.3 Interventions

Group I (50 Patients): This group of patients were managed with a figure of eight bandage. It was given for 3 to 4 weeks with weekly follow up for adjusting the immobilization. Patient can continue to do simple activities (writing, typing and other activities). Patient and relatives were also trained about tightening and adjusting of bandage whenever required.

Patient is sitting with back arched and stretched. Cotton padding done in between shoulder blades, axilla and over the fracture site. Arms were positioned through the straps of the bandage. The straps are then pulled tightened to adjust and then pulled back. Patient was instructed not to use the bandage all day and also adjust it whenever it loosens.

After 4 weeks, the bandage was discarded.

Group II (50 Patients): This group of patients were managed with standard arm sling for 4 weeks. The fractured side was immobilized with shoulder arm sling from fractured side elbow to opposite shoulder, with affected upper limb in internal rotation. The hand on the fractured side was placed at level of elbow or above the level of elbow. To prevent elbow stiffness, patients were instructed to mobilise the elbow with flexion and extension about three times per day.

2.4 Rehabilitation

Similar rehabilitation protocol was drafted for both groups. When period of 4 weeks of immobilization of fractured side is over, simple home exercises were started with Codman pendulum exercises [9] (Fig. 1).

2.5 Assessment

Patients fulfilling the inclusion criteria and willing to take part in the study were selected.

Data collection was started with identification data, age group data, gender preference data,

anthropometric data, mechanism of injury, occupational details, associated co morbidities and personal habits were documented and tabulated. The study focused on Constant and Murley Shoulder Score, Callus formation on Radiograph, displacement and shortening and associated complications.

The functional outcomes were assessed using Constant and Murley Shoulder Score. (Table 1&2). While evaluating the patients with Constant and Murley Shoulder Score; the following criteria was used.

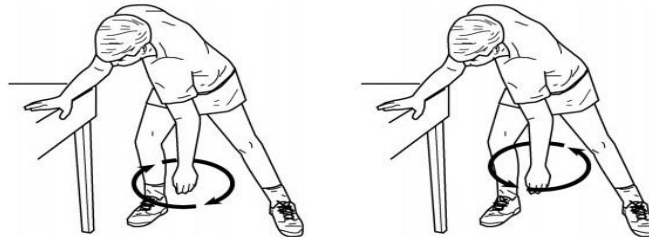
The score is a comparative criteria for expressing the outcome. In the criteria the other limb score was considered normal or near normal (i.e- 100).

Radiological union on a radiograph is the presence of trabecular bridge and bone callus over the fracture site gap at the periosteal and endosteal level. The callus formation at the fracture site is usually compared with serial radiographs at every follow up to assess the bridging callus formation and callus thickness and its progression.

Pendulum Exercises for Shoulder

All exercises should be done 5 times daily in 5 to 10 minute sessions.

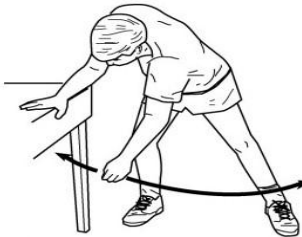
- ❑ Bend at the waist so your arm is dangling down. You may want to hold onto a table or chair for support. Gently rock your body weight from your left to your right foot or in a circular motion to move your arm in circular pattern. Reverse your movement so your arm moves in the opposite direction. Do this 5 times in each direction.



- ❑ Bend at your waist so your arm is dangling down. You may want to hold onto a table or chair for support. Move your arm forward and backward. Let your arm swing freely.



- ❑ Bend at your waist so your arm is dangling down. You may want to hold onto a table or chair for support. Move your arm side to side. Let your arm swing freely.



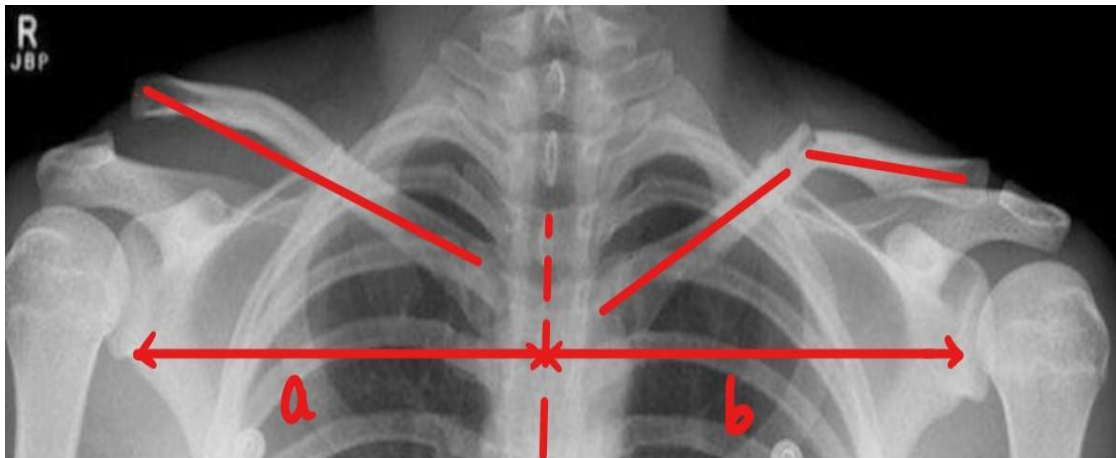
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Fig. 1. Codman pendulum exercises

