Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: www.saspublishers.com

OPEN ACCESS

Orthopedics

A Comparative Study of Conservative versus Surgical Management with Locking Compression Plates (LCP) For Displaced Midshaft Clavicle Fractures

Dr. K. Kishore Kumar[1*], Dr. Jaisingh Rathod[2], Dr. J. Venkateshwarulu[3]

[1,2]Associate Professor, [3]Professor and HOD, Department of Orthopedics, MGM Hospital, Kakatiya Medical College, Warangal, Telangana State, India

***Corresponding author:** Dr. K Kishore Kumar
| **Received:** 11.04.2019 | **Accepted:** 21.04.2019 | **Published:** 30.04.2019
DOI: 10.36347/sjams.2019.v07i04.058

Abstract **Original Research Article**

Clavicular fractures occur very commonly during road traffic accidents and sports related injuries. The most commonly involved area of the clavicle in fractures is the middle third of the bone. Traditionally clavicular fractures are treated conservatively. However, now there is a growing interest in operative management because of increased rates of non-union/malunion in conservatively treated cases. We in the present study tried to evaluate the functional outcome of the middle third clavicular fractures treated conservatively and with Locking Compression Plate [LCP]. Methods: This prospective cross sectional study was conducted in the Department of Orthopedics, KMC & MGM Hospital, and Warangal from December 2016 to November 2018. A total of n=50 patients were included in the study, and n=25 category 2A1 and 2A2 clavicle fractures were treated with conservative management, n=25 with class 2B1 and 2B2 were treated with Locking Compression Plate. Those treated with conservatively were put on clavicle brace and arm pouch was given. Those with LCP underwent standard surgical procedure for placement of pre-contoured LCP of appropriate length. Follow up was done at the interval of 1 week, 1 month, 2months, 4 months, 6 months and 12 months. Clinically the range of motion, pain, condition of scar and DASH scores were analyzed along with Constant Murley score. Results: The mean time to radiological union was 21 weeks in conservative group and 15 weeks in the LCP group and the mean duration to functional recovery was 8.5 weeks in conservative group and 6.1 weeks in the LCP group. The average Constant Murley scores at the end of all stages of follow up in conservative treatment group was 76.35 ± 5.27 similarly the average scores in the LCP group at the end of all stages of follow up was 81.6 ± 3.77. The functional outcomes of the patients with treatment was assessed and in the conservative treatment group excellent results were found in n=4(16%) good functional outcome was in n=10(40%), poor outcomes was seen in 4(16%) of the cases. In the LCP group excellent results were found in n=9(36%), good results were in n=7(28%), satisfactory was n=5(20%), fair functional outcomes was in 4(16%) of the cases. Conclusion: it can be concluded that primary fixation with locking compression plate leads to better results and predictable outcomes. This allows the patients to return to function early and also decreases the high rates of complication associated with conservative management. However, patient factors, type of fracture, and costs of treatment must be kept in mind for choosing the best treatment option for the particular patient.

Keywords: Clavicle fractures, Conservative Treatment, Surgical Treatment, Locking Compression Plates.

