

# A PROSPECTIVE STUDY OF CLINICAL AND FUNCTIONAL OUTCOME OF CLAVICLE FRACTURE TREATED WITH LOCKING PLATES IN ADULTS

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## ABSTRACT

### BACKGROUND

Fracture of clavicle accounts for approximately 5%-10% of all fractures. In adults, about 70% of clavicle fractures involve middle third part of the clavicle. Clavicle fractures are more common in young age group. Surgery is accepted more and more as primary treatment for dislocated mid shaft clavicle fractures as studies have shown that operative treatment results in lower rate of fracture non-union, symptomatic mal-union than conservative management. Incidence of high energy clavicle fracture is increasing and may contribute to these findings because, increased initial fracture displacement, shortening, comminution have been predictive of non-union and poor patient outcome with non-operative care. Open reduction & locking compression plating thus may be better options for displaced mid clavicle fracture.

The objective of the study is to evaluate the role of open reduction and internal fixation and to evaluate clinical and functional outcome of fracture of the clavicle treated with pre-contoured clavicular anatomical locking plates in adults with six month follow up using 'Disabilities of the Arm, Shoulder and Hand Score'.

### MATERIALS AND METHODS

The study was carried out during the period of June 2015 to June 2017 in the Department of Orthopedics, Inlaks and Budhrani Hospital, Pune, (MH). Study includes 30 cases of clavicle fracture in the population aged between 18 years to 60 years, irrespective of sex, with fracture midshaft of clavicle (amenable to open reduction, internal fixation with LCP with minimum of three screw in medial and lateral fragment). The clinical and radiological outcome was evaluated using DASH score and plain radiograph. Union was evaluated clinically and radiographically. Complications were recorded.

### RESULTS

Highest number of patients were seen mainly in the age group of 21-40 years. 19 patients (63.3%) achieved radiological union in 12 weeks. Other 11 patients (36%) achieved union by the end of 18 weeks. 4 patients (13%) had plate prominence. Restriction of shoulder movement was seen in 3 patients (10%). None of the patients had neurovascular compromise. 83.3% of study subjects showed excellent outcome.

### CONCLUSION

This study showed clinically and radiologically satisfactory results. Overall operative treatment with locking compression plates can be used to obtain stable fixation and excellent outcome.

### KEYWORDS

Clavicle Fractures, Comminuted, Displaced, Locking Compression Plates.

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### BACKGROUND

Clavicle is the bony link from thorax to shoulder girdle and contributes to movements at shoulder girdle.<sup>1</sup> Clavicle fracture is a common traumatic injury around shoulder girdle due to their subcutaneous position.<sup>1</sup> It is caused by

either low-energy or high-energy impact.<sup>2</sup> The traditional view that most of the clavicular fractures heal with good functional outcomes following non-operative treatment is no longer valid. Recent studies have showed a higher rate of non-union and shoulder dysfunction in subgroups of patients with clavicle fractures.<sup>2</sup> Because of this, these fractures should therefore be considered as a spectrum of injuries with various functional outcomes, each requiring cautious assessment and individualized care.<sup>3</sup> Fracture of the clavicle is common, accounting for 5 to 10% of all fractures.<sup>1</sup> About 70 to 75% of these fractures are in the middle third of the bone,<sup>1</sup> where the typical compressive forces applied to the shoulder and the narrow cross section of the bone combines and result in bony failure.

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Displaced mid shaft clavicle fractures are common and are generally treated non-operatively. Non-operative treatment of these fractures with axial shortening is associated with non-union, delayed union, and mal union.<sup>1-3</sup> Other complications are severe pain, neurological complications, loss of shoulder function and protuberant callus forming swelling and stretching of skin which is cosmetically unacceptable.<sup>4-7</sup> The proponents of early fixation of fresh clavicular fractures to prevent complications like mal union and non-union emphasize the value of accurate reduction and rigid fixation in affording quick pain relief and promoting early functional recovery.<sup>4-8</sup>