Table 1. Constant and Murley shoulder score (Grading)

Grades	Difference between normal and affected side
Excellent	<11
Good	11-20
Fair	21-30
Poor	>30



Over a radiograph, a line was plotted from medial point of sternum and acromial process tip (a). On the healthy side, length of the healthy side was calculated. On the fractured side, length of affected side was calculated (b). Percentage of shortening was calculated with difference of length of two side (a-b) to the length of healthy side(a) [7].

The patients were followed up at 1, 2, 4 and 6 months using the above-mentioned criteria with respective radiographs.

2. OBSERVATION AND RESULTS

In our study, Constant and Murley Score was used in the study to evaluate the patients. The

variables include Pain, Activities of daily living, Range of motion and Power.

The overall Constant and Murley Score for both groups were compared.

In our study, Group II- Patients treated with Sling for Middle third Clavicle Fractures had better outcome than Group I- Patients treated with Figure of Eight for Middle third Clavicle Fractures with statistically significant (p < 0.01).

Pain is the most common complain and the most persistant of all the four parameters. In group II – Patient treated with Sling for Midshaft Clavicle fracture, pain is less as compared to Patient treated with Figure of Eight Bandage. (Table 2).

Table 3. Constant murley score of midshaft clavicle fracture patients

		1 month	2 months	4 months	6 months
Poor	i	38 (76 %)	22 (44%)	08 (16%)	06 (12%)
	ii	34 (68%)	18 (36%)	04 (8%)	04 (8%)
Fair	i	12 (24%)	26 (52%)	21 (42%)	16 (32%)
	ii	16 (32%)	24 (48%)	10 (20%)	10 (20%)
Good	i	0	02 (4%)	19 (38%)	24 (48%)
	ii	0	08 (16%)	32 (64%)	26 (52%)
Excellent	i	0	0	02 (4%)	04 (8%)
	ii	0	0	04 (8%)	10 (20%)

Table 2. Constant and Murley shoulder score

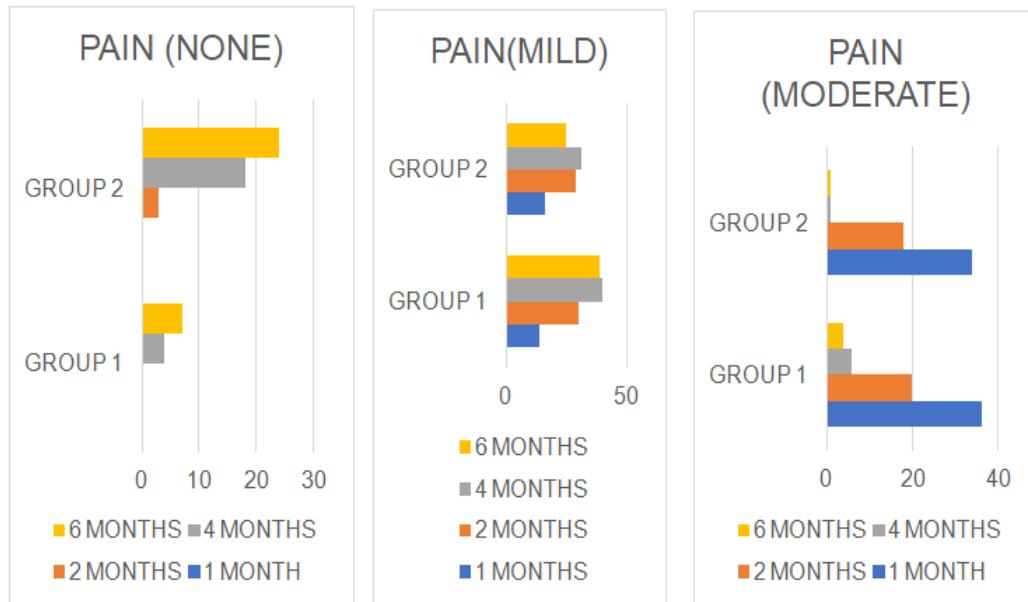
Parameters	Score
PAIN	15
None	15
Mild	10
Moderate	5
Severe	0
Activities of daily living	20
Activity level	
Full work	4
Full recreation / sport	4
Unaffected sleep	2
Positioning	
Up to waist	2
Up to xiphoid	4
Up to neck	6
Up to top of head	8
Above head	10
Range of motion	40
Forward flexion	
31 - 60 degrees	2
61 - 90 degrees	4
91 – 120 degrees	6
121 – 150 degrees	8
151 – 180 degrees	10
External rotation	
Hand behind head; elbow forward	2
Hand behind head; elbow back	4
Hand to top of head; elbow flexed	6
Hand to top of head; elbow back	8
Full elevation	10
Lateral elevation	
31 - 60 degrees	2
61 - 90 degrees	4
91 – 120 degrees	6
121 – 150 degrees	8
151 – 180 degrees	10
Internal rotation	
Lateral thigh	0
Buttock	2
Lumbosacral junction	4
Waist (l3)	6
T 12 vertebrae	8
Interscapular (t7)	10
Power	25
Strength of abduction	
0	0
1 – 3	2
4 – 6	5
7 – 9	8
10 – 12	11
13 – 15	14
15 – 18	17
19 – 21	20
22 - 24	23
>24	25
Total	100