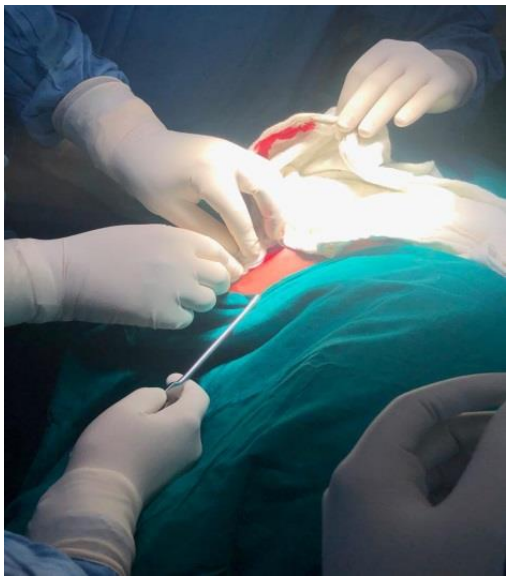
INTRODUCTION

Fractures of the clavicle are very common injuries of the skeleton representing 3% to 5% of all the fractures and about 45% of shoulder injuries. About 70% to 80% of fractures of clavicle involve the middle third of the bone and less often the lateral third 12% - 15% and medial third in 5 -8% [1]. The proximal clavicle fractures usually occur in elderly men, the middle third occurs in children (undisplaced) and adolescents (displaced) and young male adults (comminuted) distal third occurs in middle-aged patients [2]. Most of the fractures occur due to a direct blow to the anterior chest wall or due to falling on the outstretched hand [3]. Open clavicle fractures are very rare and can be found only in 0.1% to 1% of cases. The clavicle is an S-shaped bone with an anterior apex medially and posterior apex laterally. It provides important structural and functional stability to shoulder girdle; therefore, maintaining length, alignment, rotation and angulations are necessary for optimal shoulder joint functions [4]. The middle third of the clavicle is a transitional zone between both curvature and cross-sectional anatomy and it is mechanically weak it is not supported by any muscles or ligaments hence, it is more vulnerable to fractures. Generally, clavicular fractures are considered as benign injuries and have been treated by conservative methods [5].

However, recent studies have shown that the results of conservative management of displaced midshaft clavicular fractures are not good as previously thought [6-8]. There is a greater incidence of non-union or mal-union and poor functional outcomes with conservative management; as a result, more recently all the displaced midclavicular fractures have been treated with primary fixation [9-11]. Studies have shown that safety and efficacy of primary open reduction and internal fixation for displaced midshaft clavicular fractures have a high union rate and lesser complications [12]. Studies have found that a large number of complex clavicle fractures satisfactory outcome was possible with lower rates of complication using locking compression plates [13]. With this background, we in the present tried to evaluate the clinical and functional outcome of the patients treated with conservative management and Locking compression plates in patients with mid-shaft clavicle fractures.

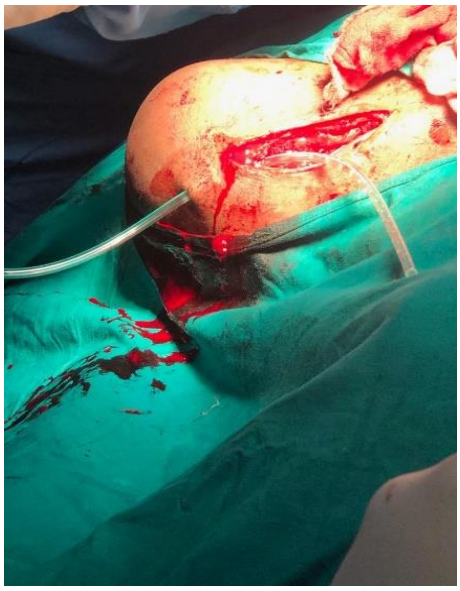
MATERIAL AND METHODS

This prospective cross-sectional study was conducted in the Department of Orthopedics, KMC & MGM Hospital, and Warangal from December 2016 to November 2018. Institutional Ethical Committee permission was obtained for the present study. Written consent was obtained from all the participants of the study after explaining the details of the nature of study in their local language. The inclusion criteria were adult patients with mid clavicle fractures, clavicle fractures of the category 2A1 and 2A2 were treated with conservative management and fractures of class 2B1 and 2B2 were treated with locking compression plates. Exclusion criteria: open fractures of the clavicle, pathological fractures, floating shoulder or multifocal shoulder girdle injury. Those associated with neurovascular deficits, upper limb fractures. A total of n=50 patients were included in the study, and n=25 category 2A1 and 2A2 clavicle fractures were treated with conservative management, n=25 with class 2B1 and 2B2 were treated with Locking Compression Plate. A detailed clinical history and thorough clinical examination were carried on each patient. Those treated with conservatively were put on clavicle brace and arm pouch was given. Patients were encouraged to perform active shoulder exercises and elbow movements as much as they can. Load bearing exercises were restricted for up to 6 weeks. The LCP patients underwent complete pre-anesthetic evaluation including blood investigations. The surgical procedures were carried out as per the standard protocol under general anesthesia. A curvilinear incision was done along the superior edge of the clavicle the fracture site was exposed with minimal periosteal dissection soft tissue attachments of comminuted fragments were preserved. A 3.5mm pre-contoured anatomical LCP of appropriate length was chosen the plate is position on the reduced bone using plate holding forceps and cortical screws are first inserted followed by locking screws. The final fixation is visualized by image intensification and the wound was closed in layers and sterile dressing given. Post-operatively patients were given an arm pouch. Shoulder exercises like abduction up to 90° were advised for 6 weeks. Follow up was done at the interval of 1 week, 1 month, 2months, 4 months, 6 months and 12 months. Clinically the range of motion, pain, the condition of scar and DASH scores were analyzed along with Constant Murley score. Any complication was also recorded.



