

# Original Article

## Is removal of clavicle plate after fracture union necessary?

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Access this article online

Website:

[www.internationalshoulderjournal.org](http://www.internationalshoulderjournal.org)

DOI:

10.4103/0973-6042.90998

Quick Response Code:



### ABSTRACT

**Purpose:** To review whether clavicle plates should be removed after union of the fracture.

**Materials and Methods:** 48 patients with middle third clavicle fractures treated by plating were assessed with UCLA shoulder rating and Oxford shoulder scores.

**Results:** At an average follow up of 13 months, 96% of 27 patients with plates out recommended its removal. 86% of 21 patients with plates in were happy to keep them.

**Conclusions:** We recommend leaving clavicle plates in unless requested by the patient.

**Level of Evidence:** IV-retrospective study.

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**Key words:** Clavicle fracture, complications, internal fixation

### INTRODUCTION

The incidence of midshaft clavicular fracture is common and at 50 fractures per 100,000 person-years.<sup>[1,2]</sup> Traditional teaching recommended non-operative treatment as 99% would be expected to heal with little residual symptoms apart from shortening.<sup>[3,4]</sup> Esokola in 1986 reported 27% of his patients continued to have pain at 2 years if their united clavicle were short by 15 mm or more.<sup>[5]</sup> In 1998, Robinson studied 1000 clavicle fractures treated non-operatively. He found delayed union developed in 2.7% and non-union in 4.8%. These were all in displaced fractures.<sup>[6]</sup> Results of a Canadian multicenter prospective study between non-operative treatment and plating have confirmed superior results in favor of surgery.<sup>[7]</sup> Since then, open reduction and fixation of displaced clavicle fractures is accepted by most surgeons. While plate fixation is the commonest surgical options, scar-related pain and numbness distal to the scar were often complained by patients with plates.<sup>[7]</sup> Plates were often not removed unless they became symptomatic. The aim of our study is to assess whether clavicle plates caused symptoms when they were left in.

### MATERIALS AND METHODS

In this retrospective study, patients were divided into two groups. Those who still have their plates in and those whose

plates been taken out. We used Oxford Shoulder score and UCLA shoulder rating scale to assess shoulder function at rest, work, and sports. We also administered a patient-based questionnaire to assess the following: presence of discomfort, cosmetic concern related to the plate, ability to return to sports, and ability to carry a backpack. In patients with plate removed, we asked about their shoulder function outcome compared to that with the period when they had the plate-in. We also quantified the severity of pain/discomfort in each patient by asking their symptom at rest, at work, and during sports. For both groups, we asked if they were satisfied with the treatment and whether they would recommend the same if injured again [Table 1]. To assess morbidity of the plate removal procedure, we asked the patients time taken to return to work and sports and whether they had any complications. This study was approved by our institutional committee.

Between 2005 and 2009, 48 patients with displaced middle third clavicle fractures treated with plate fixation at our institution were available for review. Forty-two were male and six were female with an average age of 40 (15–79) years. Their average follow-up was 13 (12–22) months. We classified each fracture according to Robinson's system<sup>[8]</sup> [Table 2].

Statistical analysis was performed using the SPSS version 16 software. Fisher's exact test was used to assess the patient's

Please cite this article as: Wang J, Chidambaram R, Mok D. Is removal of clavicle plate after fracture union necessary? *Int J Shoulder Surg* 2011;5:85-9.

**Table 1: Assessment of shoulder function questions for patients**

**Background of Injury and Operation**  
 What is your occupation prior to the injury?  
 How did the clavicle fracture happen?  
 The time between the clavicle fracture injury to the operation. Were there multiple operations?  
 Has the plate been removed?

**Work Postoperation**  
 How long did it take to get back to work?  
 Any change in job after operation?  
 Any restriction in the job after operation?  
 Any pain or discomfort related to work?

**Recreation Postoperation**  
 What types of sports did you do prior to the injury? Level of sports? (recreational, school level, county level, national level, professional)  
 How long did it take to return to sports after operation?  
 Any change in sports after operation? Any restriction?  
 The level of sports after operation? (recreational, school level, county level, national level, professional)  
 Any pain or discomfort related to sports after operation?

