

Treatment of displaced midshaft clavicular fractures: A comparison between smooth pin and LCDCP and reconstruction plate fixation

Saeid Tabatabaei¹, Sharareh Shalamzari²

ABSTRACT

Objectives: To compare the results of internal fixation of the clavicular fractures by pin and LCDCP and reconstruction plates in displaced fractures of middle third.

Methodology: Between April 2008 to December 2010 a total of 68 clavicular fractures were treated in Razi hospital of Jundishapur University of Medical Sciences in Ahvaz, Iran and the results of the operations were investigated and reviewed according to DASH score (Iranian version) and Oxford Shoulder score. Comparison of the results performed using K and Fisher exact tests and the data analyzed by SPSS software and the values less than 0.01 considered as a significant difference.

Results: Eighteen patients were excluded because 11 patients did not return for follow up and seven patients had other fractures in extremities that could interfere with the results and at the end of the study 50 patients completed the follow up program. There were 42 male and 8 female patients with mean age of 28 years (18-48 years), pin group had 25 and plate group also had 25 members. There were not any significant differences in the union time, malunion, infection and DASH and Oxford shoulder scores. Significant differences were seen between the operation time and bleeding that both were lesser in pin group. Eight patients in plate group complained of symptomatic hardware compared with pin group (no symptomatic hardware) with P value = 0.001.

Conclusion: Although both the procedures have been used in clavicular fractures with high rates of success, but pin fixation has lesser morbidity and complications if it is used by experienced surgeons with close observation.

KEY WORDS: Clavicular fractures, Smooth pin, LCDCP fixation, DASH score, Oxford shoulder score.

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INTRODUCTION

Clavicular fractures consist of 2.6 to 5% of all body fractures and 35-45% of all shoulder girdle injuries.¹ Middle third fractures consist of up to 85% of these fractures.² The results of nonoperative treatment of the middle third clavicular fractures are disappointing. 3-5 Malunion and nonunion are the complications of nonoperative treatment of displaced middle third clavicular fractures and the rate of nonunion is up to 20%.^{6,7}

The operative treatment must be reserved for healthy and active patients who can benefit from stable and secure fixation and earlier return of function.⁸ Although there is not any absolute indication in operative treatment of the clavicular fractures, relative indications for operative treatment include: painful nonunion, multiple trauma, open fractures, severe malposition and tenting the skin, neurovascular injuries, and persistent separation of the fracture with a gap of more than half of the diameter of the clavicle.⁹ Other indications are more than 2cm of shortening or displacement, comminution, segmental fractures, winging of scapula in initial examination, vascular injury, progressive neurological deficit, ipsilateral fracture in same extremity, bilateral clavicular fractures, and multiple trauma patients.¹⁰⁻¹²

Although plate fixation has been used largely for treatment of the displaced clavicular fractures¹³, other forms of less invasive methods has also been used with acceptable results.^{14,15}

The purpose of this prospective observational study was comparing the results of fixation of the displaced midshaft clavicular fractures by smooth 3.5 mm pin and 3.5 mm LCDCP and reconstruction plates.

METHODOLOGY

From April 2008 until December 2010 a total of 68 patients with clavicular fractures were treated using smooth 3.5 mm pins or 3.5 mm LCDCP (Limited Contact Dynamic Compression Plate) intermittently. We used reconstruction and LCDCP plates because of limited contact with bone and fewer chance of osteoporosis under plate. We operated the first patient with pin and the other with plate and continued the operations in the same manner. Eleven patients were lost to follow up and in seven patients there were other musculoskeletal trauma and thus 18 patients were excluded and 50 patients completed the follow up program.

There were 42 male and 8 female patients. The age of the patients was between 18 to 60 years (mean age 28 years). Before the operation a questionnaire consisting of age, sex, side of the fracture, dominant hand, mechanism of the fracture, type of the fracture according to AO classification, accompanying injuries, and the time between injury and operation was completed by the responsible physician.