Persons with high activity level will hesitate to accept prolonged recovery and impaired shoulder function, therefore may require more aggressive treatment of middle third clavicle fractures.<sup>9-11</sup> Prompt fixation of these clavicle fractures permits increased patient comfort, and early shoulder mobility.<sup>12-14</sup> In cases of associated scapula fractures, fixation of the clavicle provides restoration of shoulder mechanics leading to improvement of function.<sup>4,12</sup> Operative treatment of displaced mid shaft clavicular fractures can be achieved successfully using plates or intra-medullary implants like rush pins, Kushner wires or nails.<sup>14-16</sup> Open reduction and internal fixation with plating provides rigid fixation, early functional recovery and low rates of non-union, mal union.<sup>17-20</sup> The purpose of the study was to prospectively analyse the functional outcome of mid third displaced clavicular fractures treated by open reduction and internal fixation with pre-contoured anatomical clavicular plate osteosynthesis.

### Aims and Objectives

To study clinical and functional outcome of fracture mid shaft of clavicle treated with pre-contoured anatomical locking compression plates in adults with 6 months follow up using Disability of the Arm, Shoulder and Hand score (DASH score).

### MATERIALS AND METHODS

A prospective study was done at Department of orthopaedics, Inlaks and Budhrani Hospital, Pune, Maharashtra from June 2015- June 2017. In this study 30 patient with mid shaft clavicle fracture, irrespective of sex, from age group between 18-60 years were chosen by purposive sampling technique and were treated with pre-contoured anatomical locking compression plate. The clinical and radiological results were evaluated according to DASH scoring and plain radiographs. Union was evaluated clinically and radio graphically. Complications were recorded. Functional assessment was conducted at 4 weeks, 12 weeks, and 24 weeks.

History was noted with name, age, sex, occupation with mechanism of injury like fall on outstretched hand, direct injury to shoulder, road traffic accident. Clinical examination (both local and systemic) was done. On inspection the following points were noted, patients with fracture clavicle often support the flexed elbow of the injured side with the other hand. Abnormal swellings,

tenderness, present in the middle third for middle third clavicle fracture and in the lateral third for lateral third clavicle fracture were looked for. The condition of the skin over the clavicle was noted for any abrasion, laceration and contusion. On palpation the following points were noted palpation of the entire length of the affected clavicle for tenderness in the medial middle third or in the lateral third fracture. The clavicle was also palpated for any abnormal mobility and crepitus. If movement of the affected side shoulder was restricted due to pain, distal neurovascular status of the affected upper limb was examined and also the associated injuries along with fractured clavicle were noted.

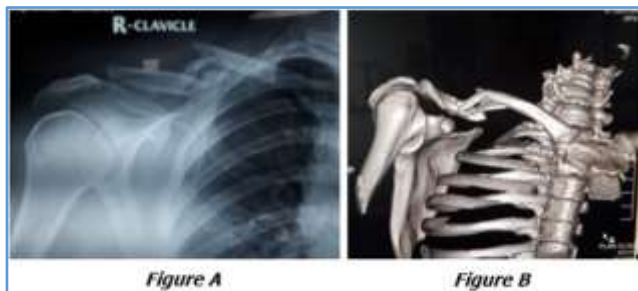
Routine investigation including complete blood count, Blood urea, Serum creatinine and ECG were done. HIV, HBsAg screening tests were done before surgery on all Subjects. Fracture anatomy was assessed with X-rays. Diagnosis was done after clinical and radiological assessment. Written informed consent was taken for surgical procedure. All patients were operated as early as possible once the patient was declared fit for the surgery by the physician. All cases were operated by experienced senior consultant orthopaedic surgeon.

An inclusion criterion was adult male or female patient above 18 years of age with mid-clavicle fracture which require open reduction internal fixation were included. Patients with age less than 18 years of age or more than 60 years of age, pathological fracture, who lost follow up, fracture in proximal or distal one third fracture of clavicle, old clavicle fracture, associated acromioclavicular dislocation, any medical condition contraindication for surgery were excluded.