Graph 1. Patient treat figure of eight and patient treated with sling with Constant Murley Score

Table 4. Patient of Midshaft clavicle fractures and pain

Pain grade		1 month	2 months	4 months	6 months
None	I	0	0	4 (8 %)	7 (14 %)
	II	0	3 (6 %)	18 (36 %)	24 (48 %)
Mild	I	14 (28 %)	30(60 %)	40 (80 %)	39 (78 %)
	II	16 (32 %)	29 (58 %)	31 (62 %)	25 (50 %)
Moderate	I	36 (72 %)	20 (40 %)	6 (12 %)	4 (8 %)
	II	34 (68 %)	18 (36 %)	1 (2 %)	1 (2 %)
Severe	I	0	0	0	0
	II	0	0	0	0



Graph 2. Patient of Midshaft clavicle fractures and pain

One of the most subjective criteria to describe the effect of Midshaft Clavicle Fractures is the Index disturbed in Activities of Daily Living. The average of patient's activities of Daily Living is tabulated and compared. The activities of Daily living less affected in Group treated with Sling as compared to Patient treated with Figure of Eight Bandage for Midshaft Clavicle Fractures.

The average range of motion of both the groups are compared and tabulated. All the range of motions were achieved little more in Group II – Patient treated with Sling as compared to Patients treated with Figure of Eight Bandage.

The power (Strength of Abduction) was compared for both the groups. The power was little more for Group II – Patient treated with Sling as compared to Group I – Patient treated with Figure of Eight Bandage.

In our study, serial radiographs were taken on each follow up to assess callus formation at fracture site.

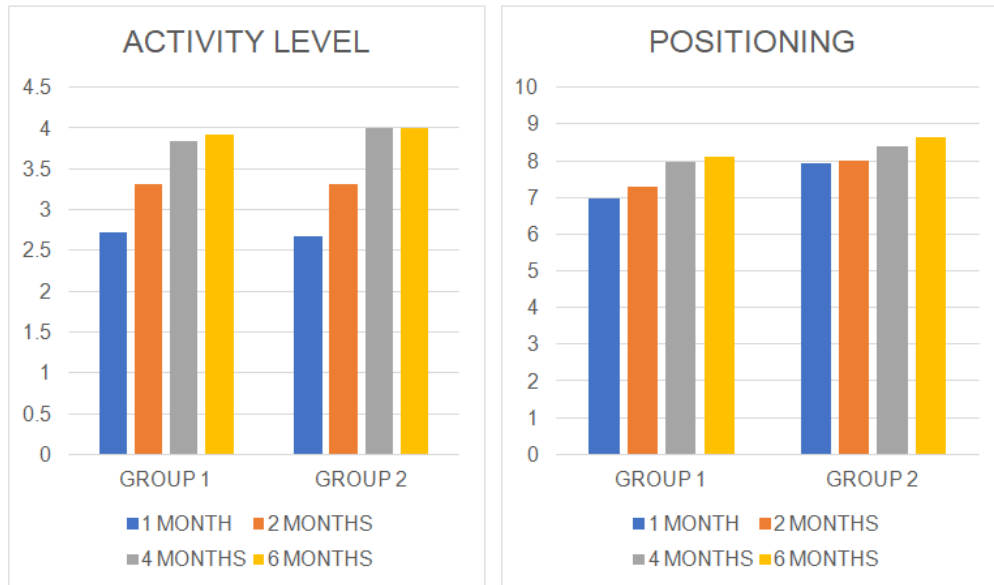
The Patients treated with Sling had better callus than Patient treated with Figure of Eight Bandage for Midshaft Clavicle Fractures.

In our study, 16% patients in Group I and 4% patients in Group II had Fracture Displacement < 20mm and Shortening after Fracture at 4 Months follow up. In our study, patients with Fracture Displacement >21mm at 4 months follow up had significantly reduced Range of Motion ($p < 0.01$) while patients with Fracture Displacement <20 mm at 4 months follow up had range of motion near normal; similar to other patients.