The patients had only middle 1/3 clavicular fracture with more than 2 cm of displacement or shortening without any other musculoskeletal or neurological injury and the most common mechanism of

the injury was vehicular accident (38%). We used the superior portion of the Thompson-Henry anteromedial approach of the shoulder and extended the incision to the medial to expose the fracture site in all of the patients.¹⁶

After the operation, the velpeau bandage was applied in all patients and the length of the operation, amount of bleeding and the type of the fixation device added to the questionnaire.

The patients were followed up until complete union (Fig.1) and the mean time of follow up was about 14 months. The criteria of union was the absence of motion and tenderness at the fracture site and disappearance of the fracture line in Roentgenogram. In pin group there were 25 patients with the mean age of 29 years and in plate group there were 25 patients with mean age of 27.3 years.

The postoperative protocol was velpeau bandage for a few days and then sling and early pendulum exercise. We visited the patients 2, 4, and 6 weeks after operation and after 6 months. Anteroposterior roentgenogram was performed for the patients

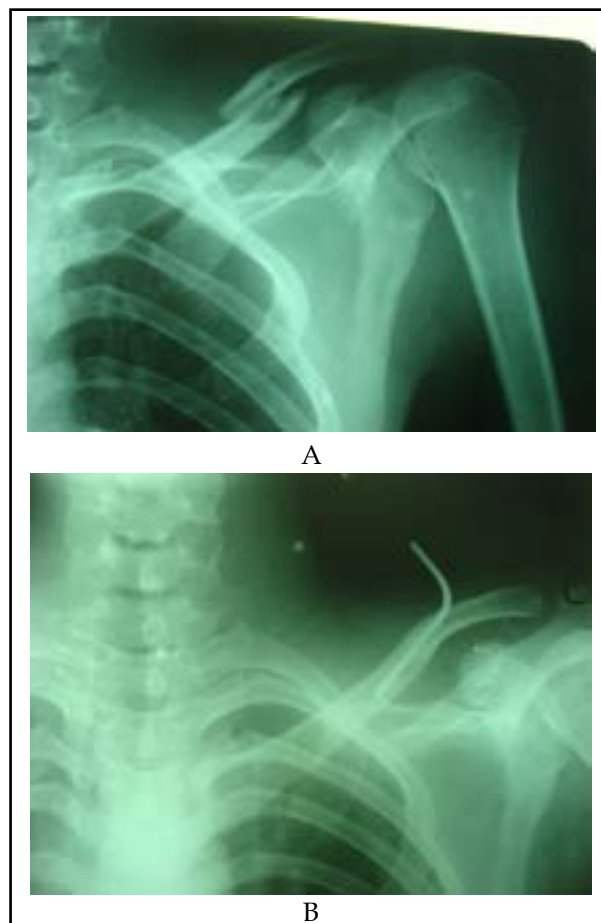


Fig-1: A patient with clavicular fracture before fixation by smooth pin (A) and after union (B).

Table-I: Oxford Shoulder Score.

| | | | | | |
|-----|---|-------------------------|--------------------------|------------------------|-------------------|
| 1. | How would you describe the worst pain you had from your shoulder? | | | | |
| | Unbearable | Severe | Moderate | Mild | No |
| 2. | How would you describe the pain you usually get from your shoulder? | | | | |
| | Unbearable | Severe | Moderate | Mild | None |
| 3. | How much has the pain from your shoulder interfered with your usual work (including housework)? | | | | |
| | Totally | Greatly | Moderately | A little bit | Not at all |
| 4. | Have you been troubled by pain in your shoulder in bed at night? | | | | |
| | Every night | Most nights | Some nights | Only 1 or 2 | No nights |
| 5. | Have you had any trouble dressing yourself because of your shoulder? | | | | |
| | Impossible to do | Extreme difficulty | moderate trouble | Very little trouble | No trouble at all |
| 6. | Have you had any trouble getting in and out of a car or using public transport because of your shoulder? (Whichever you tend to use) | | | | |
| | Impossible to do | Extreme difficulty | moderate trouble | Very little trouble | No trouble at all |
| 7. | Have you been able to use a knife and fork at the same time? | | | | |
| | No. Impossible | With extreme difficulty | With moderate difficulty | With little difficulty | Yes, easily |
| 8. | Could you do the household shopping on your own? | | | | |
| | No. Impossible | With extreme difficulty | With moderate difficulty | With little difficulty | Yes, easily |
| 9. | Could you carry a tray containing a plate of food across a room? | | | | |
| | No. impossible | With extreme difficulty | With moderate difficulty | With little difficulty | Yes, easily |
| 10. | Could you brush/comb your hair with the affected arm? | | | | |
| | No. Impossible | With extreme difficulty | With moderate difficulty | With little difficulty | Yes, easily |
| 11. | Could you hang your clothes up in a wardrobe, using the affected arm? | | | | |
| | No. Impossible | With extreme difficulty | With moderate difficulty | With little difficulty | Yes, easily |
| 12. | Have you been able to wash and dry yourself under both arms? | | | | |
| | No. Impossible | With extreme difficulty | With moderate difficulty | With little difficulty | Yes, easily |

