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Locking plate fixation of mid-shaft clavicle fractures: analysis of complications, reoperation rates and functional outcome

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Abstract

Introduction: Clavicle fractures account for about 5-10% of all fractures and most of these fractures are located in the middle third of clavicle. Traditionally, these fractures have been treated by conservative methods. In recent years, surgical fixation of these fractures is becoming a preferred method of treatment and locking plate fixation is a commonly used mode of osteosynthesis. However, the functional results and complications of locking plate fixation documented in the literature are not clear and often conflicting. So the aim of this study is to analyse the results of locking plate osteosynthesis of mid-shaft clavicle fractures.

Objective: To study complications, reoperation rates and functional outcome of clavicle fractures treated with locking plate osteosynthesis.

Methods: Sixty Seven cases of mid-shaft clavicle fractures who underwent locking plate fixation in our orthopaedic department from January 2013 to December 2016 were identified. Those patients who attended regular follow-up and had recorded Constant-Murley Scores (CMS) were included. Seven patients who did not attend regular follow-up or had incomplete records were excluded from analysis. The study group comprising 60 patients were analysed for complications and functional outcome by studying patient records and x-rays.

Results: There was one case of failure of fixation with non-union and 8 patients had their plate removed for discomfort. Overall, there were 92 % excellent to good, 5% fair and 3% poor results. There were no cases of infection.

Conclusion: The locking plate osteosynthesis gives good to excellent functional outcome in most of the patients. It helps with early mobilisation and prevents shoulder stiffness. The overall rate of implant failure and non-union after plate fixation is low. The necessity of removal of implant in significant number of patients should be kept in mind.

Keywords: Midshaft clavicle fractures, Locking plate, functional outcome, complications

Introduction

Clavicle fractures are one of the common injuries in adult patients and can occur in all age groups. They account for about 5% of all fractures and approximately 80% of clavicle fractures located in mid-shaft area^[1-3]. About half of midshaft clavicle fractures are displaced^[2, 3]. Historically, the preferred method of treatment for most of midshaft clavicle fractures has been non-operative with figure of 8 bandage and sling^[4, 5]. Initial reports of plate fixation shown that non-union rates were higher than those following conservative treatment. A systematic review of complications of plate fixation of clavicle by F.J.G Wijdicks *et al* noted that complications related to the implant requiring a second operation were frequent^[1]. However, another meta analysis by McKee *et al* noted that combined malunion and non-union rate of fracture clavicle was 23% in non-operative group and 1.4% in operative group^[6]. Many other studies on primary plate fixation of displaced midshaft clavicle fractures have also noted high union rate and low complication rates^[3].

In view of these conflicting reports on outcomes and complications of plate fixation of displaced midshaft clavicle fractures, our aim is to analyse the results of cohort of patients having similar fractures treated with plate fixation osteosynthesis.

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Materials and Methods

Our study group involves sixty seven patients with displaced midshaft clavicle fractures treated with pre-contoured locking plate fixation in our department from January 2013 to December 2016. Patient records, Operation notes, pre-operative and post-operative x-rays were studied. Those patients who attended regular follow-up for at least 6 months and had recorded Constant and Murley Scores were included. Seven patients who did not attend regular follow-up or had incomplete records were excluded from analysis. A total of 60 patients were included for analysis. Patient demographics, fracture type, rehabilitation and follow-up details, Constant-Murley Scores, complications and reoperations were analysed.

We followed Allman classification for clavicle fractures, which is most commonly used system of classification. All fractures who underwent surgery were displaced middle third clavicle fractures (Allman Group 1) [7]. Robinson classification was used to classify displaced fractures [8].

After admission of the patient, detailed physical examination and required investigations were done. All patients were counselled about their injuries and treatment options. Decision regarding the operation was taken in consultation with patients after detailed counselling. Informed consent was obtained from all patients. Associated injuries, if any, were treated as per indicated treatment protocol.

The pre-contoured locking plate was used for fixation of the fracture. Operations were performed with patients positioned in beach-chair position. The standard surgical procedure was: antibiotic prophylaxis, standard scrubbing and draping, incision directly over the middle part of the clavicle, direct reduction of the fracture with minimal soft tissue and periosteal dissection, fracture reduction with a clamp, use of one or two lag screws as necessary across the oblique fracture or comminuted fragments was done. Then pre-contoured locking plate was fixed with three bicortical screws on each side of the fracture by taking proper care to avoid any injury to pleura or other underlying structures. All patients had the plate positioned on the superior surface of clavicle.

Post-operative care was given as per standard protocol and early mobilisation was started. Gentle pendulum exercises were started after a week as per comfort of the patient. ROM exercises were gradually increased with an aim to regain full range of movement in 4-6 weeks. After suture removal, patients were followed-up at 6 weeks, 3 months and 6 months for x-rays to assess the fracture union and functional outcome by using Constant-Murley Scores. They were also followed-up by physiotherapy team for exercises.

Results

1. Fracture union: Out of 60 fractures, fifty six cases had fracture union at an average of 12.7 weeks (93.3%). Three patients had delayed union which were united by 16-18 weeks (5%). There was implant failure in one case which went on to develop painless non-union as patient was did not want to have reoperation (1.7%).
2. Complications: There was one case of failure of osteosynthesis with non-union (1.7%) (Fig 1,2 & 3). There were 3 cases of delayed union (5%). There were no wound healing problems, infection or refracture. Two patients developed incisional numbness. There were no peri-operative complications. There were 5 cases with moderate pain around shoulder joint, decreased strength and restricted ROM of shoulder.

