

# Provisional Mini-Fragment Plate Fixation in Clavicle Shaft Fractures

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## Abstract

Plate fixation has an increasingly prominent role in the management of select clavicle fractures. However, many fracture patterns are not easily reduced and provisionally stabilized with conventional clamp application and lag-screw placement, and maintaining an appropriate reduction can be a challenge. In this article, we present a technique in which a mini-fragment plate is used to provisionally maintain fracture reduction while the definitive plate is applied.

There is a growing appreciation for the role of plate fixation in optimizing outcomes of significantly displaced fractures of the shaft of the clavicle. With long oblique or spiral fracture patterns, an anatomical reduction can often be obtained using reduction clamps and maintained with interfragmentary lag screws while definitive plating is undertaken. However, transverse, short oblique, and comminuted fracture patterns are often not amenable to these techniques, and in these cases it can be challenging to obtain and maintain an appropriate reduction. Moreover, the relatively small size of the surgical field and fracture fragments, the proximity of critical neurovascular structures, and the need to respect the local soft-tissues can add to the difficulty.

Initially popularized by Benirschke and colleagues<sup>1</sup> and promoted more broadly by Archdeacon and Wyrick,<sup>2</sup> reduction plating involves applying a small plate through a limited exposure for provisional maintenance of reduction while a definitive implant is applied. Reduction plating, useful where traditional tools and reduction techniques cannot be used, has been described in the treatment of fractures of many different bones, including the tibia,<sup>1-3</sup> the humerus,<sup>2,4</sup> and the acetabulum.<sup>2</sup>

We have found that a modified reduction plating technique using mini-fragment plates and screws greatly facilitates efficient and reliable reduction and fixation of select fractures of the shaft of the clavicle. In the setting of either extensive comminution or simple fracture patterns with-



**Figure.** (A) Patient sustained closed clavicle fracture in high-speed motor vehicle collision. Given significant foreshortening, fracture was treated with open reduction and internal fixation. (B) Provisional mini-fragment plate with 2.4-mm screws was used to maintain reduction during application of definitive plate. (C) Provisional plate was removed once definitive plate was in place. Fracture healed uneventfully.

out sufficient obliquity for clamp reduction and lag-screw stabilization, we routinely use provisional mini-fragment plate fixation. As with previously described provisional applications, this technique is simple and not associated with significant complications.

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**Table. Patient Demographics, Fracture Classification, Surgical Details, and Outcomes of Provisional Mini-Fragment Fixation in Patients With Clavicle Shaft Fractures**

| Patient | Age, y | Sex | Follow-Up, mo | Fracture Pattern <sup>a</sup> | Plate Position |            | Provisional Plate Retained | Union |
|---------|--------|-----|---------------|-------------------------------|----------------|------------|----------------------------|-------|
|         |        |     |               |                               | Provisional    | Definitive |                            |       |
| 1       | 54     | M   | 3.5           | 15-B3.1                       | Anterior       | Anterior   | Yes                        | Yes   |
| 2       | 48     | F   | 2.5           | 15-B3.1                       | Superior       | Superior   | Yes                        | Yes   |
| 3       | 40     | F   | 14            | 15-B2.3                       | Superior       | Superior   | Yes                        | Yes   |
| 4       | 58     | M   | 6.5           | 15-B3.3                       | Anterior       | Superior   | Yes                        | Yes   |
| 5       | 49     | M   | 6.5           | 15-B1.2                       | Superior       | Superior   | Yes                        | Yes   |
| 6       | 32     | M   | 4             | 15-A.3                        | Anterior       | Superior   | Yes                        | Yes   |
| 7       | 50     | M   | 3             | 15-B3.3                       | Superior       | Superior   | Yes                        | Yes   |
| 8       | 58     | M   | 12            | 15-A.3                        | Superior       | Superior   | Yes                        | Yes   |
| 9       | 27     | M   | 2.5           | 15-B2.3                       | Superior       | Anterior   | Yes                        | Yes   |
| 10      | 58     | M   | 6             | 15-B1.3                       | Superior       | Anterior   | No                         | Yes   |
| 11      | 53     | M   | 6.5           | 15-B2.2                       | Superior       | Anterior   | No                         | Yes   |
| 12      | 25     | M   | 6             | 15-B2.3                       | Superior       | Anterior   | Yes                        | Yes   |
| 13      | 30     | M   | 3.5           | 15-B3.3                       | Superior       | Anterior   | No                         | Yes   |

<sup>a</sup>Orthopaedic Trauma Association (OTA) classification: 15-A.3, comminuted; 15-B1.2, diaphyseal oblique; 15-B1.3, diaphyseal transverse; 15-B2.3, diaphyseal comminuted wedge; 15-B3.1, diaphyseal segmental spiral; 15-B3.3, diaphyseal segmental complex comminuted.