Picture-1: Intra-operative

Picture-2: Intra-operative



Picture-3: Intra-operative

Picture-4: Intra-operative

Picture-5: Antero-posterior view of the case managed conservatively

Picture-6: Antero-posterior view of the case managed conservatively resulting in mal-union

Picture-7: Pre-operative Antero-posterior view of the case managed surgically

Picture-8: Post-operative Antero-posterior view of the case managed surgically showing good union at follow-up

RESULTS

In the present study n= 50 patients were included out of which n=25 were in the conservative treatment group and n=25 in locking compression plate group. According to Robinson's Classification of fractures of the clavicle, the 2A1 and 2A2 were treated with conservative management and fractures of class 2B1 and 2B2 were treated with locking compression plates. In the conservative group n=17(68%) were in type 2A1 and n=8 (32%) were 2A2. The 2B1 type of fractures was found in n=19(76%) of the patients and n=6(24%) were found in the locking compression plate group (table 1). In the conservative treatment group out of n=25 patients, n=17 (68%) were male and n=8 (32%) were females. In the Locking compression plate group n=15 (60%) in male and n=10 (40%) female was present out of a total of n=25 patients (figure 1).

Table-1: Type of fractures according to Robinson's Classification and treatment

Robinson's classification	Conservative Treatment		Locking Compression Plates	
	Number (n)	Percentage (%)	Number (n)	Percentage (%)
2A1	17	68	0	0
2A2	8	32	0	0
2B1	0	0	19	76
2B2	0	0	6	24

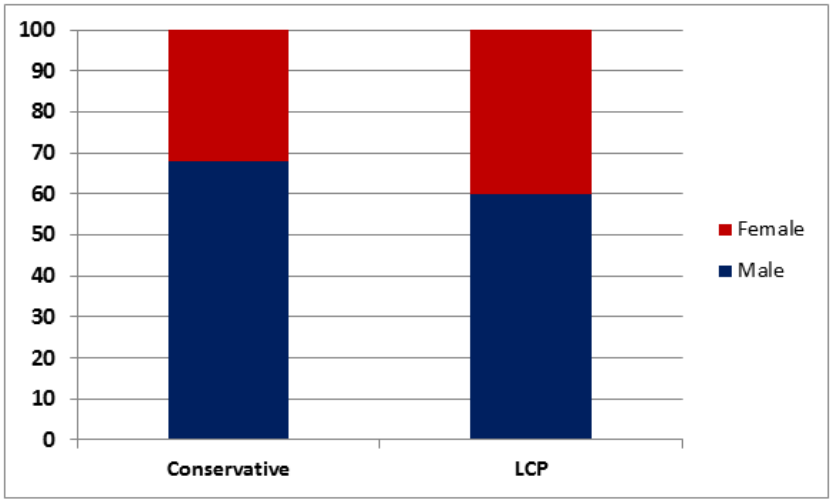


Fig-1: Showing the sex wise distribution of cases in two groups

The dominant side right side was involved in n=16 (64%) of cases and the left side was in n=9(36%) cases in conservative treatment group and similarly in the Locking compression plate group n= 14(56%) of cases and left side involved in n= 11(44%) of cases shown in figure 2.