**Daily Living Activity (Oxford Shoulder Score)**  
 During the past 4 weeks  
 How would you describe the worst pain you had from your shoulder?  
 • none                      • mild                      • moderate  
 • severe                      • unbearable

Have you had any trouble dressing yourself because of your shoulder?  
 • no trouble                      • little trouble                      • moderate trouble  
 • extreme difficulty                      • impossible to do

Have you had any trouble getting in and out of a car or using public transport because of your shoulder?  
 • no trouble at all                      • very little trouble                      • moderate trouble  
 • extreme difficulty                      • impossible to do

Have you been able to use a knife and fork—at the same time?  
 • yes, easily                      • little difficulty                      • moderate difficulty  
 • extreme difficulty                      • no, impossible

Could you do the household shopping on your own?  
 • yes, easily                      • little difficulty                      • moderate difficulty  
 • extreme difficulty                      • no, impossible

Could you carry a tray containing a plate of food across a room?  
 • yes, easily                      • little difficulty                      • moderate difficulty  
 • extreme difficulty                      • no, impossible

Could you brush/comb your hair with the affected arm?  
 • yes, easily                      • little difficulty                      • moderate difficulty  
 • extreme difficulty                      • no, impossible

How would you describe the pain you usually had from your shoulder?  
 • none                      • very mild                      • mild  
 • moderate                      • severe

Could you hang your clothes up in a wardrobe, using the affected arm? (whichever you tend to use)  
 • yes, easily                      • little difficulty                      • moderate difficulty  
 • great difficulty                      • no, impossible

Have you been able to wash and dry yourself under both arms?  
 • yes, easily                      • little difficulty                      • moderate difficulty  
 • extreme difficulty                      • no, impossible

How much has pain from your shoulder interfered with your usual work (including housework)?  
 • not at all                      • a little bit                      • moderately  
 • greatly                      • totally

Table 1: Contd...

**Table 1: Contd...**

Have you been troubled by pain from your shoulder in bed at night?  
 • no nights                      • only 1 or 2 nights                      • some nights  
 • most nights                      • every night

Oxford Shoulder Score: \_\_\_\_\_

Can you carry purse, backpacks while walking long distance?  
 • yes, easily                      • little difficulty                      • moderate difficulty  
 • extreme difficulty                      • no, impossible

Any other restriction on daily living activity?

**UCLA Shoulder Rating Scale**  
 During the past 4 weeks.....

**Section 1: Pain**

- Present always and unbearable. Strong medication occasionally
- Present always but bearable. Strong medication occasionally
- None of little at rest. Present during light activities; salicylates use frequently
- Present during heavy or particular activities only; salicylates used occasionally
- Occasional and slight
- None

**Section 2: Function**

- Unable to use limb
- Only light activities possible
- Able to do light housework or most activities of daily living
- Most housework, shopping, and driving possible; able to do hair and to dress and undress, including fastening bra.
- Slight restriction only able to work above shoulder level
- Normal

**Section 3: Active Forward Flexion**

- 150 degrees
- 120–150 degrees
- 90–120 degrees
- 45–90 degrees
- 30–45 degrees
- Less than 30 degrees

**Section 4: Strength of Forward Flexion (Manual Muscle Testing)**

- Grade 5 (Normal)
- Grade 4 (Good)
- Grade 3 (Fair)
- Grade 2 (Poor)
- Grade 1 (Muscle Concentration)
- Grade 0 (Nothing)

**Section 5: Satisfaction of Patient**

- Satisfied and better
- Not satisfied and worse

UCLA Shoulder Rating Scale Score: \_\_\_\_\_

**Cosmetic Concern Postoperation**  
 Is there any obvious scar from the operation?  
 • yes                      • no

Is the plate causing any visible prominence in your shoulder?  
 • yes                      • no

Is the scar or prominence an issue for you?  
 • yes                      • no

If the look is an issue, would you consider removing the plate?  
 • yes                      • no

**Complications in Patient with Removed Plate**  
 List any complication after removal of the plate. (Ex. Refracture, infection, etc.)  
 List any treatment for the complication.  
 Are you satisfied with the treatment and overall outcome?  
 • yes                      • no

**Table 2: Patients' fracture type by Robison's classification**

Type of fracture	Number of patients
1B1	1
2B1	8
2B2	38
2A2	1

satisfaction and if there were any reported complications. Mann–Whitney *U* test was used to assess the difference of the days returned to work and sports between the plate-in and plate-out groups.