## Surgical Technique

We anticipate the need for provisional plating as part of our preoperative plan in the setting of extensively comminuted or short oblique/transverse fracture patterns. Provisional plating is compatible with either superior or anterior placement of the definitive implant. We use a standard approach to the clavicle, preserving supraclavicular nerves whenever possible and raising a full-thickness fascial flap to facilitate a 2-layer closure at the end of the procedure. The fracture is exposed, and we take care to avoid unnecessarily devitalizing any fragments.

When the fracture cannot be held reduced during definitive implant placement, which is most often the case in transverse, short oblique, or highly comminuted patterns, we then consider provisional fixation. We prefer to use 2.0-mm mini-fragment plates that accept 2.4-mm screws and are low-profile (Figures A-C). This limits the biological footprint of the plate and allows for the definitive implant to be placed directly on top of the provisional implant if necessary. These provisional plates only need to provide enough stability for the definitive implant to be applied, so we typically use 2 screws on either side of the fracture; unicortical fixation is often adequate. Even within the limitations of a soft-tissue-friendly exposure of the clavicle, there is sufficient room for a surgical assistant to maintain a difficult reduction with appropriately placed clamps while mini-fragment fixation is performed. Given the small size of the provisional implants, the clamps or hands of the assistant are seldom obstructive.

The provisional plate is positioned to facilitate reduction and minimize disruption of local biology. Whether the surgical plan calls for definitive anterior or superior plating is not critical, as the provisional implant can be removed, retained, or even covered by the definitive implant at the discretion of the surgeon.

Definitive plate fixation of the clavicle can then be carried out according to surgeon preference in the setting of a provisional reduction without obstructive clamps or wires. The definitive implant most often functions as a bridge plate, though the provisional fixation is sufficiently flexible to allow compression by eccentric screw and drill placement in appropriate fracture patterns. We use a precontoured plate (designed specifically for the clavicle) with locking or non-locking screws (type of screw depends on fracture pattern and bone quality). Routine layered wound closure is then performed. After surgery, the patient is kept non-weight-bearing for 6 weeks. A sling is used for comfort, and pendulum exercises and gentle passive shoulder motion are instituted as soon as comfort allows. Active motion and progressive weight-bearing are started 6 weeks after surgery.

## Clinical Series

At our institution, we have used this technique to treat 13 fractures over a 14-month period. All operations were performed by a fellowship-trained orthopedic trauma surgeon (JB). Bone grafting was not done. All fractures healed uneventfully, and there were no wound-related complications

or reduction losses. To date, no patients have requested implant removal because of prominence. Patient demographics, fracture classification, surgical details, and union rates are listed in the **Table**. Mean patient age was 45 years. Eleven of the 13 patients were men. Mean follow-up was 6 months. Seven different Orthopaedic Trauma Association clavicle fracture patterns<sup>5</sup> were successfully treated with provisional plating.

## Discussion

Provisional reduction plating has previously been described in the orthopedic literature. Our experience is that this technique is particularly useful for the surgical treatment of select clavicle fractures where effective provisional clamp application or wiring can be difficult given the fracture pattern, the relatively small surgical field, and the complex 3-dimensional anatomy. Given its low profile, provisional plating also allows for the definitive plate to be placed atop the provisional plate if necessary. This facilitates unencumbered definitive implant placement, and extra attention can then be devoted to contouring the definitive implant to the anatomy.

Surgical indications and techniques for the treatment of displaced clavicle fractures continue to evolve, and the combination of open reduction and plating is now well established as a viable option. Although our series is relatively small, our patients' outcomes compare favorably with those in other reported series in terms of quality of reduction, fracture healing, and avoidance of complications. Moreover, whether a provisional plate is removed or retained seems to have no impact on outcome in terms of union or need for implant removal.

## Conclusion

Applying this provisional mini-fragment reduction plating technique to extensively comminuted or short oblique/transverse clavicle fracture patterns may help facilitate treatment of these often challenging fracture patterns.

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