

Clavicle Fracture Open Reduction Internal Fixation: Results of Modern Technique

Abstract

Background: Clavicle fractures are common. Surgical treatment of displaced clavicle fractures is controversial. We present our experience with 68 patients over an 11 year period.

Methods: Sixty-eight patients underwent open reduction and internal fixation (ORIF) of displaced, closed clavicle fractures and non-unions. Most fractures demonstrated comminution. Modern plate fixation was used in all cases. The majority of patients underwent local bone graft application at the fracture site.

Results: All patients went on to complete union at an average of 135 days after surgery. No major complications were identified. Five patients required a second surgery for symptomatic hardware removal.

Conclusion: ORIF of displaced clavicle fractures and nonunions is a reliable treatment with predictable outcomes when fundamentals of fracture fixation and soft tissue technique are followed.

Keywords: Clavicle; Fracture; Surgery; Non-union; ORIF

Research Article

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Introduction

Clavicle fractures are common. Clavicle fractures account for 2.6 % of all fractures and 44 % of those in the shoulder girdle. Fractures of the middle third of the clavicle are most common (81%) [1].

Surgical treatment of displaced clavicle fractures is controversial. Traditionally, these fractures have been treated non-operative [2-6]. This traditional treatment is not without complications, including shortening, nonunion, deformity and unsatisfactory patient outcomes [7-14]. More recently, modern operative treatment has demonstrated superior results [15-26].

We present our experience with 68 patients over an 11 year period. All treated with modern open reduction and internal fixation (ORIF) technique leading to union in all cases without serious complication.

Materials and Methods

During a 11 year period (2003-2014), sixty-eight patients with an average age of 34 years (14-77) underwent ORIF of an acute clavicle fracture an average 30 days after injury (62) or non-union (6) 165 days after injury. In all cases, the incision was placed along the superior border of the clavicle. All acute fractures were reduced anatomically with minimal soft tissue stripping or devitalization.

All fractures were closed. All fractures were displaced. Fifty-Nine fractures demonstrated comminution and nine did not.

Sixty-one fractures were mid-shaft (Figure 1) and seven were distal third (Figure 2) or had a distal component.

Forty-five patients had local autologous bone graft added at the fracture site. This was usually taken from the comminuted fragments that did not lend themselves to direct reduction. No bone graft was harvested from a separate site.

Fixation included precontoured clavicle plates (Synthes (Paoli, PA), Acumed (Hillsboro, OR), and Smith & Nephew (Memphis, TN) in 62 patients (Figures 1 & 2), a reconstruction plate (contoured at the time of surgery) in 5 patients, and a LCDC plate was used in one patient. Regardless of the plate, locking screw fixation was used distally when bone quality was compromised. Sixty-six of the plates were placed superiorly and or anterior with 2 plates placed in the inferior position.



Figure 1a: Displaced midshaft clavicle fracture.



Figure 1b: Typical fixation used for midshaft clavicle fracture patterns with pre-contoured plate.



Figure 2a: Displaced segmental clavicle fracture with distal fragment.



Figure 2b: Typical fixation used for distal fracture patterns with pre-contoured plate.

Nearly all fixation constructs included at least 8 cortices of fixation on the distal fragment and 6 cortices of fixation on the medial fragment (Figure 1b). Additional interfragmentary screws

were used when appropriate. The only time that the number of cortices were less than 8 distal and 6 medial is when multiple interfragmentary screws were utilized.

Meticulous technique was used to prevent neurovascular injury during dissection, reduction, and fixation. All fractures were treated by a single surgeon.

Results

All fractures (100%) went on to complete union with no hardware failures. All patients had achieved complete bony union at an average of 135 days after surgery.

There were no infections, neurovascular injuries, or other major complications. All patients had symmetric range of motion when compared to the contralateral side at the time of fracture union. The majority of patients had some degree of paresthesia on the inferior side of the incision.

Five patients underwent a second surgery for hardware removal, secondary to symptomatic hardware prominence.

Discussion

Beginning with classic papers by Neer [22] and Rowe [24], most authors recommended that ORIF of displaced midshaft clavicle fracture should be avoided because of the high rate of union with non-operative treatment, high rate of failure with operative treatment, and the potential risk of neurovascular complications due to the close proximity of vital structures including the underlying subclavian artery, vein, brachial plexus, and pleura.

Over 25 years ago, Jupiter & Leffert [19] noted that fracture displacement of greater than 2 cm was associated with non-union in their series of patients. Since then, the treatment of displaced midshaft clavicle fractures has evolved. Recent clinical studies demonstrate high rates of nonunion and symptomatic malunion with non-operative treatment [15].

In our series of 68 patients with midshaft and distal third fractures and non-unions of the clavicle, we found 100% union rate with no major complications. Skin paresthesia was the only minor complication, and all patients had been counseled preoperatively of this high potential. We attribute our outcome to meticulous surgical technique including minimal devitalization of soft tissues providing blood supply to the bone, anatomic reductions whenever possible, and following established principles for internal fixation. Local bone graft was used when appropriate in more than half the cases. Evolved plating systems designed specifically for the clavicle have also made a difference in fixation success and minimizing the need for hardware removal.

Conclusion

In a review of 68 patients in an 11 year period, ORIF of displaced clavicle fractures and nonunions proved to be a reliable treatment with predictable outcomes when fundamentals of fracture fixation and soft tissue technique are followed. All patients went on to fracture union without major complication. Five patients required hardware removal.

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