in each visit. In the 6th week, the Roentgenogram was sought for signs of union and if there was radiological union, the patient was allowed to perform restricted exercise. The patients were instructed not to perform contact sports until 12th week after operation.

The mean follow up time was six months for all of the patients. The functional results of the operation were reviewed according to DASH¹⁷ and Oxford shoulder scores (Table-I). DASH score is a questionnaire about symptoms of the patients like pain and weakness and also their abilities in doing some daily living activities like turning key, pushing heavy doors, carrying heavy objects, hair washing, wearing shirts, etc (20 different activities). Each activity has five scores from one (without difficulty) to five (not able to do) hence the point 100 is the maximum and 20 is the minimum score and the lower the score better the results.

In Oxford Shoulder score, also the patients were asked about having pain and discomfort in daily living activities dressing, using knife and fork,

shopping, carrying a tray, brushing and so on (12 questions). The difficulty and pain of these activities is divided into five grades from very difficult to very easy (1 to 5). Thus in this score the best result is 60 and the worst is 12.

The results of the operation were analyzed using K and Fisher exact tests and the data analyzed by SPSS software and the P values of less than 0.01 considered as a significant difference.

RESULTS

Mean time of operation was 65 minutes in plate and 42 minutes in pin group (P= 0.001) and in plated patients there was a longer incision. The amount of bleeding in plate group was 98 cc and in pin group was 47 cc. (P= 0.001)

Mean union time was 10 weeks in both groups (8-14 weeks). There was only one asymptomatic nonunion in plate group thus we had 100% union rate in pin and 96% in plate group. Three patients had malunion (two patients in pin and one patient in plate group) with P value of 0.31.



Fig-2: Skin breakdown in plate fixation.

Two patients in pin and one patient in plate group had infection in operation site that recovered with antibiotic therapy and hardware removal ($P= 1$). Three patients in pin group had pin track infection necessitating antibiotic therapy and irrigation. Eight patients in plate group complained of skin breakdown (Fig.2) and symptomatic hardware compared with no patients in pin group. ($P= 0.001$) For the patients with skin breakdown and infection,

antibiotic therapy was performed until complete union and then the patients had hardware removal. All the patients in two groups completed the questionnaire for DASH and Oxford shoulder scores. In pin patients the mean DASH score was 40 and the mean Oxford score was 45 and in plate patients the mean scores were 38 and 43 respectively without any significant difference. The demographic characteristics of the patients of pinned and plated patients are shown in Tables II and III respectively.

DISCUSSION

Due to difficulties of nonoperative treatment including pain and instability in fracture site, tightness of 8 bandage resulting in venous stasis, difficulties in self hygiene, and high percentage of nonunion especially in high energy fractures, operative treatment is a good option in midshaft clavicular fractures.¹⁸ Our study compares the results of load sharing with load shielding fixation devices and thus we include the results of threaded and smooth pins and compared the results with plating techniques.

