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(CASE REPORT)

Optimal timing of clavicle hook plate removal: Is early removal necessary? A retrospective comparative study

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Abstract

Background: Clavicle hook plates are widely used in the management of unstable distal clavicle fractures, but prolonged retention is associated with potentially harmful subacromial complications. The optimal timing of implant removal remains controversial.

Objective: To evaluate the impact of implant removal timing on functional outcomes and complications.

Methods: A retrospective comparative study was conducted including patients treated for distal clavicle fractures with hook plate fixation, divided into early (< 4 months) and late (≥ 4 months) removal groups. Functional outcomes were assessed using the Constant score and pain using the Visual Analog Scale (VAS).

Results: Early removal was associated with significantly better functional outcomes (90 ± 5 vs 82 ± 8; $p < 0.01$) and lower pain levels (VAS 1.5 ± 0.8 vs 2.8 ± 1.1; $p < 0.01$). Subacromial complications were significantly reduced (10% vs 30%), with no increase in instability.

Conclusion: Implant removal performed between 3 and 4 months after confirmed bone union appears to optimize clinical outcomes.

Keywords: Distal clavicle fracture; Hook plate fixation; Implant removal timing; Early versus delayed removal; Subacromial complications; Constant score

1. Introduction

Distal clavicle fractures represent a specific entity in trauma surgery due to their intrinsic instability related to coracoclavicular ligament disruption, with nonunion rates reaching up to 30% in unstable patterns treated conservatively [1,2]. Hook plate fixation has become a widely used surgical option, providing reliable stability regardless of distal fragment size and allowing early mobilization [3].

However, the biomechanical principle of the hook plate relies on a non-physiological subacromial support, inducing repetitive mechanical stress within the subacromial space. These stresses increase local pressure and alter scapulohumeral kinematics, leading to dynamic impingement [4]. Clinically, several studies have reported a high incidence of complications, including persistent pain, subacromial impingement, and rotator cuff lesions, with a frequency correlated to implant duration [5,6,11–13,15].

In this context, secondary implant removal is widely recommended. However, the optimal timing remains debated. Early removal may reduce prolonged mechanical stress and prevent irreversible lesions, whereas delayed removal may

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ensure more complete bone healing at the cost of increased complication risk [7,8,11,12]. The absence of consensus highlights the need for comparative clinical studies.

The aim of this study was to evaluate the impact of implant removal timing on functional outcomes and complications, and to define an optimal therapeutic window based on clinical findings and literature data.

2. Methods

A retrospective single-center comparative study was conducted including patients treated for unstable distal clavicle fractures between January 2018 and December 2023. Inclusion criteria were age ≥ 18 years, Neer type II fractures, hook plate fixation, and a minimum follow-up of 6 months after implant removal. Patients with associated rotator cuff injuries, open fractures, or incomplete data were excluded.

Patients were divided into two groups according to implant removal timing: early (< 4 months) and late (≥ 4 months). This threshold was defined based on literature suggesting an optimal window between 3 and 5 months [7,9,11]. The decision for implant removal was based on combined clinical and radiological assessment of bone union.

Primary outcomes included the Constant-Murley score and VAS pain. Secondary outcomes included complications such as subacromial impingement, stiffness, and loss of reduction. Statistical significance was set at $p < 0.05$.

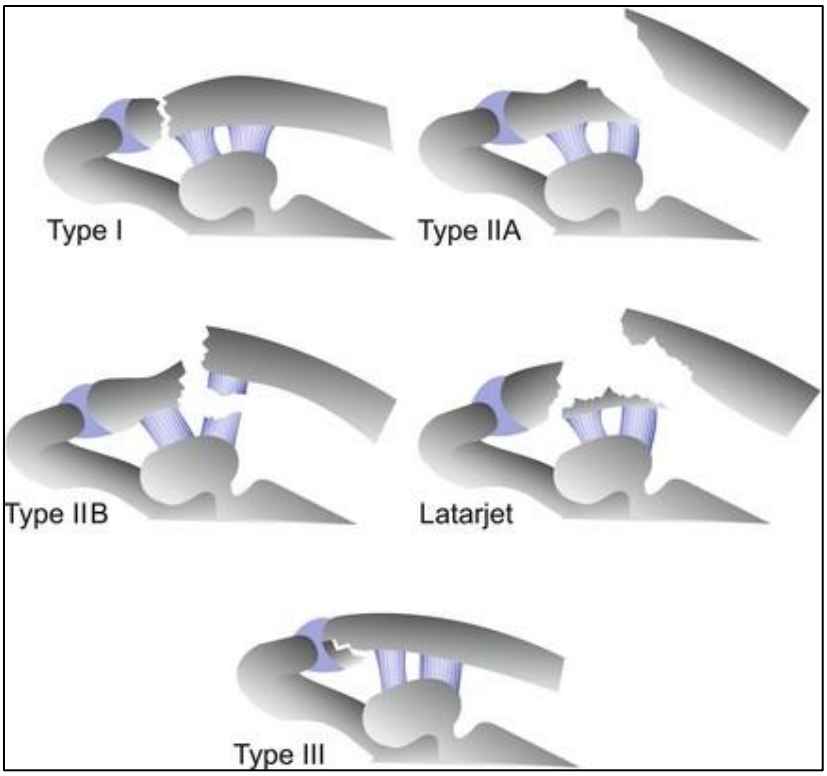

Figure 1 Neer classification of distal clavicle fractures

3. Results

Sixty-four patients were included, with 31 in the early group and 33 in the late group. Demographic and fracture characteristics were comparable between groups.