3. Reoperation rates: Removal of implant was done in 8 patients for discomfort or pain (13%). The patient with failure of osteosynthesis did not wish to undergo reoperation and developed painless non-union with full range of movements of shoulder.
4. Functional outcome: As per Constant-Murley Scores, there were 55 patients (92%) with excellent to good, 3 patients (5%) with fair and 2 patients (3%) with poor results.

Discussion

This study was done mainly to look at the complications, reoperation rates and functional outcome in a reasonably large cohort of patients as only limited information exists about overall complications and reoperation rates of midshaft clavicle fractures treated with locking plate osteosynthesis.

Despite the widespread use of locking plate fixation in midshaft clavicle fracture management, the clinical information about outcome and potential benefits of the procedure is limited. A study by Campochiaro *et al* (2012) [9] noted that excellent clinical outcomes can be achieved in cases with midshaft clavicle fractures treated with locking plate osteosynthesis.

In our study, all midshaft fractures were displaced and closed type. Out of 60 patients, 49 patients had Robinson type -2 b1 (displaced, simple or with wedge) fracture (81.6%) and 11 patients had Robinson type-2 b2 (displaced, comminuted) fracture (18.3%). This compares with previously published studies where Robinson type -2 b1 is a common type [10].

The reported radiological union time for midshaft clavicle is usually 12-14 weeks. In a study by Lazarus MD [11], union of the fracture occurred between 6-12 weeks. In a study by Cho *et al*. [12], bony union time was 13.2 weeks and 14.6 weeks for locking compression plate fixation and reconstruction plate fixation respectively. In our study, the average time for union of majority of the fractures was 12.7 weeks (56 patients i.e 93.3%). Three patients had delayed union which were united by 16-18 weeks (5%) and one case of failure of osteosynthesis developed non-union (1.7%). The studies by the COTS [13] and Kulshrestha *et al* [14] reported non-union rate of 3% and 0% respectively.

A major complication in our study was one case of implant failure in out of 60 patients (1.7%). Screws in medial 1/3 of clavicle were failed and loosened at around 6 weeks after surgery. This implant failure in early stage suggests that primary rigid and strong fixation is challenging. This patient didnt want re-surgery and went on to develop painless non-union. Patient is satisfied with the outcome as he has full ROM and strength and no pain except a small prominence of the implant. Reported rate of failure of osteosynthesis in literature is about 0-16% [1, 10, 13, 14].

Regarding other complications, two patients complained of significant incisional numbness. There were no peri-operative complications like vascular, neurological or pleural injuries. There were no problems with wound healing or infection. Five patients reported moderate pain around shoulder joint with activities of daily living affected, decreased strength and restricted ROM of shoulder. Our findings are similar to that reported in previous studies on midshaft clavicle fracture locking plate fixation [1, 10, 13]. Decreased level of function (related to decreased ROM or strength) seems to be the common complication after locking plate fixation. However, some degree of decreased function is expected after these type of injuries irrespective of mode of treatment [15]

Removal of implant was done in 8 patients for discomfort or pain(13%). The patient with failure of osteosynthesis did not want to undergo re-operation and implant has not been removed. Soft tissue irritation seems to be the biggest problem of plate fixation even with pre-contoured locking plates. In one study, nearly one third of patients had their plate removed from the clavicle because of local discomfort or irritation [15]. So it is important to counsel the patient pre-operatively about possibility of plate removal.

Functional outcomes were assessed using Constant-Murley Scores and there were 55 patients (92%) with excellent to good, 3 patients (5%) with fair and 2 patients (3%) with poor results.

Five patients had pain around shoulder joint and their activities of daily living were affected. They also had decreased strength and restricted ROM of shoulder leading to low Constant-Murley scores.

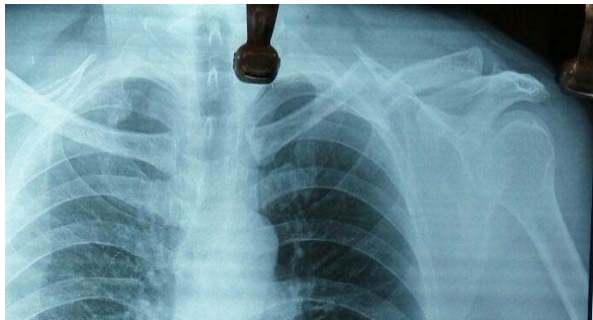


Fig 1: Pre-op xray: Displaced comminuted left clavicle fracture

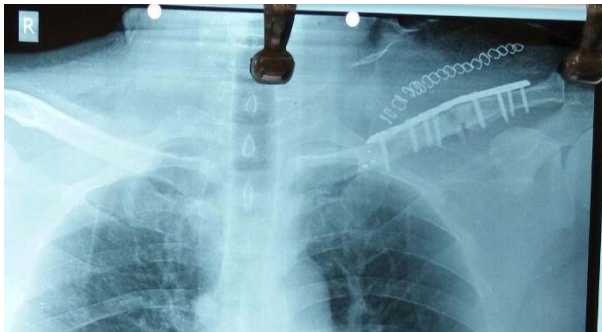


Fig 2: Post-op xray: Displaced Clavicle fracture fixed with precontoured plate.



Fig 3: Six months Post-op xray: Failed osteosynthesis with Non-union.

Conclusion

This study explores the impact of surgery on the outcome of fracture middle part of clavicle. It provides the information about complications and re-operation rates following locking

plate fixation of midshaft clavicle fractures, which is lacking in the current literature. The low implant failure rate and complication rate indicates that pre-contoured locking plate fixation is a safe procedure with excellent results in majority of patients. However, implant removal is required in significant number of patients due to soft tissue irritation. So this information should be included in pre-operative counselling of patients.

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