Table-II: Demographic characteristics of Pin patients

| Age(year) | Gender | Side | Operation time (min) | Bleeding (CC) | Union time(week) | DASH score | Oxford score |
|-----------|--------|------|----------------------|---------------|------------------|------------|--------------|
| 22 | F | L | 35 | 45 | 10 | 40 | 45 |
| 38 | F | R | 45 | 50 | 8 | 42 | 50 |
| 48 | F | L | 40 | 45 | 8 | 35 | 55 |
| 32 | F | R | 45 | 45 | 10 | 37 | 40 |
| 21 | M | R | 40 | 50 | 10 | 35 | 45 |
| 18 | M | L | 40 | 55 | 12 | 44 | 40 |
| 40 | M | R | 40 | 45 | 10 | 38 | 44 |
| 27 | M | L | 45 | 50 | 10 | 40 | 42 |
| 47 | M | L | 45 | 50 | 10 | 32 | 44 |
| 22 | M | L | 40 | 45 | 10 | 36 | 46 |
| 34 | M | L | 40 | 55 | 10 | 38 | 44 |
| 28 | M | R | 45 | 50 | 8 | 44 | 45 |
| 18 | M | R | 40 | 50 | 10 | 43 | 48 |
| 21 | M | R | 40 | 45 | 8 | 47 | 40 |
| 20 | M | L | 45 | 45 | 12 | 40 | 38 |
| 41 | M | R | 40 | 40 | 10 | 36 | 42 |
| 18 | M | R | 45 | 40 | 10 | 48 | 40 |
| 46 | M | L | 45 | 55 | 12 | 34 | 46 |
| 31 | M | R | 45 | 50 | 10 | 42 | 48 |
| 25 | M | R | 40 | 50 | 10 | 38 | 50 |
| 25 | M | L | 45 | 50 | 8 | 42 | 45 |
| 20 | M | L | 45 | 40 | 8 | 36 | 45 |
| 21 | M | L | 40 | 45 | 10 | 42 | 40 |
| 19 | M | R | 40 | 40 | 14 | 44 | 45 |
| 22 | M | R | 45 | 45 | 10 | 38 | 45 |

Table-III: Demographic characteristics of plate patients

| Age(year) | Gender | Side | Operation time (min) | Bleeding (CC) | Union time(week) | DASH score | Oxford score |
|-----------|--------|------|----------------------|---------------|------------------|------------|--------------|
| 28 | M | R | 60 | 100 | 10 | 40 | 45 |
| 32 | F | R | 65 | 90 | 10 | 42 | 38 |
| 25 | F | R | 65 | 110 | 8 | 43 | 40 |
| 44 | M | L | 60 | 90 | 8 | 36 | 44 |
| 48 | M | L | 70 | 90 | 10 | 35 | 46 |
| 33 | M | R | 60 | 90 | 14 | 38 | 48 |
| 31 | M | R | 60 | 100 | 10 | 32 | 40 |
| 22 | M | R | 65 | 100 | 8 | 30 | 42 |
| 39 | M | R | 90 | 110 | 8 | 42 | 44 |
| 20 | M | R | 70 | 100 | 10 | 36 | 48 |
| 35 | M | R | 65 | 100 | 12 | 38 | 46 |
| 27 | M | L | 65 | 90 | 10 | 40 | 44 |
| 28 | M | L | 60 | 90 | 14 | 42 | 48 |
| 22 | M | L | 50 | 100 | 10 | 42 | 46 |
| 32 | M | R | 60 | 110 | 10 | 40 | 48 |
| 22 | M | R | 65 | 110 | * | 46 | 40 |
| 18 | M | R | 60 | 110 | 8 | 30 | 45 |
| 22 | M | L | 60 | 90 | 10 | 38 | 40 |
| 26 | M | L | 80 | 90 | 12 | 36 | 46 |
| 22 | M | R | 70 | 95 | 10 | 36 | 38 |
| 38 | M | R | 70 | 95 | 8 | 44 | 43 |
| 23 | M | R | 65 | 90 | 10 | 40 | 35 |
| 38 | F | R | 60 | 100 | 12 | 34 | 46 |
| 33 | F | L | 70 | 110 | 10 | 36 | 36 |
| 23 | M | L | 80 | 95 | 10 | 38 | 44 |

*Refers to nonunion patient

Vacili et al¹⁹ in a study on 40 patients with clavicular fractures treated by pin and plate, reported union in all pinned patients but one patient in plate group had nonunion. They reported similar functional results in both groups but, patients in pin group reported fewer complications, more acceptable scars, shorter time of staying in hospital and more rapid mobilization which are consistent with our results.

