

Operative treatment of displaced midshaft clavicular fracture: is it the best management?

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ABSTRACT

Background:

Recent studies have shown satisfying results of operative treatment of displaced midshaft clavicular fractures.

Methods:

We reviewed 48 patients with 48 displaced midshaft clavicular fractures treated from January, 2003, to December, 2007, in a large community teaching hospital. Thirty-eight patients were treated with a locking plate and 10 patients with a nonlocking plate. Outcomes and complications of clinical treatment were reviewed. Blinded preoperative and direct postoperative radiographs were compared; treatment was judged to be optimal or suboptimal based on fracture characteristics by two separate surgeons. This judgment was compared with postoperative complications.

Results:

No wound infections were documented. Complications consisted entirely of implant failure, which occurred in 11 patients (22%). Nine patients (19%) underwent supplementary surgical intervention because of these complications. All implant failures occurred in locking plates. In 26 osteosyntheses that were judged as optimal, two implant failures occurred (8%). In 22 osteosyntheses that were judged as suboptimal, nine complications were scored (41%). Our series of operatively treated displaced midshaft clavicular fractures showed a high rate of implant failure. Failures occurred significantly more often in patients in whom the osteosynthesis was judged to be suboptimal ($P > 0.01$).

Conclusions:

Clavicular fractures are not forgiving fractures. When basic principles of fracture treatment are not respected, significantly more implant failures will occur.

Keywords

clavicular, fracture, operative, implant failure

INTRODUCTION

Displaced midshaft clavicular fractures (Figure 1) were traditionally treated nonoperatively with a high rate of union.^{1,2} Operatively treated fractures had a high complication rate. Complications consisted mainly of wound infections and implant failure.³⁻⁶ However, recent studies focusing more on nonoperative treatment of displaced midshaft clavicular fractures in adults showed that nonunion was far more frequent, even up to 15%.⁷⁻⁹ Malunion of midshaft clavicular fractures also was considered clinically important.⁸⁻¹⁴ Displaced midshaft clavicular fractures most commonly heal in a classic pattern in which the lateral fragment is medially translated and anteriorly deformed.^{11,12} Malunion of the clavicle is reported to result in lower Disabilities of the Arm, Shoulder, and Hand (DASH) and Constant scores, but also in decreased strength of the affected arm, leading to impairment.^{8,11} A recent randomized, controlled trial by the Canadian Orthopaedic Trauma Society¹⁵ showed a better functional outcome after nonoperative treatment compared with earlier studies and a lower complication rate for operative treatment than previously reported.

The aim of this study was to review the results of the operative treatment of displaced midshaft clavicular fractures in a large teaching hospital.

MATERIALS AND METHODS

Institutional review board approval was obtained from Albert Schweitzer Hospital, Dordrecht, The Netherlands. All patients over 16 years of age with a displaced midshaft clavicular fracture (AO/OTA 15-B1-3) between January, 2003, and December, 2007, were reviewed. Exclusion criteria were previous fracture of the clavicle, additional skeletal trauma of the shoulder girdle or thorax, and an age under 16 years or over 70 years. All initial radiographs were reviewed by three surgeons to determine the site and classification of the fracture. The patients with displaced midshaft clavicular fractures were selected. Postoperatively, patients were seen during regular follow-up at the outpatient clinic at 2, 6, 12, and 52 weeks after surgery. The data (patient characteristics, radiographs, operation, consolidation, functional outcome, pain, and complications) concerning the outcome of the treatment were collected. Outcome was scored as being excellent, good, fair, or poor based on shoulder function and pain. The outcome was excellent when patients had no pain and were able to return to previous activity levels. The outcome was good when there was no impairment in daily life activities but pain prevented patients from physically

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FIGURE 1. Radiograph showing a displaced midshaft clavicular fracture (AO/OTA 15-B) in a 37-year-old man.

high demanding activities. The outcome was judged as fair when patients experienced little pain in daily life and some limitations. The outcome was poor when patients had pain and were fully compromised. Two surgeons compared the preoperative and direct postoperative radiographs and every single treatment was judged to be optimal or suboptimal based on fracture characteristics and the operation record. In judging the radiographs, the basic treatment principles, as described by the AO¹⁶ were compared with the eventual treatment. A simple fracture was to be treated with an interfragmentary lag screw and a plate to achieve absolute stability. When a wedge fragment was involved, one or more interfragmentary lag screws (when possible) could be used in association with a plate. If the fracture was more comminuted, a bridging plate was to be used, to achieve relative stability. All radiographs were blinded for name and treatment outcome before review.