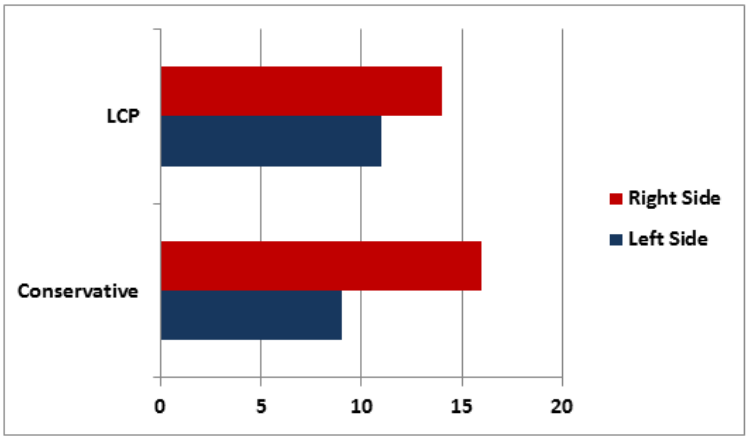


Fig-2: Showing the side of involvement of fractures

In the present study, most of the cases of fractures were due to Road Traffic Accidents a total of n=39(78%) of both groups of patients were fractures due to RTA cases. The second cause was fall from the height which was found in the 7(14%) out of the total n=50 cases. Assaults resulted in a fracture in n=1(2%) cases and Sport related injuries were seen in n=3(6%) cases details in table 2.

Table-2: Mechanism of Injury of the patients involved in the study

	Conservative Treatment	LCP	Total	Percentage
RTA	20	19	39	78
FFH	4	3	7	14
Assaults	0	1	1	2
Sport-related injury	1	2	3	6
Total	25	25	50	100

The mean duration of treatment in the conservative group was 2.0 ± 1.5 days range was 2-7 days in the LCP group the mean duration to the operation was 3.5 ± 2.5 days and the range was 2-8 days and the majority of the patients were operated in the first 5 days of the injury. The mean duration of surgery was 125 ± 10.5 min and mean blood loss was 180 ± 25.0 ml. The mean time to radiological union was 21 weeks in conservative group and 15 weeks in the LCP group and the mean duration to functional recovery was 8.5 weeks in conservative group and 6.1 weeks in the LCP group table 3.

Table-3: Operative characteristics of the patients involved in the two groups

	Conservative Treatment	Locking Compression Plates
Mean duration of trauma to treatment (days)	2.0 ± 1.5	3.5 ± 2.5
Mean duration of Surgery in (min)	-	125 ± 10.5
Operative blood loss (ml)	-	180 ± 25.0
Mean duration for Radiological Union (weeks)	21 ± 3.0	15 ± 0.5
Mean duration to Functional Recovery (weeks)	8.5 ± 1.5	6.1 ± 1.5

The Constant-Murley Scores were found to be higher (better) in the LCP group as compared to the conservative group at all the stages of follow up and the average Constant- Murley scores at the end of all stages of follow up in conservative treatment group was 76.35 ± 5.27 similarly the average scores in the LCP group at the end of all stages of follow up was 81.6 ± 3.77 (table 4). The DASH scores at the end of 12 months were analyzed in the conservative group the mean scores were 8.1 ± 3.3 and the mean DASH scores in the LCP group was 4.2 ± 3.2.

Table-4: Constant- Murley scores in the two treatment groups of patients

Constant-Murley score	Conservative Treatment	Locking Compression Plates
6 weeks	67.64 ± 5.6	71.5 ± 3.5
12 weeks	72.15 ± 7.5	78.9 ± 4.4
24 weeks	80.14 ± 4.5	84.5 ± 4.6
1 year	85.5 ± 3.5	91.5 ± 2.6
Average scores	76.35 ± 5.27	81.6 ± 3.77

The functional outcomes of the patients with treatment were assessed and in the conservative treatment group excellent results were found in n=4(16%) good functional outcome was in n=10(40%), poor outcomes were seen in 4(16%) of the cases. In the LCP group, excellent results were found in n=9(36%), good results were in n=7(28%), satisfactory was n=5(20%), fair functional outcomes were in 4(16%) of the cases.

Table-5: Functional outcomes of the patients with treatment

Outcomes	Conservative Treatment		Locking Compression Plate	
	Number (n)	Percentage (%)	Number (n)	Percentage (%)
Excellent	4	16	9	36
Good	10	40	7	28
Satisfactory	5	20	5	20
Fair	2	8	4	16
Poor	4	16	0	0

The rate of complications were recorded in the study in the conservative treatment group cosmetic bulge was the most common complication seen in n=10(40%) of cases and non-union was n=3(12%) and malunion was n=2(8%) cases and in the LCP the hypertrophic scar was seen in n=3(12%), n=2(8%) were the cases of palpable implant and n=1(4%) each has been seen of superficial infection and brachial plexus symptoms.