Post operatively patients were kept nil orally for 4 to 6 hours post-operatively. Intravenous fluids were given as needed. Antibiotics were continued for 7 days. Adequate analgesia was given as per need and tolerability of patient. Post op x-ray was done to note the fixation findings and alignment of fragments. Arm pouch was given to immobilize. The wound was inspected at 2<sup>nd</sup> or 4<sup>th</sup> postoperative day. Suture/staple removal was done on 21<sup>st</sup> postoperative day. Patients were discharged with the arm pouch. Rehabilitation of the affected arm was started at the end of 3 weeks. Abduction upto 80 degree with range of movement exercises was started in 4-6 weeks. Complete range of motion was started after 8 weeks. Follow up was done at 6, 12 and 24 weeks. X ray was done in each post op visit and progression of union was noted, as well clinical examination was done on operated side for any sign of infection, tenderness or deformity. Follow up done up to 6 months. Physiotherapy of affected extremity was done during follow up as per stage of fracture union. Evaluation of outcome was done using DASH score.<sup>21</sup>

Statistical analysis was done using descriptive and inferential method. Continuous variables were measure and presented as Mean, SD and Categorical measurements were presented in number (%). Significance is assessed at 5% level of significance. Dependent variables should be normally distributed.

For continuous scale parameters between two groups two tailed independent Student 'T' test was used. For categorical scale parameter between two or more groups chi-square/fisher exact test was used to find significance of the study. For qualitative data analysis nonparametric setting was use. To generate tables, graphs, Microsoft word and excel was use. Data collected was entered in Microsoft excel and analysed in Epi Info 3.4.3, SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and for the data analysis Environment Ver 2.11.1 was used.



**Figure A) Preop Image of Right Clavicle Mid-Shaft Fracture. B) CT Scan with 3D Reconstruction of Right Clavicle**



**Figure C) Intraop Incision with Preoperative Bony Landmark Markings. D) Precontoured Clavicular Plates Markings**



**Figure E) Intraop Precontoured Clavicular Plate being Fixed. F) Immediate Postop X-Ray with Clavicular Plate Fixation**



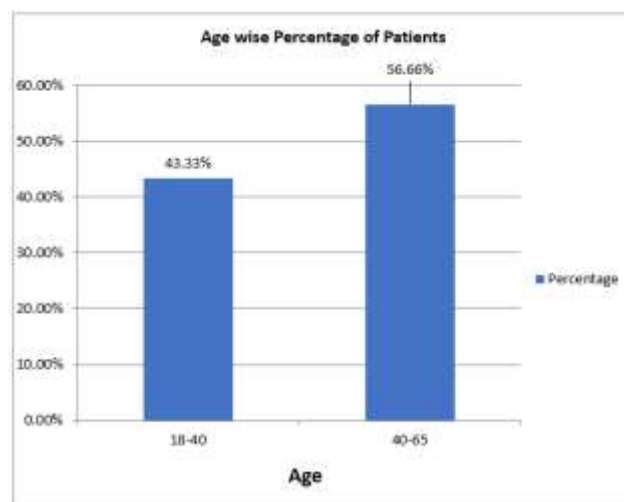
**Figure G & H) Postop 6 weeks Range of Movement at Shoulder Joint**



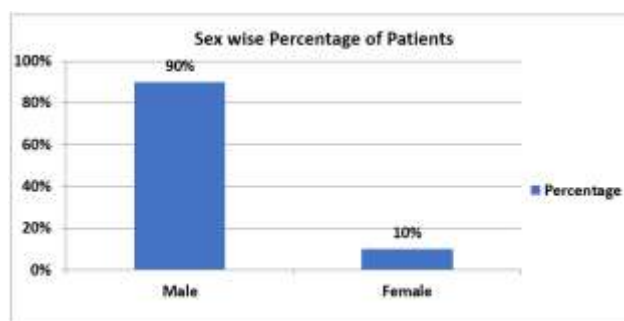
**Figure I. Postop 6-week X-Ray Right Clavicle with Stable Fixation and Sign**

## RESULTS

In a study of 30 cases of clavicle fractures treated with locking compression plate. In this study we have included patients ranging from the age of 18-60. Among them we had the highest number of patients in the age group of 18-40 years (43.3%). The mean age was 36 years with the standard deviation being six (Graph 1).