Yih-Shiunnlee et al²⁰ in a study compared the results of Knowles pin and plate on 62 elderly patients (more than 50 years) with clavicular fracture and reported 100% union in pin and 96.7% union in plate group consistent with our results.

According to their study, although plating can cause stable fixation in osteoporotic bone but, the fixation is not rigid and fixation by Knowles pin produces more rigid fixation, significantly shorter operative time, smaller wound size, shorter hospital stay, less meperidine use, lower complication rate and less symptomatic hardware. In our study there is significant difference in amount of bleed-

ing, length of operation and skin breakdown which are fewer in pin group.

In a prospective study comparing the results of Knowles pin and plate in 88 midshaft clavicular fractures, Lee YS⁹ treated 56 patients with the mean age of 40.1 year by Knowles pin and 32 patients with mean age of 38.2 years by plate and finally concluded that if the surgery of mid-third clavicular fractures is indicated, fixation with a Knowles pin is more advantageous than plate fixation.

Liu HH et al²¹ in study of 110 patients with midshaft clavicular fractures treated by pin (51 patients) and plate (59 patients) concluded that there is no difference between the clinical and functional results of the two methods. Thyagarajan^{22,23} in two different studies in 2005 and 2009 concluded that using threaded pins in midshaft clavicular fractures produces lesser complications and offers Rockwood pins for treatment of these fractures.

Nicholas²⁴ in a study comparing the results of locked intramedullary pins versus plates concluded that these two methods have comparable results

but, plate fixation has the disadvantage of second operation for removal. The pins used in our study were smooth and these pins have the potential disadvantage of migration but in our study there was no case of pin migration because we carefully bent the pins at right angle after fixation besides we tried to fix the pins on the clavicular near and far cortices and thus improving the fracture fixation quality.

CONCLUSION

The standard fixation device for the clavicular fracture fixation have been plating and newer studies suggest the effectiveness of special forms of threaded pins in these fractures. However, according to our study, there is significant difference in amount of blood loss, length of operation and skin breakdown which all three parameters are fewer in pin group and if we consider the second operation which is necessary in plate fixation to remove the device, one can conclude that if we use smooth pins in displaced midshaft clavicular fractures secure the pin in near and far cortices, bending the pin at right angle and follow the patients carefully, we can achieve the results not only equal to the standard plates, but in some cases the results are superior due to fewer complications and the ease of hardware removal.