Table-6: Complication of the treatment in two different groups

Complications	Conservative		Locking Compression Plate	
	Number (n)	Percentage (%)	Number (n)	Percentage (%)
Non Union	3	12	0	0
Mal union	2	8	0	0
Cosmetic bulge	10	40	0	0
Palpable implant	0	0	2	8
Implant failure	0	0	0	0
Superficial infection	0	0	1	4
Hypertrophic scar	0	0	3	12
Brachial plexus symptoms	0	0	1	4

DISCUSSION

Historically the clavicle fractures have been treated conservatively. However, several studies have shown poor results after treatment of displaced middle third clavicle fractures [6-8]. Neer and Rowe had a non-union rate of 0.1% and 0.8% and thus they advocated conservative treatment as the standard of care [14, 15]. Zlowodzky *et al*. have found that the non-union rates after conservatively treated fractures are higher than claimed earlier [16]. In the present study, we found the rate of non-union following conservative treatment to be 12% and mal union to be 8%. There are several factors that affect the outcome of conservative treatments it includes female patients, patients with severe displacement, and age of the patients. In this study we found the mechanism of injury was due to road traffic accidents 78%, it has been seen that the common cause of unilateral injuries of the clavicle is due to direct trauma to the clavicle or fall on the outstretched hand. 60% of cases of our study were having clavicular fractures on the right side and 40% cases were on the left side. There is a preponderance of dominant hand side in the fractures of clavicle as reported by other studies [17, 18]. Our study found the mean time of radiological union in the conservative group was 21 weeks and the mean time for the radiological union after LCP was 15 weeks. In a similar study by Shobha H *et al*. found the meantime for radiological union in the Group A conservative group was 23 weeks and the mean time for the Group B Plate osteosynthesis was 14 weeks our results are comparable to the results of Shobha H *et al*. [4] Although the type of fracture is important for selecting the methods of management of clavicular fractures there are other factors which must also be taken into consideration during the treatment. As the patients of today cannot afford to be immobilized for a longer duration due to economic or other factors the fractures of the clavicle with primary fixation is now be considered due to faster healing and better functional outcomes [6-8]. The main objective of surgical treatment is also to achieve anatomical reduction and reconstruction of the clavicular length and alignment of the shoulder girdle. It is also necessary to prevent stress on the implant, therefore, pre-contoured plates the plates are placed superiorly and three screws applied medially and three screws laterally they are the preferred as they involve locking between screw and plate and since there is a minimal contact between the plate and cortical bone there is minimal risk of injury to blood supply also it promote rapid union [19]. With the same reasons, we in the present study used 3.5mm pre-contoured anatomical

LCP. We in the present study the LCP results were superior to the conservative treatment group based on Constant Murley scores. The average constant Murley scores at all the stages of follow up in the conservative group were 76.35 ± 5.27 and in the LCP the mean scores were 31.6 ± 3.77 (table 4). The DASH scores in the conservative group were 8.1 ± 3.33 and in LCP it was 4.2 ± 3.2. Shobha H *et al*. [4] have also found similar results with better scores in the locking compression plate group as compared to the conservative group. In this study we found cosmetic bulge was the most common complication seen in n=10(40%) of cases and non-union was n=3(12%) and malunion was n=2(8%) cases of the conservative group and in the LCP the hypertrophic scar was seen in n=3(12%), n=2(8%) were the cases of palpable implant and n=1(4%) each has been seen of superficial infection and brachial plexus symptoms. Kulshrestha *et al*. found nonunion in 2(4%) of cases of patients treated with conservative management [11]. In the operative group, they found superficial infection in 4(9%) of patients, brachial plexus symptoms in 8(13%) of the patients.

CONCLUSION

Within the limitations of the present study, it can be concluded that primary fixation with a locking compression plate leads to better results and predictable outcomes. This allows the patients to return to function early and also decreases the high rates of complication associated with conservative management. However, patient factors, type of fracture, and costs of treatment must be kept in mind for choosing the best treatment option for the particular patient.