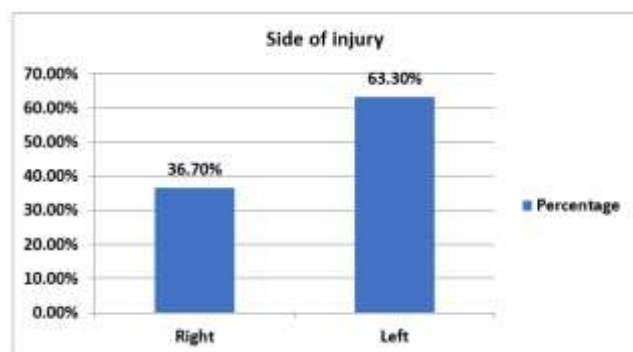
**Graph 1. Age Wise Percentage of Patients**



**Graph 2. Sex Wise Percentage of Patients**

Among 30 patients, 27 (90%) were males and 3 (10%) were females (Graph 2).

Mode of injury was Road traffic accident and fall constituted 50% each. With left sided fracture was noted in 19 patients (63.3%) whereas 11 patients (36.7%) had clavicular fractures on the right side (Graph 3).



**Graph 3. Side of Injury**

66.7% of the subjects had 1-2 days' time interval between trauma and surgery with mean time of 4 days and standard deviation of 4.10% of the patient had hospital stay of 1- 3 days. 70% had a stay of 4-6 days, 18% stayed for 7-10 days, 2% were admitted for 11-16 days. Mean hospital stay was of 7 days with standard deviation of 5 days. 19 patients (63.3%) achieved radiological union in 12 weeks. Other 11 patients (36%) achieved union by the end of 18 weeks (Graph 4). 4 patients (13%) had plate prominence. Restriction of shoulder movement was note in 3 patients (10%). None of the patient had neurovascular compromise, plate breakage, or infection. 83.3% of study subjects showed excellent outcome.



**Graph 4. Radiological Union**

## DISCUSSION

In 2007 Canadian Orthopaedic Trauma Society conducted a multicenter, randomized clinical trial to compare patient-oriented outcome and complication rates following non-operative treatment and those after plate fixation of displaced mid shaft clavicle fracture. In the trial 132 patients with displace mid shaft clavicle fracture were randomized to either operative treatment with plate fixation or non-operative treatment with sling. Constant shoulder score, DASH (disability of arm, shoulder and hand), standard clinical follow-up and radiograph were used for outcome analysis. The trial showed operative fixation of displaced clavicular fracture results in improved functional outcome and decreased rate of malunion and non-union compared with non-operative treatment after 1 year follow up.<sup>10</sup> Wun-Jer Shen M.D. et al, operated on 251 fresh completely displaced mid-third clavicle fractures in

adult. The fractures were plated with a Mizuho C-type plate or an AO/ASIF 3.5 mm reconstruction plates .mean time for radiographic union completely displaced mid-clavicle fracture plating is a reliable procedure.<sup>12</sup> Partal et al and Favre et al reported other biomechanical studies showing that anteroinferior plating led to a more stable construct in bending rigidity and induced deformation modes similar to the intact clavicle and concluded that anteroinferior plating would be less likely to fail during normal physiological loading.<sup>13</sup>

## CONCLUSION

Anatomical reduction with reconstruction of clavicular length and alignment of shoulder girdle which is the goal of surgical treatment can be attained with LCP osteosynthesis of the clavicle. Strong fixation due to locking between the screw and plate, blood supply preservation due to minimal contact, fixation which can be achieved without tip of screw reaching the opposite bone cortex, potentially reduces the risks of injury to the subclavian artery and brachial plexus and hence the plates are precontoured and do not require any contouring. It reduces surgical time and makes this a more desirable option. The functional outcome as assessed by DASH scoring of clavicular fractured treated in our study with open reduction and internal fixation with LCP, showed that 83.3% of the study subjects as having excellent outcome. All the study subjects attained early mobilization.

So, the present study recommends that operative management of clavicular fracture by LCP as a superior treatment modality.