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REFERENCES

1. Nordqvist A, Petersson C. The incidence of fractures of the clavicle. *Clin Orthop Relat Res* 1994;300:127-132.
2. Postacchini F, Gumina S, De Santis P. Epidemiology of clavicle fractures. *J Shoulder Elbow Surg* 2002;11:452-456.
3. Ledger M, Leeks N, Ackland T. Short malunions of the clavicle: an anatomic and functional study. *J Shoulder Elbow Surg*. 2005;14:349-354.
4. McKee MD, Pedersen EM, Jones C, Stephen DJ, Kreder HJ. Deficits following non-operative treatment of displaced, midshaft clavicle fractures. *J Bone Joint Surg Am* 2006;88A:35-40.
5. Nowak J, Holgersson M, Larsson S. Can we predict long-term sequelae after fractures of the clavicle based on initial findings? A prospective study with 9 to 10 years follow up. *J Shoulder Elbow Surg* 2004;13:479-486.
6. Mouzopoulos G, Morakis E, Stamatakis M, Tzurbakis M. Complications Associated With Clavicular Fracture Orthopaedic Nursing, September/October 2009 Clinical Topic: Orthopedics.
7. Robinson CM, Coun-Brown CM, McQueen MM. Estimating the risk of nonunion following nonoperative treatment of a clavicle fracture. *J Bone Joint Surg Am* 2004;86A:1359-1365.
8. Canadian Orthopaedic Trauma Society (MD McKee, principal investigator). Plate fixation versus nonoperative care for acute, displaced midshaft fractures of the clavicle. *J Bone Joint Surg* 2007;89A:1-10.
9. Lee YS, Huang HL, Lo TY, Hsieh YF, Huang CR. Surgical treatment of midclavicular fractures: a prospective comparison of Knowles pinning and plate fixation. *International Orthopaedics (SICOT)* 2008;32:541-545.
10. Judd DB, Bottoni CR, Pallis MP. Intramedullary fixation versus nonoperative treatment for midshaft clavicle fractures. In *Proceedings of the 72nd Annual Meeting of the American Academy of Orthopaedic Surgeons*. Washington DC, February 2005.
11. Robinson CM, Coun-Brown CM, McQueen MM. Estimating the risk of nonunion following nonoperative treatment of a clavicle fracture. *J Bone Joint Surg Am*. 2004;86A:1359-1365.
12. Wick M, Muller EJ, Kollig E, Muhr G. Midshaft fractures of the clavicle with a shortening of more than 2 cm predispose to nonunion. *Arch Orthop Trauma Surg* 2001;121:207-211.
13. Bostman O, Manninen M, Pihlajamäki H. Complications of plate fixation in fresh displaced midclavicular fractures. *J Trauma* 1997;43(5):778-783.
14. Siebenmann RP, Spieler U, Arquin A. Rush pin osteosynthesis of the clavicles as an alternative to conservative treatment. *Unfallchirurgie* 1987;13(6):303-307.
15. Strauss EJ, Egol KA, France MA, Koval KJ, Zuckerman JD. Complications of intramedullary Hagie pin fixation for acute midshaft clavicle fractures. *J Shoulder Elbow Surg* 2007;16(3):280-284.
16. Crenshaw AH. *Campbell's operative orthopedics* 11th edition, Vol 1 2008: 92-94.
17. Tabatabaei S, Khorrami M, Ahmaderabi M, Mousavi S. Results of Magnuson-stack operation in recurrent anterior shoulder instability. *Pak J Med Sci* 2010;26(4):805-808.
18. Zlowodzki M, Zelle BA, Cole PA, Jeray K, McKee MD. Treatment of midshaft clavicle fractures: systemic review of 2144 fractures. *J Orthop Trauma* 2005;19:504-507.
19. Vasili C, Duck Worth D, Bokor D. Mid-shaft fractures of the clavicle; a retrospective comparison of plate versus intramedullary fixation. *Cueenstown, New Zealand - October 7- 12, 2001*.
20. Yih-Shiunnlee. Operative treatment of mid clavicular fractures in 62 elderly patients: Knowles pin versus plate. *Orthopedics* 2007;30(11):959-964.
21. Liu HH, Chang CH, Chia WT, Chen CH, Tarng YW, Wong CY. Comparison of plates versus intramedullary nails for fixation of displaced midshaft clavicular fractures. *J Trauma* 2010;69(6):E82-87.
22. Thyagarajan DS. Treatment of midshaft clavicle fractures: A comparative study. DOI:10.4103/0973-6042.57895. 1-Dec-2009.
23. Thyagarajan DS. Treatment of displaced midclavicle fractures with Rockwood pin: a comparative study. In: *Proceedings from the 72nd Annual Meeting of the American Academy of Orthopaedic Surgeons Rosemont (IL): American Academy of Orthopaedic Surgeons*; 2005.
24. Ferran NA. Locked intramedullary fixation vs plating for displaced and shortened mid-shaft clavicle fractures: A randomized clinical trial, *Journal of Shoulder and Elbow Surgery* 2010;19:783-789.