REFERENCES

1. Jupiter JB, Leffert RD. Non-union of the clavicle. Associated complications and surgical management. J Bone Joint Surg Am. 1987;69(5):753-60.
2. Nowak J, Mallmin H, Larsson S. The aetiology and epidemiology of clavicular fractures: a prospective study during a two-year period in Uppsala, Sweden. Injury. 2000 Jun 1;31(5):353-8.
3. Robinson CM, Cairns DA. Primary nonoperative treatment of displaced lateral fractures of the clavicle. JBJS. 2004 Apr 1;86(4):778-82.
4. Shobha HP, Syed Wahaj, Neelangowda Patil, Bellad SH. Antero superior plate osteosynthesis versus conservative treatment for diaphyseal clavicle fractures: A prospective comparative study. International Journal of Orthopaedics Sciences. 2018; 4(2): 116-121.
5. Neer CS. 2nd Nonunion of the clavicle. J Am Med Assoc. 1960; 172:1006-11.
6. Hill JM, Mcguire MH, Crosby LA. Closed treatment of displaced middle-third fractures of the clavicle gives poor results. The Journal of bone and joint surgery. British volume. 1997 Jul;79(4):537-8.
7. Nordqvist A, Petersson CJ, Redlund-Johnell I. Mid-clavicle fractures in adults: end result study after conservative treatment. Journal of orthopaedic trauma. 1998 Nov 1;12(8):572-6.
8. Robinson CM, McQueen MM, Wakefield AE. Estimating the risk of nonunion following nonoperative treatment of a clavicular fracture. JBJS. 2004 Jul 1;86(7):1359-65.
9. Shen WJ, Liu TJ, Shen YS. Plate fixation of fresh displaced midshaft clavicle fractures. Injury. 1999; 30(7):497.
10. Canadian OT. Nonoperative treatment compared with plate fixation of displaced midshaft clavicular fractures. A multicenter randomized clinical trial. The Journal of bone and joint surgery. American volume. 2007 Jan;89(1):1.
11. Kulshrestha V, Roy T, Audige L. Operative versus nonoperative management of displaced midshaft clavicle fractures: a prospective cohort study. Journal of orthopaedic trauma. 2011 Jan 1;25(1):31-8.
12. Stegeman SA, de Jong M, Sier CF, Krijnen P, Duijff JW, van Thiel TP, de Rijcke PA, Soesman NM, Hagenaars T, Boekhoudt FD, de Vries MR. Displaced midshaft fractures of the clavicle: non-operative treatment versus plate fixation (Sleutel-TRIAL). A multicentre randomised controlled trial. BMC musculoskeletal disorders. 2011 Dec;12(1):196.
13. T Agarwal, H Bhugra, S Jadhav, K Saurav, A Bhugra. Operative treatment of mid-shaft clavicle fracture by locking plate. Indian Journal of Orthopaedics Surgery. 2017;3(4):356-359.
14. Jesse JA, Jupiter B. Fractures of the. Disorders of the Shoulder: Diagnosis & Management. 2007;1:943.
15. Rowe CR. 4 An Atlas of Anatomy and Treatment of Midclavicular Fractures. Clinical Orthopaedics and Related Research®. 1968 May 1;58:29-42.
16. Zlowodzki M, Zelle BA, Cole PA, Jeray K, McKee MD. Treatment of acute midshaft clavicle fractures: systematic review of 2144 fractures: on behalf of the Evidence-Based Orthopaedic Trauma Working Group. Journal of orthopaedic trauma. 2005 Aug 1;19(7):504-7.
17. Stanley D, Trowbridge EA, Norris SH. The mechanism of clavicular fracture. A clinical and biomechanical analysis. The Journal of bone and joint surgery. British volume. 1988 May;70(3):461-4.
18. Sankarankutty M, Turner BW. Fractures of the clavicle. Injury. 1975 Nov 1;7(2):101-6.
19. Hathiwale MI, Sasnur PA, Tapadar MJI. A prospective study on operative management of displaced fracture of midshaft of clavicle. Int J Res Orthop. 2017;3:619-22.