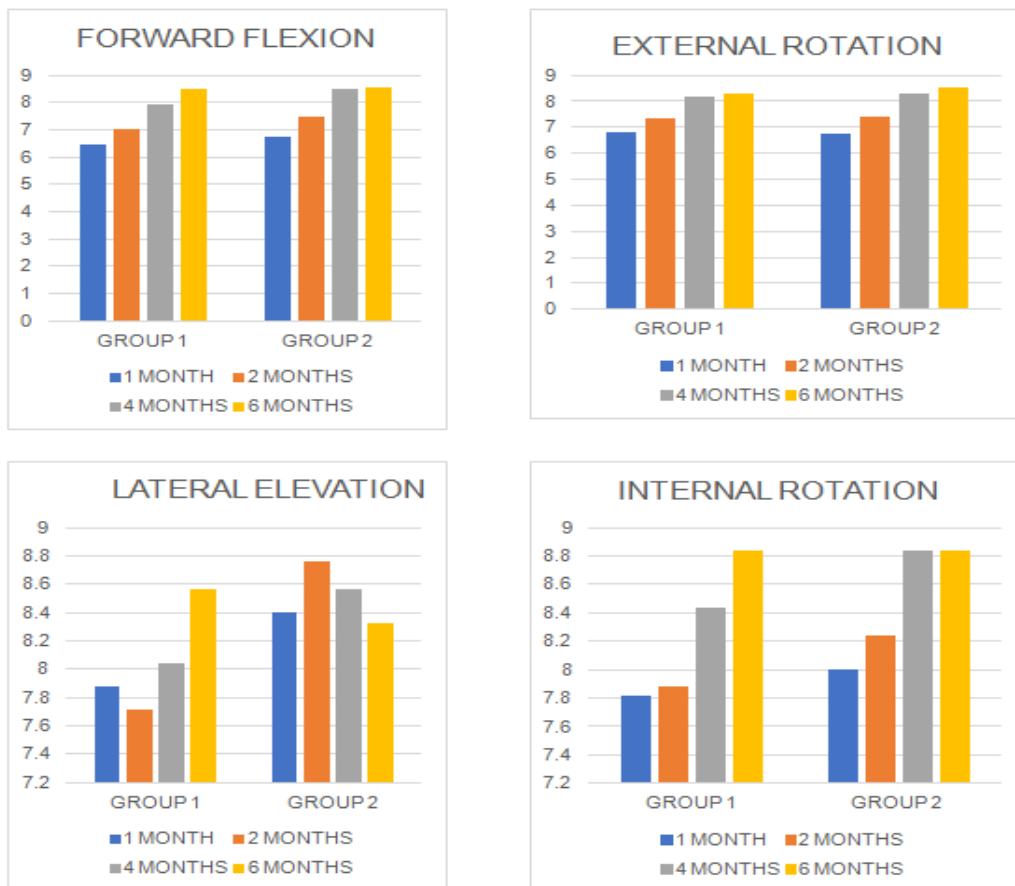
In our study 14% patients in Group I- Patients treated with Figure of Eight Bandage had Malunion, while 2% patients in Group II- Patients treated with Sling had Malunion, 2% patients had Non union in Group I- Patients treated with Figure of Eight Bandage, and these patients had Poor outcome according to Constant and Murley Score. 8% had Skin Necrosis due to pressure of figure of eight bandage in group I- Patient treated with Figure of Eight Bandage. (Graph 9).

Table 5. Activities of daily living and Midshaft clavicle fractures

Activities of daily living		1 month	2 months	4 months	6 months
Activity level	I	2.72	3.32	3.84	3.92
	II	2.68	3.32	4	4
Positioning	I	6.96	7.28	7.96	8.12
	II	7.92	8	8.4	8.64