## RESULTS

Of the 48 patients, 27 (56%) had their plates removed (plate-out) and 21 (44%) still have their plates in (plates-in). Five patients had LCDCP (Synthes) and 43 had anatomic plates (Acumed). The mean age in the plate-out group was 40 years compared with 42 years in the plate-in group; 81% of the plate-out group participated in active sports compared with 67% in plate-in group.

Both categories of patients scored well in the Oxford and UCLA score for their shoulder function. The average Oxford Shoulder score is 13 for plate-out patients and 16 for plate-in patients. The average UCLA shoulder rating scale is 34 for both groups. There was no statistical difference between the plate-out and plate-in groups in both Oxford Shoulder score ( $P = 0.178$ ) and UCLA score ( $P = 0.293$ ).

Reasons for plate removal included local symptoms of pain and discomfort (6 patients), limited range of motion in the shoulder during rigorous sports (13 patients), interferences of daily living activity (10 patients), and concern of refracture around the plate (3 patients).

In plate-out group, 18 (67%) patients had both discomfort and problems related to the plate prominence prior to its removal. Nine (33%) patients only had problem related to local prominence; 26 (96%) patients had complete resolution of both issues after their plates were taken out. One patient, whose clavicle fracture was associated with a brachial plexus injury from a motor vehicle accident, continued to experience neurologic pain after removal of the plate; 15 (70%) patients who participated in extensive athletic activities expressed an improvement in their shoulder function.

Following plate removal, the mean number of days returning to work was 14 (1–90) days and to sports was 26 (1–150) days. Three patients in the plate-out group sustained a further fracture of their clavicle after plate removal. Two patients were involved in a separate motor vehicle accident and a third through an inter-fragmentary screw hole several weeks after plate removal. One patient in the plate-in group developed infection which responded to oral antibiotics treatment. Twenty-six (96%) of 27 patients who had the plate removed

**Table 3: Types of discomfort experienced by patients with plate-in**

Types of pain/discomfort	Number of patients
Pain on impact	11
Harness on shoulder, people knocked on the plate, played with kids	
Plate caught with objects	9
Backpack, carried ski equipment, restricted range of motion	
Unusual sensation	4
Cold patch in shoulder, ached during cold weather, carried backpack caused numbness	

were satisfied with the outcome of the procedure and would recommend removal of the plate.

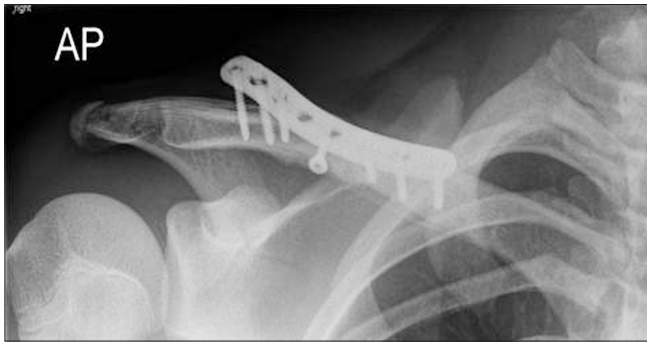
In the group of patients with their plates still in, 15 (71%) complained of local pain/discomfort and plate prominence. This when the clavicle was impacted upon, or plate getting caught while carrying objects as well as an unusual sensation during weather changes [Table 3]. Patients who had the plate in stated they were never offered to have the plate out (4 patients, 19%) or did not feel symptoms were severe enough to go through another procedure (4 patients, 19%). Eighteen (86%) patients were satisfied with the outcome and would only consider plate removal if it interfere with patients' quality of life. Only three (14%) patients would consider plate removal.

A total of 36 patients participated in extensive sporting activities; 23 had plates out and 13 still had plates in. All 23 (100%) patients without plates had alleviation of their discomfort after plate removal compared with only 2 (15%) with plates in who were asymptomatic.

## DISCUSSION

Plating, anatomic with contour matching that of the clavicle, with or without locking as well as intramedullary devices such as locked pins or elastic nails are contemporary fixation devices. In a biomechanical analysis, reconstruction plate was found to be weaker to bending than locking plates and LCDCP, particularly in the presence of cortical defects. Clavicle pins (Rockwood, Depuy) performed poorly compared with the plates.<sup>[8]</sup> Precontoured plates fixed with unicortical locking screws did not show superior results when compared with those fixed with bicortical non-locking screws.<sup>[9]</sup> The authors concluded the stiffer plate fixation enables early return to daily functions for the patients.