From a total of 524 clavicular fractures, we identified 48 adult patients who underwent surgery for a displaced midshaft clavicular fracture (9.2%). Twenty-seven percent (13 patients) of the operatively treated fractures were comminuted. Most patients were men (81.3%, 39 patients) with a mean age of 37 years (range 17–68 years). Fractures were caused by a fall (n = 35), motor vehicle accident (n = 3), sports accident (n = 5), or other (n = 5). Thirty-two patients underwent surgery within 10 days after the injury. Sixteen patients were operatively treated after failed conservative treatment, 13 patients were treated within 8 months because of a symptomatic delayed union and three patients had surgery for a symptomatic nonunion after a period longer than 8 months after the trauma date. The patients were operated by or under direct supervision of an experienced surgeon. The methods of fixation are shown in Figure 2.

Categorized variables were analyzed using the Fishers' exact test. All tests were two-sided. A *P*-value of 0.05 was considered to be statistically significant. SPSS version 17.0 (SPSS, Inc., Chicago, Illinois) was used for all analyses.

RESULTS

From the 524 available patients with a clavicular fracture, 48 patients were included in this study. All patients achieved

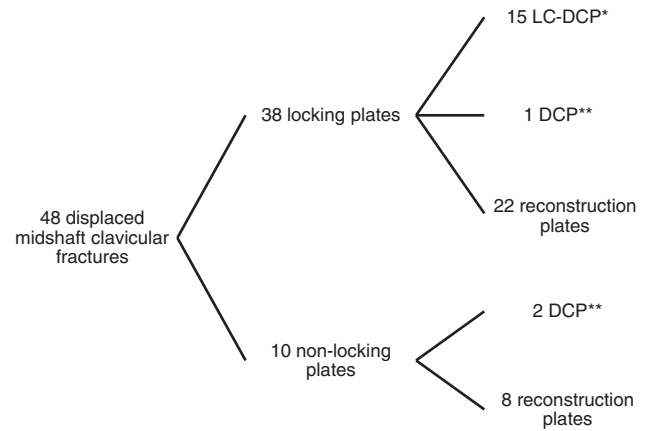


FIGURE 2. Methods of fixation in 48 displaced midshaft clavicular fractures. LC-DCP indicates limited contact dynamic compression plate; DCP, dynamic compression plate.

both clinical and radiographic union. Clinical union was documented after a median of 75 days (range 30–850 days) and radiographic union was seen after a median of 120 days (range 50–850 days). Outcome was rated as excellent in 37 patients (77%), good in 10 patients (21%), and fair in one patient. After consolidation, the implant was removed in 17 patients (35%), because of local pain over the plate caused by bulkiness of the implant. No wound infections were documented. Our complications consisted entirely of implant failure, of which we reported 11 cases (22%). Details are shown in Figure 3. No differences in complications were seen when comparing the timing of surgery (direct compared with indirect; 32 patients compared with 16 patients; *P* < 0.52), plate localization, type of plate (*P* < 0.15), or differences in complications were seen when comparing the timing of surgery (direct compared with indirect; 32 patients compared with 16 patients; *P* < 0.52), plate localization, type of plate (*P* < 0.15), or type of osteosynthesis (absolute compared with relative stability; *P* < 0.6).

Eleven implant failures (23%; Figures 4 and 5) occurred in locking osteosynthesis and none in nonlocking plates (*P* < 0.07). Nine patients (19%) underwent a second operation in which a new osteosynthesis was performed. Afterwards two patients (4.2%) had new complications (plate breakage and plate loosening) for which a third operation was necessary.

Judgment of the chosen treatments in relation to post-operative complications is shown in Figure 6. Twenty-two (46%)

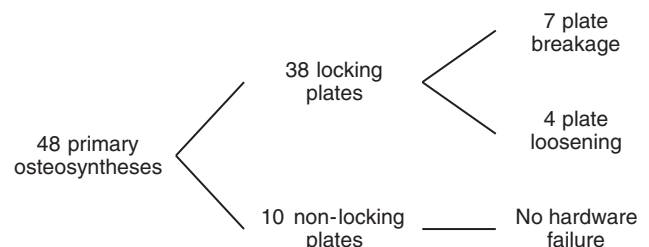


FIGURE 3. Details of implant failure in 48 operatively treated displaced midshaft clavicular fractures.