Functional outcomes were significantly better in the early group, with a mean Constant score of 90 ± 5 compared to 82 ± 8 in the late group ($p < 0.01$). Pain was also significantly reduced in the early group (VAS 1.5 ± 0.8 vs 2.8 ± 1.1; $p < 0.01$), consistent with literature showing progressive functional deterioration with prolonged implant retention [5,6,11,12].

Subacromial complications were significantly more frequent in the late group (30% vs 10%), with rates consistent with previously reported clinical series [5,11,13]. Shoulder stiffness was also more common in the late group.

No cases of loss of reduction or secondary instability were observed in the early group when bone union was confirmed, supporting literature suggesting the safety of early removal after consolidation [3,10].

Figure 2 Preoperative radiograph showing a distal clavicle fracture (Neer type II) with an associated non-displaced scapular fracture

4. Discussion

The results of this study confirm that complications associated with hook plate fixation are primarily time-dependent. Prolonged implant retention leads to continuous subacromial mechanical stress, resulting in progressive soft tissue damage. Biomechanical studies have demonstrated that the hook exerts constant pressure beneath the acromion, altering scapulohumeral kinematics and inducing dynamic impingement [4].

Arthroscopic findings reported in the literature demonstrate characteristic lesions, including synovitis, rotator cuff erosion, and chronic inflammation, whose severity increases with implantation duration [5,11,13,15]. These findings support a time-dependent pathophysiological mechanism.

Early implant removal appears to be an effective strategy to limit prolonged mechanical stress. Our findings, consistent with those of Good et al. and Flinkkilä et al., suggest that removal after confirmed bone union improves functional outcomes while reducing complications [3,7,11,12].

However, implant removal should not be performed too early. Current evidence suggests that removal before 8–10 weeks increases the risk of secondary instability, particularly in the absence of sufficient bone union [7,9,11]. Conversely, retention beyond 5–6 months is associated with a significant increase in complications, including irreversible rotator cuff lesions and chronic pain [5,6,11–13,15].

Overall, the available evidence supports an optimal therapeutic window between 3 and 4 months, balancing sufficient bone healing and prevention of mechanical complications. This timing should be interpreted cautiously, as bone union remains the key determinant in decision-making.

These findings suggest that management should not rely on a fixed timeline but rather on an individualized approach integrating clinical and radiological criteria. The lack of standardized criteria for assessing bone union remains a limitation.

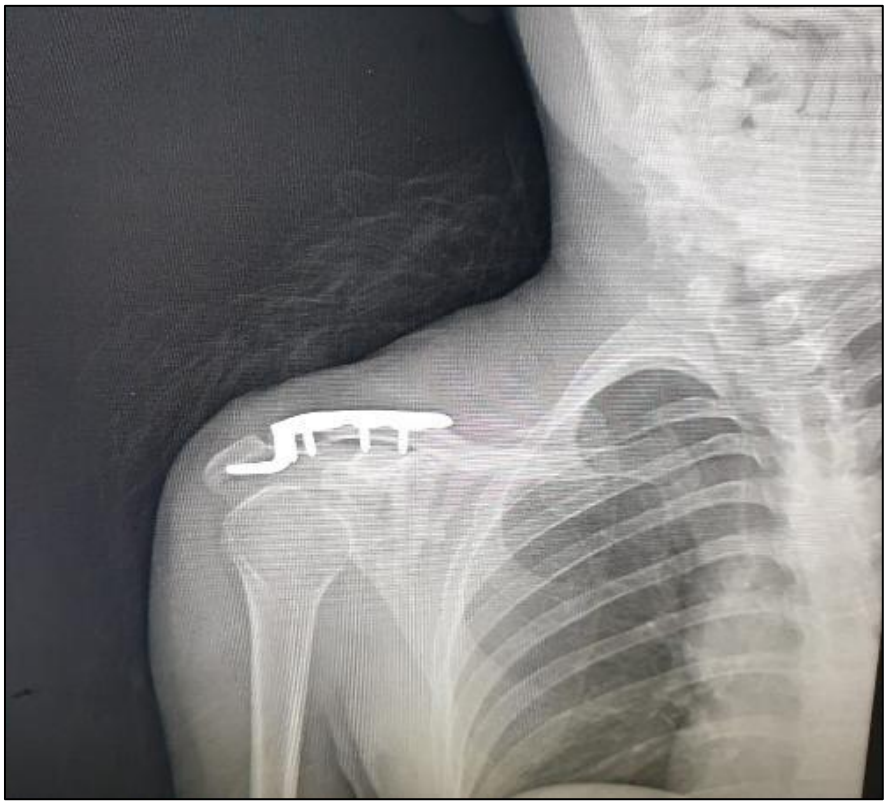

Figure 3 Postoperative radiograph showing hook plate fixation of a distal clavicle fracture with an associated non-displaced scapular fracture managed conservatively

5. Conclusion

Hook plate removal represents a critical step in the management of distal clavicle fractures. The timing of removal directly influences functional outcomes and complication rates.

Removal performed too early, before sufficient bone union, may lead to secondary instability, whereas prolonged retention beyond 5–6 months significantly increases subacromial complications.

Current evidence supports implant removal between 3 and 4 months after confirmed bone union, representing the best balance between mechanical safety and complication prevention.

An individualized approach based on careful clinical and radiological assessment is essential to optimize patient outcomes.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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