## REFERENCES

- [1] Neer CS. Fractures of the clavicle. In: Rockwood CA, Green DP, eds. Philadelphia: JB Lippincott 1984:707-713.
- [2] Cho CH, Song KS, Min BW, et al. Operative treatment of clavicle mid-shaft fracture: comparison between reconstruction plate and reconstruction locking compression plate. Clin Orthop Surg 2010;2(3):154-159.
- [3] Jiang H, Qu W. Operative treatment of clavicle midshaft fractures using a locking compression plate: comparison between mini-invasive plate osteosynthesis (MIPPO) technique and conventional open reduction. Orthop Traumatol Surg Res 2012;98(6):666-671.
- [4] Iannotti MR, Crosby LA, Stafford P, et al. Effects of plate location and selection on the stability of midshaft clavicle osteotomies: a biomechanical study. J Shoulder Elbow Surg 2002;11(5):457-462.
- [5] Chen CE, Juhn RJ, Ko JY. Anterior-inferior plating of middle-third fractures of the clavicle. Arch Orthop Trauma Surg 2010;130(4):507-511.
- [6] Huh J, Posner MA, Bear RR, et al. Performance of military tasks after clavicle plating. Mil Med 2011;176(8):950-955.

- [7] Kulshrestha V. Primary plating of displaced mid-shaft clavicular fractures. *Med J Armed Forces India* 2008;64(3):208-211.
- [8] Collinge C, Devinney S, DiPasquale T, et al. Anterior-inferior plate fixation of middle-third fractures and nonunions of the clavicle. *J Orthop Trauma* 2006;20(10):680-686.
- [9] Drosdowech DS, Manwell SE, Ferreira LM, et al. Biomechanical analysis of fixation of middle third fractures of clavicle. *J Orthop Trauma* 2011;25(1):39-43.
- [10] Canadian Orthopaedic Trauma Society. Non-operative treatment compared with plate fixation of displaced midshaft clavicular fractures. A multicenter randomized clinical trial. *J Bone Joint Surg Am* 2007;89(1):1-10.
- [11] Huang JI, Toogood P, Chen MR, et al. Clavicular anatomy and the applicability of precontoured plates. *J Bone Joint Surg Am* 2007;89(10):2260-2265.
- [12] Shen WJ, Liu TJ, Shen YS. Plate fixation of fresh displaced midshaft clavicle fractures. *Injury* 1999;30(7):497-500.
- [13] Partal G, Meyers KN, Sama N, et al. Superior versus anteroinferior plating of the clavicle revisited: a mechanical study. *J Orthop Trauma* 2010;24(7):420-425.
- [14] Smith CA, Rudd J, Crosby LA. Results of operative versus non-operative treatment for 100% displaced mid-shaft clavicle fracture. Proceeding from the 16<sup>th</sup> Annual Open Meeting of the American Shoulder and Elbow Surgeons. San Francisco, CA, March 8, 2000: p. 41.
- [15] Poigenfurst J, Rappold G, Fischer W. Plating of fresh clavicular fractures: results of 122 operations. *Injury* 1992;23(4):237-241.
- [16] Demirhan M, Bilsel K, Atalar AC, et al. Biomechanical comparison of fixation techniques in midshaft clavicular fractures. *J Orthop Trauma* 2011;25(5):272-278.
- [17] Kloen P, Sorkin AT, Rubel IF, et al. Anteroinferior plating of midshaft clavicular nonunions. *J Orthop Trauma* 2002;16(6):425-430.
- [18] Modi N, Patel AD, Hallam P. Outcome of 62 clavicle fracture fixations with locked compression plate: is this the right way to go? *Injury* 2011;42(9):118-118.
- [19] van der Meijden OA, Gaskill TR, Millett PJ. Treatment of clavicle fractures: current concepts review. *J Shoulder Elbow Surg* 2012;21(3):423-429.
- [20] Celestre P, Roberston C, Mahar A, et al. Biomechanical evaluation of clavicle fracture plating techniques: does a locking plate provide improved stability? *J Orthop Trauma* 2008;22(4):241-247.
- [21] Gummeson C, Atroshi I, Ekdahl C. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: longitudinal construct validity and measuring self-rated health change after surgery. *BMC Musculoskelet Disord* 2003;4:11.