Intramedullary devices result in better cosmetic appearance for the patients but carried a higher complication rate of 25.8%.<sup>[10]</sup> The narrow isthmus of the lateral medullary canal is difficult to negotiate for initial pin insertion. The authors experienced non-union of 8.6% requiring revision and 17.2% minor complications related to wound infections, hardware failure, and skin erosions by the pin. In addition, hardware removal is necessary. While



**Figure 1:** Eight holes Acumed plate with the lateral end lifted up above the clavicle. Fracture united

pin fixation can be useful in holding the reduction of simple displaced midshaft fractures, those with multifragmentary fractures are not suitable.

Plate fixation remains the treatment of choice for most surgeons.<sup>[7,11-17]</sup> Plating on the superior surface of the clavicle is technically easier than anterior or anteroinferior plating. Most plates mentioned in the literature were often reconstruction plates and LCDCP. The former broke easily and the latter were bulky.<sup>[9,11]</sup> Both factors contributed unfavorably to the outcome of plating. Shen reported 171 of 232 patients had their plates removed, mostly for cultural reasons and hardware prominence.<sup>[15]</sup> In the Canadian multicenter study, most of their 13.4% complications after plate fixation were hardware-related. These complications were resolved after plate removal in all cases.<sup>[8]</sup> In order to overcome problems of superior plate irritation, some surgeons adopted anterior plating of the fractured clavicle. They argued this has the additional benefit of drilling away from neurovascular structures that lie beneath the clavicle as well as gaining more purchase in the bone compared with the shorter screws of superior plating.<sup>[18]</sup>

To our knowledge, we are not aware of any prior study on the assessment of patients' symptoms related to their clavicle plates. We used a patient-based subjective questionnaire to analyze the impact of plates in patients who had them left in and compared with a group who had them electively removed.

In spite of introduction of anatomic plates (Acumed, USA) in our practice, 88% of patients with plate fixations complained of local prominence, pain, and discomfort. In patients who have their plates removed, 96% were satisfied as their symptoms completely resolved. They would recommend having the clavicle plate removed. The second operation to remove the plate, however, is not without morbidity.<sup>[15]</sup> One patient (3.7%) sustained a further fracture through a previous interfragmentary screw hole and two other through a separate accident in the group of patients with their plates out. On the contrary, we did not find a single spontaneous fracture in patients with clavicle plate in. This effectively refutes the anecdotal view that clavicle plate left in would become stress riser resulting in a higher incidence of refracture. Review of the

group of patients who kept their plate in has shown that plate removal was not universally offered as an option. Although 88% of patients experienced discomfort related to the plate, 86% felt they would not want to go through a second procedure to have their plates taken out. It is worth noting that there was no statistical difference in shoulder function in both groups. On balance, we would not recommend routine plate removal after consolidation of clavicle fracture unless requested by the patient.

Limitations of the study were that being retrospective, patients in each group were likely to have been preselected to have either the plate out or in by surgeons in charge of their care. The patients would have been given an explanation as to why the plates should be removed or not at the index operation. This may have influenced each patient's subsequent assessment about their plates. In addition, the operative experience of different surgeons was variable. This may have resulted in improper plate placement [Figure 1] and in turn may have contributed toward patient's discomfort. In our series, even patients with perfect anatomic plate placement developed symptoms. We did not find any statistical correlation between different plates against symptoms or between plate positions and symptoms.

## CONCLUSION

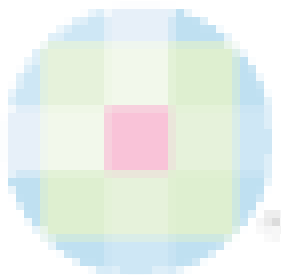
Our study has shown that over 88% of plates over the united clavicle can cause clinical symptoms, particularly in younger patients who are involved with extensive athletic activities; 96% of patients who had their plate taken out recommended its removal; 86% of those who still have their plates in were happy to keep them. As plate removal is not without its morbidity, we recommend leaving clavicle plates in unless requested by the patient.

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**Source of Support:** Nil, **Conflict of Interest:** None declared.



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