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Complications of clavicle fractures treated with intramedullary fixation

Peter J. Millett, MD, MSc[a,*], Jason M. Hurst, MD[a], Marilee P. Horan, MPH[a], Richard J. Hawkins, MD, FRCS(C)[b]

[a]*Steadman Clinic & Steadman Philippon Research Institute, Vail, CO, USA*
[b]*Steadman Hawkins Clinic of the Carolinas, Greenville, SC, USA*

Hypothesis: Recent studies have demonstrated better outcomes with operative fixation of displaced midshaft clavicle fractures. We hypothesize that the risk of major complication with intramedullary fixation for clavicle fractures will be low.

Materials and methods: Clavicle fractures in 58 patients were treated with intramedullary fixation. Patients were excluded for concomitant pathologies and prior surgery status. Data collected included age, gender, treatment, fracture location, time of pin removal, type of complication, dates of further surgery, and American Shoulder and Elbow Surgeons (ASES) score. Complications were grouped into major (infection, nonunion, malunion) and minor (skin erosion, painful hardware, hardware breakage without consequence) categories. The mean age at surgery was 38 years (range, 18-67 years). All pins were removed at an average of 67 days (95% confidence interval, 54-85).

Results: Of the 58 patients, 15 (25.8%) complications occurred in 14 patients (24.1%). Five (8.6%) were classified as major (5 nonunions requiring revision surgery). Ten (17.2%) were classified as minor (1 delayed union, 2 superficial wound infections, 2 hardware failures after union, 5 skin erosions with pin exposure but without significant infection). Postoperative ASES scores average 89 at a mean follow-up of 7 years.

Discussion: Complete union and function were achieved in most patients, with an 8.6% risk of major complication. Intramedullary fixation has the potential for early but temporary hardware prominence, hardware exposure, and a slightly higher incidence of nonunion.

Conclusion: Patients with intramedullary fixation can expect smaller scars, no long-term hardware complications, and small potential for refracture or further hardware-related complications after hardware removal.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Midshaft clavicle; intramedullary fixation; Rockwood clavicle intramedullary fixation

Clavicle fractures are relatively common injuries and have traditionally been treated with nonoperative care.[9] Studies have historically report a high rate of union and insignificant sequelae from malunited fractures.[10,13] More recent reports, however, have shown a higher nonunion rate and worse patient outcomes with displaced clavicle fractures treated nonoperatively than previously reported.[6]

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*Reprint requests: Peter J. Millett, MD, MSc, Steadman Philippon Research Institute, 181 W Meadow Dr, Ste 400, Vail, CO 81657.

E-mail address: drmillett@steadmanclinic.net (P.J. Millett).

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A recent study has also shown that patients with displaced midshaft clavicle fractures tend to have Constant shoulder scores and Disabilities of Arm, Shoulder and Hand (DASH) scores that indicate significant residual shoulder disability in addition to loss of significant shoulder strength and endurance.[7]

Operative fixation of displaced midshaft clavicle fractures has become more common in the last few years, possibly as a reaction to these more recent studies.[4,6,17] In fact, a recent multicenter, randomized, clinical trial comparing nonoperative treatment of displaced clavicle fractures with plate fixation demonstrated improved patient satisfaction, objective functional scores, time to union, and less symptomatic malunion in the group treated with open reduction and plate fixation.[4]

The most common surgical options for operative management of displaced midshaft clavicle fractures are plate fixation and intramedullary fixation. Plate fixation has been extensively studied and used with good results and few complications.[8,12,17] However, some patients complain of scar-related pain, prominent plate hardware, and cosmetic complaints due to the scar.[16]

Intramedullary fixation is an accepted method of treating displaced midshaft clavicle fractures and was originally described by Peroni in 1950.[11] The modern use of intramedullary fixation has advantages of smaller incisions, less extensive dissection, load-sharing fixation that encourages copious callous formation, and obligatory hardware removal that eliminates the concern for future hardware complications.[2,15] Despite these potential advantages, some significant complications have been recently reported:

- Strauss et al[14] reported complications in 8 of 16 patients (50%) after the use of smooth Hagie pins, including 3 cases of hardware prominence with 1 case of skin breakdown, 2 cases of pin breakage, 2 cases of decreased sensation at the incision, and 1 case of persistent pain at the fracture site after pin removal.
- Arrington and Johnson[1] document an intraoperative complication rate of 16% while using the Hagie pin. These problems included incidents of pin breakage, anterior cortical penetration, and drill bit breakage during placement of the implant. They also reported postoperative complications of 43% skin irritation, 22% loss of reduction greater than 5 mm, and 5% superficial wound infections.
- Grassi et al[5] evaluated the outcomes after the use of 2.5-mm threaded pins and reported complications of 20% infection, 7.5% refracture after pin removal, and 5% hardware failure.

Despite literature outlining significant complications using Steinman and Hagie pins, reports regarding the complication profile of the intramedullary clavicle pin (Rockwood Pin, Depuy, Warsaw, IN) appear more promising. Thyagarajan et al[16] reported a complete lack of complications after the use of the modern Hagie-type clavicle pin in 17 cases. To date, this small case series of 17 patients is the only reported series of this type of fixation device and its use for acute displaced midshaft clavicle fractures that compares results with plate and screw and nonoperative treatment.

The purpose of this study was to examine the complication profile of 58 consecutive patients with displaced clavicle fractures treated with the modern type intramedullary clavicle pin, a device specifically designed for operative treatment of clavicle fractures.

Materials and methods

Data collection for this study was approved by the Vail Valley Medical Center Institutional Review Board, which had a yearly renewal protocol.

This was a retrospective chart review of consecutive patients who underwent operative treatment with intramedullary clavicle fixation using the Rockwood Clavicle Pin from 2000 to 2007. We identified 66 patients with diaphyseal midshaft clavicle fractures that failed conservative management or elected for acute operative fixation. No patients with proximal or distal clavicle fractures were included. Eight patients were excluded, 2 with concomitant fractures that required surgical intervention, 1 patient had a prior surgery on the involved shoulder, and 3 patients were aged younger than 18. There were 58 patients (45 men, 13 women) in the final study population. The mean age at surgery was 38 years old (range, 18-67 years). All patients that presented to the senior authors (P.J.M., R.J.H.) were candidates for inclusion in this series. Patients typically had type 2 midshaft fractures. Patients with butterfly fragments were included.

A plate was chosen if there was a segmental component, the bone quality was poor, there were relevant comminution, or if the fracture extended beyond the middle third. Even with these preoperative selection criteria, 51 patients underwent intramedullary fixation, with plate fixation used in only 7 patients. Data collected included age, gender, injury site, surgery date, surgeon, treatment, fracture location, the time of pin removal, type of complication, dates of further surgery, and American Shoulder and Elbow Surgeons (ASES) score (scale 0-100, 100 = best) and daily pain (1-10, 1 = no pain and 10 = extreme pain).

Complications were classified as major and minor. Minor complications included skin irritation, skin breakdown with pin exposure but without infection, superficial wound infection, painful prominent hardware, delayed union, or hardware failure with union. Major complications included deep tissue infection, fracture nonunion or malunion, nerve injuries, and hardware failure without union. The postoperative course was reviewed in an effort to determine the incidence of postoperative complications. Univariate analysis was performed with the analysis of variance test for 2-group comparisons. Continuous data are reported with the 95% confidence intervals (CI).

Surgical technique

After administration of general anesthesia, the patient was placed in the beach chair position with the injured extremity prepared and