Graph 3. Midshaft Clavicle fracture and activities of daily living



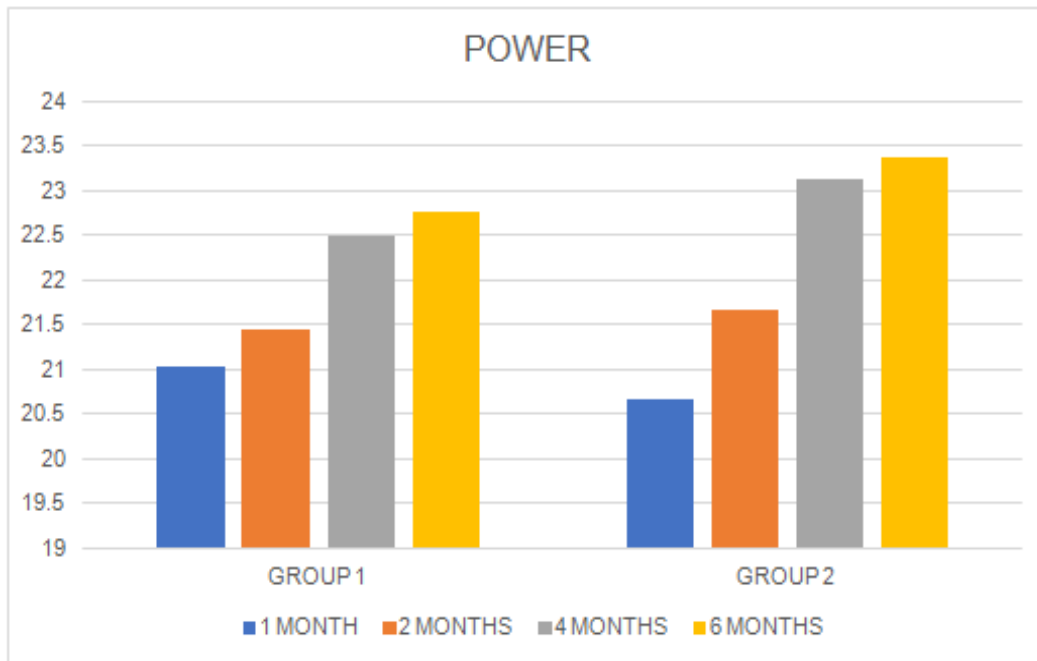
Graph 4. Midshaft clavicle fractures and range of motion

Table 6. Range of motion and Midshaft Clavicle fractures

Range of motion		1 month	2 months	4 months	6 months
Forward flexion	i	6.44	7	7.92	8.52
	ii	6.72	7.48	8.52	8.54
External rotation	i	6.84	7.36	8.2	8.32
	ii	6.76	7.4	8.32	8.56
Lateral elevation	i	7.88	7.72	8.04	8.56
	ii	8.4	8.76	8.56	8.32
Internal rotation	i	7.82	7.88	8.44	8.84
	ii	8	8.24	8.84	8.84

Table 7. Power and Midshaft Clavicle Fractures

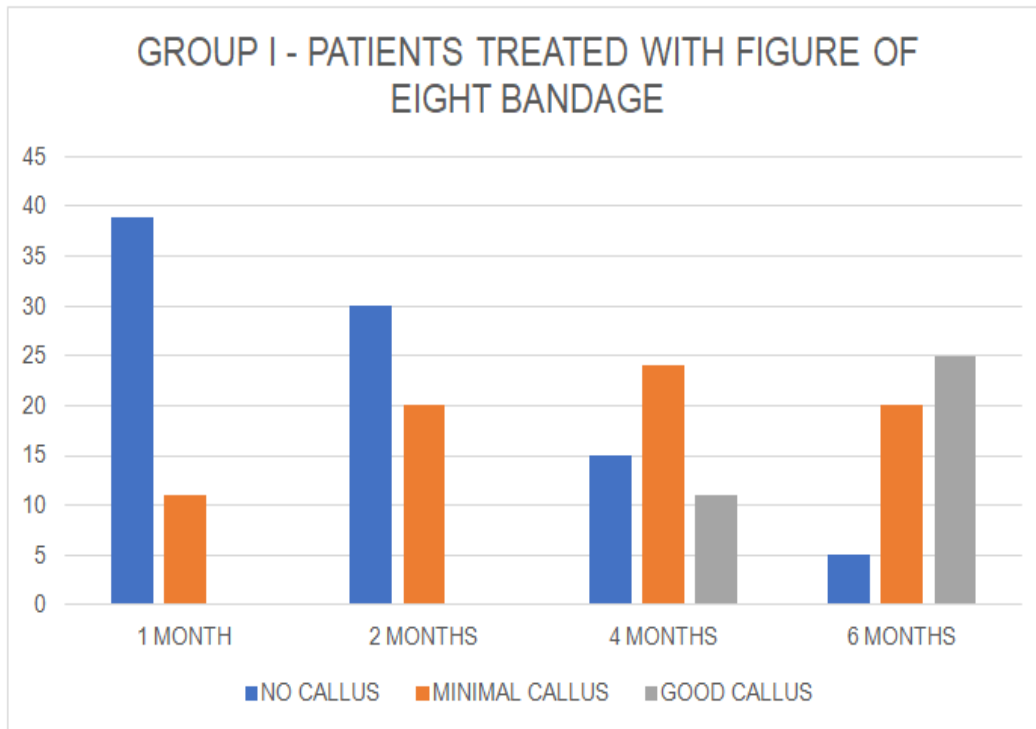
Power		1 month	2 months	4 months	6 months
Strength of abduction	i	21.02	21.44	22.48	22.76
	ii	20.66	21.66	23.12	23.36