FIGURE 4. Plate breakage in a patient treated for an acute displaced midshaft clavicular fracture with a locking compression plate.

osteosyntheses were judged to be suboptimal, not respecting the guidelines of treatment as described in the materials and methods section. Patients with a suboptimal osteosynthesis had a significantly higher complication rate (18% compared with 3%; $P < 0.01$) than those deemed optimal.

DISCUSSION

Traditionally, treatment of clavicular fractures was focused on the prevention of nonunions. Neer¹ reported excellent results of nonoperative treatment, resulting in less than 1% nonunions. Therefore, nonoperative treatment was justified. Nevertheless, more recent studies¹⁷ have shown nonunion rates up to 15% when displaced midshaft clavicular fractures were isolated. Furthermore, other publications have shown poor outcomes of nonoperative treatment.^{8,11,13,18–20} The recommendation of Neer¹ that nonoperative treatment be the gold standard has been abandoned, since several studies have shown that malunion of clavicular fractures leads to high morbidity.^{7,11,13,15,18} Operative treatment of displaced midshaft clavicular fractures has been advocated in recent publications.^{7,11,15,21,22} In some of these studies, operative treatment of these fractures has shown a significant lower nonunion rate and superior clinical outcomes compared with nonoperative treatment. The complication rates were low and consisted of wound problems and implant failure.



FIGURE 5. Plate loosening in a patient treated for a delayed union with a limited-contact dynamic compression plate.

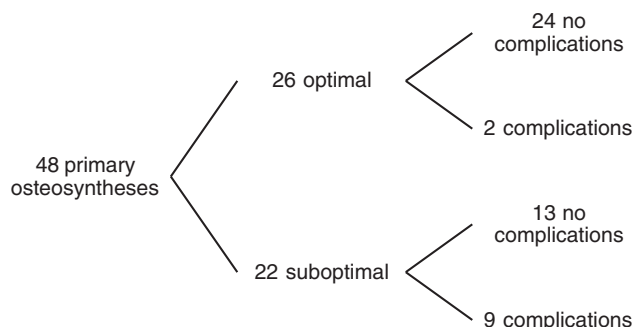


FIGURE 6. Results of judgment preoperative and postoperative radiographs in relation to postoperative implant failure.

Our series showed a high complications rate. Twenty-two percent of the operated patients developed implant failure, resulting in a 19% re-intervention rate. This is in line with more dated reports of outcomes of operative treatment of displaced midshaft clavicular fractures^{3–6} that show a complication rate of 23% and more.

Although we report no wound infections, our implant failure rate shows serious discrepancy with the more recent publications.^{15,23} Our results showed a higher failure rate of locking plates. Retrospective analysis of the implemented osteosynthesis showed that significantly more implant problems were seen in patients in whom the performed osteosynthesis was judged to be suboptimal ($P = 0.01$). The implant failure rates were higher because of the suboptimal choice of osteosynthesis. Suboptimal choices included: (1) use of a bridging plate in a simple fracture, (2) suboptimal technical execution of a bridging technique, and (3) the lack of fracture compression. The first leads to insufficient stability, which might result in delayed union or nonunion. The clavicle tends to rotate during abduction and anteflexion of the shoulder.²⁴ When insufficient compression is given to the fracture, there will be an excessive amount of strain on the callus, leading to delayed union, implant breakage or outbreak of the screws. When a bridging plate was used in a more comminuted fracture, too many holes in the plate were filled, not leading to a relative stable osteosynthesis but to a situation in which excessive stress was exercised on the plate, leading to implant failure.^{25,26}

Since more complications were seen in patients in whom fracture treatment basics were not respected, one might state that a displaced midshaft fracture of the clavicle is not a forgiving fracture. Preoperative planning of a displaced midshaft clavicular fracture might be of cardinal importance. All series favoring operative treatment are reported by large orthopaedic trauma centers. If great expertise is available, operative treatment might give satisfactory and superior results over nonoperative treatment.

In our series we report a 22% implant failure. This is higher in comparison with recent publications. Forty-six percent of osteosyntheses were found to be suboptimal. A significantly higher percentage of suboptimal osteosyntheses led to implant failure. All complications were noted in patients treated with locking plates. Fractures of the clavicle are not forgiving fractures, and the locking plate is not a sanctifying attribute. Expertise in operative treatment of

displaced midshaft clavicular fractures is necessary to achieve good results. When not available, a reluctant approach to these fractures is recommended.

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