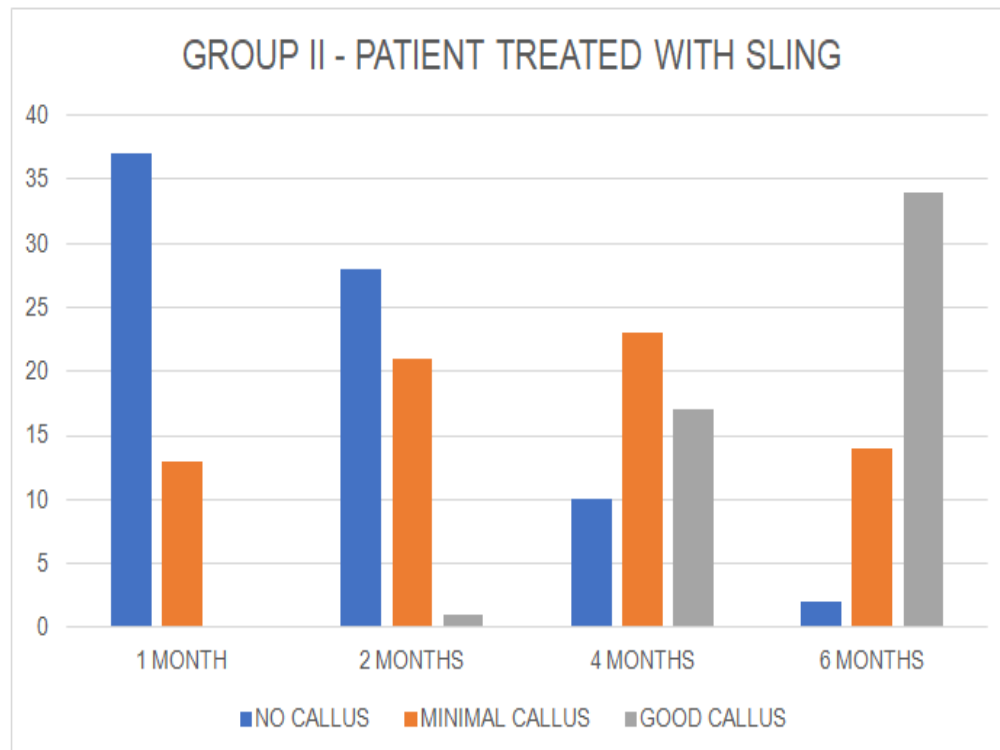
Graph 5. Power and Midshaft clavicle fractures

Table 8. Callus evaluation of Midshaft clavicle fracture patients

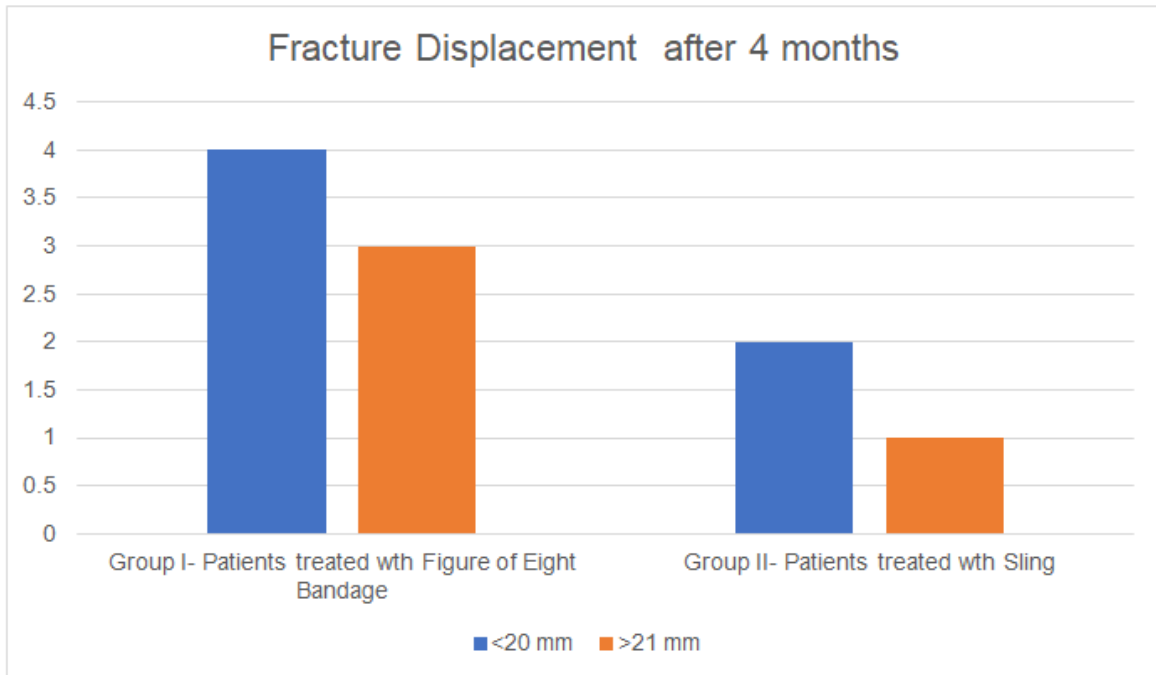
		1 month	2 months	4 months	6 months
No callus	i	39 (78%)	30 (60 %)	15 (30%)	05 (10%)
	ii	37 (74%)	28 (56%)	10 (20%)	02 (4%)
Minimal callus	i	11 (22%)	20 (40%)	24 (48%)	20 (40%)
	ii	13 (26%)	21 (42%)	23 (46%)	14 (28%)
Good callus	i	0	0	11 (22%)	25 (50%)
	ii	0	01(2%)	17 (34%)	34 (68%)



Graph 6. Patient treated with figure of eight bandage & callus formation



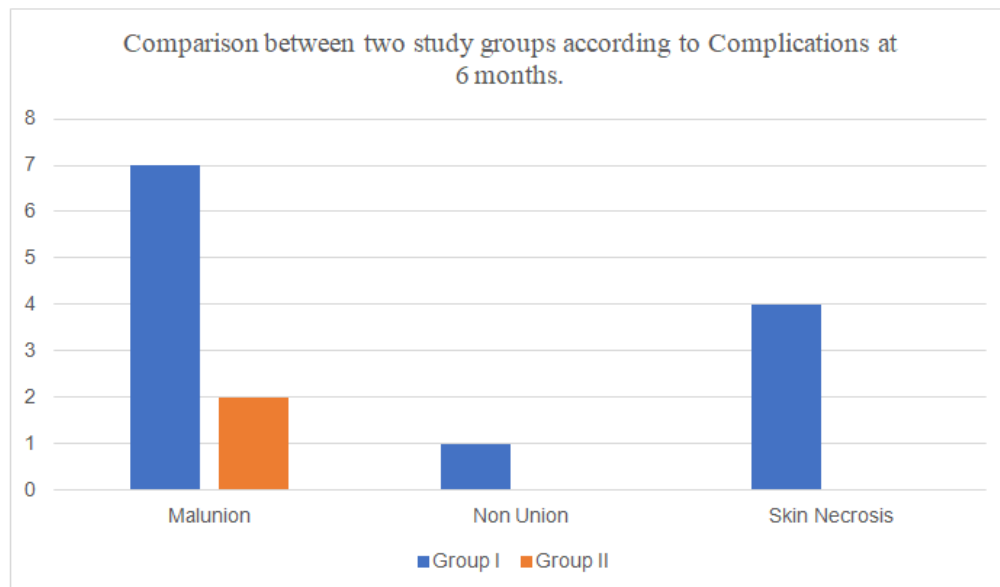
Graph 7. Patient treated with sling & callus formation



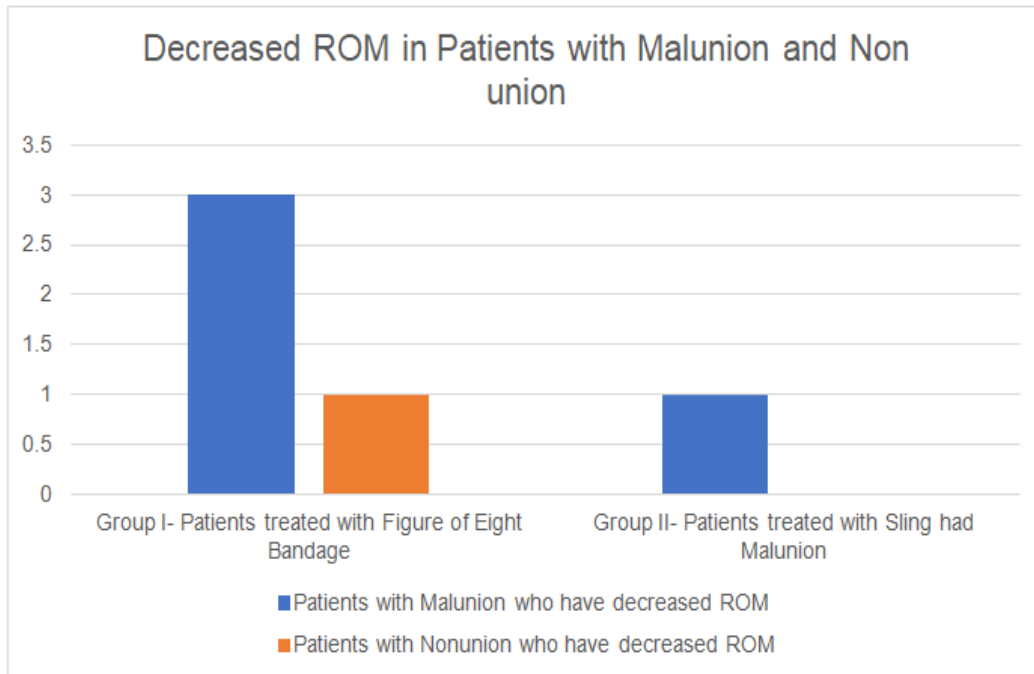
Graph 8. Fracture displacement after 4 months

Table 9. Fracture displacement after 4 months

	Displacement <20 mm	Displacement >21mm
Group I- Patients treated with Figure of Eight Bandage	4	3
Group II- Patients treated with Sling	2	1



Graph 9. Comparison between two study groups according to complications at 6 months



Graph 10. Decreased ROM in patients with malunion and non union

Table 10. Decreased ROM in patients with Malunion and non union

	Patients with Malunion who have decreased ROM	Patients with Nonunion who have decreased ROM
Group I- Patients treated with Figure of Eight Bandage	3	1
Group II- Patients treated with Sling had Malunion	1	0

In our study 3 patients in Group I and 1 patient from Group II with Malunion had significantly reduced Range of motion, and 1 patient in Group I with Non union had significantly reduced Range of motion.

Patients have been followed up for 6 months and relevant clinical images are attached herewith. (Figure no. 2 to 5)

3. DISCUSSION

The management of Clavicle fracture is still a debatable topic with arguments from both sides. Majority of Clavicle fractures are managed conservatively. A lot of studies show the fractures of clavicle have a high union rate. Conservative management includes Figure of Eight bandage, triangular sling or arm sling; in order to restore the shoulder activity to preinjury

status with minimal deformity and near normal shoulder range of motion.

This study explains a design which has its direct applicability to clinical practice. The patients who were willing to take part in the study and fulfilling the inclusion criteria; were selected amongst the patients visiting the outdoor patient department or admitted in the hospital. The middle third shaft fractures with displacement are most conventionally treated conservatively with high fracture union expectation and patient compliance.

Ersen et al, 2015; published 60 patients randomized control trial with isolated middle third shaft clavicle fracture. [10] The study had outcome of middle 1/3rd shaft clavicle fractures treated with broad arm sling with figure of eight bandage. The patient's outcome was compared

with pain, Constant and American Shoulder and Elbow Surgeon Scores and Degree of Radiologic Union. The result of the study stated that both techniques provided acceptable functional and radiological outcomes after treating middle 1/3rd shaft clavicle fractures conservatively.

In our study, 16% patients in Group I and 4% patients in Group II had Fracture Displacement < 20mm and Shortening after Fracture at 4 Months follow up. Our study results showed that a bone displacement of 20 mm or more decreases shoulder function. According to Nowak et al. 2004, a fracture displacement of 21 mm or more was associated with poor outcomes. [11] According to Ban et al., 2012; an initial displacement of 20 mm or more is associated with a higher risk of nonunion or a poor clinical outcome. [12]

According to Neer et al (1960), of 2000 mid clavicle fractures 0.13% went into non union; whereas Rowe's et al (1968) states 0.8% non union in 566 midshaft clavicle fracture [13,14].

Our study showed significant correlation between the fracture union and the Constant score. In our study 14% patients in Group I- Patients treated with Figure of Eight Bandage had Malunion, while 2% patients in Group II- Patients treated with Sling had Malunion, 2% patients had Non union in Group I- Patients treated with Figure of Eight Bandage, and these patients had Poor outcome according to Constant and Murley Score. Patients with significant displacement and shortening had increased incidence of fracture malunions and reduced shoulder function. [15-18]. Similar observations were observed in studies by Bajuri et al., 2011, McKee et al, 2012; Robinson et al., 2013 and Woltz et al., 2017. [19-22].

The patients treated with sling for Midshaft Clavicle Fracture had better compliance and better tolerance of the treatment than patients treated with figure of eight bandage for Midshaft Clavicle Fracture due to better psychological acceptance.

Patient no 1 : With Figure of 8 bandage



Post Trauma 1 month



Post Trauma 2 months



Post Trauma 4 months



Post Trauma 6 months

Fig. 2. Follow up X-rays of patient treated with figure of Eight Bandage

After 4 months



Fig. 3A. Follow up clinical picture of patient treated with figure of Eight Bandage



Fig. 3B. Follow up clinical picture of patient treated with Figure of Eight Bandage

Patient no 2 : With Sling



Post trauma 1 month



Post trauma 2 month



Post Trauma 4 months



Post Trauma 6 months

Fig. 4. Follow up Xray's of patient treated with sling

At 6 months:



Fig. 5A. Follow up clinical pictures of patient treated with sling



Fig. 5B. Follow up clinical pictures of patient treated with sling

4. CONCLUSION

Conservative treatment of Clavicle Fracture is a simple method but has associated complications. Surgeons should be wise in considering operative management in needed patients. Our study showed shoulder arm sling is a good conservative option of treatment with less discomfort to the patient and good outcome as compared to the figure of 8 bandage both clinically and radiologically. The patient compliance is better with sling as compared to

figure of eight bandage. However, results cannot be generalized and needs larger population study.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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