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The operative outcomes of displaced medial-end clavicle fractures

Verinder S. Sidhu, BSc, MBBS (Hons), MS[a,b,*], Deborah Hermans, RN[a,b], David G. Duckworth, MBBS, FRACS[a,b]

[a]*Hornsby Hospital, Hornsby, NSW, Australia*
[b]*Sydney Adventist Hospital, Wahroonga, NSW, Australia*

Background: Nonoperative treatment of displaced medial clavicle fractures often leads to poor functional outcomes and painful nonunions. This study investigates the functional outcomes of patients undergoing operative fixation of these fractures.

Methods: We investigated 27 patients undergoing operative fixation of a medial clavicle fracture; 24 had an acute, displaced fracture and 3 had fixation for nonunions. Preoperative radiographs or computed tomography scans were obtained, and data collected included age, sex, mechanism of injury, and fixation method. Follow-up included physical examination and radiographs for assessment of union; Disabilities of the Arm, Shoulder, and Hand scores at 12 months; and the recording of complications.

Results: The median age was 37 years (interquartile range, 17-47 years). There were 26 male patients and one female patient included, with 7 physeal injuries and 20 adult injuries. The most common mechanism of fracture was vehicular accident (n = 15). Three patients had operations for nonunions and 2 for a periprosthetic fracture medial to an existing plate. The fracture was fixed with plate and screws in 19 cases and with transosseous sutures in 8 cases. The median Disabilities of the Arm, Shoulder, and Hand score at 12 months was 0.4 (interquartile range, 0-5.0), with a union rate of 100% at 12 months. All patients had full shoulder range of motion at final follow-up and were able to return to preinjury occupational activities. There were no significant complications.

Conclusion: Operative fixation of displaced medial clavicle fractures results in anatomic reconstruction and excellent functional outcomes, even in the setting of fixation performed for symptomatic nonunion. Early intervention can minimize the risk of painful nonunion.

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

Keywords: Clavicle; fracture; medial; operative; fixation

Fractures of the medial third of the clavicle are rare and make up only 2% to 4% of all clavicle fractures.[15,18,20,21] These fractures have traditionally been treated nonoperatively, even when they are significantly displaced. Concerns about catastrophic intraoperative complications have prevented a more aggressive operative approach to these

Ethics approval was obtained from both hospitals before the commencement of this study.

*Reprint requests: Verinder S. Sidhu, BSc, MBBS (Hons), MS, Unit 5/215 Wigram Road, Annandale, NSW, 2038, Australia.

E-mail address: verinder.s.sidhu@gmail.com (V.S. Sidhu).

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fractures, with intervention classically being reserved for open fractures or fractures with neurovascular compromise.[25]

However, nonoperative treatment of these fractures can lead to poor functional outcomes and symptomatic, painful nonunions; some studies reported an overall nonunion rate approaching 15%, and others reported that up to half of patients are symptomatic a year after injury.[15,21,24] This study aims to investigate the long-term functional outcomes of 27 adult and adolescent patients undergoing open reduction and internal fixation of a displaced medial-end clavicle fracture. In doing so, we aim to expand on the series of 5 patients published by Low et al in 2008[13] (conducted at the same institution) and to demonstrate that these fractures can be treated with operative fixation, resulting in excellent long-term functional outcomes.

Materials and methods

Patients who underwent open reduction and internal fixation of an acute displaced medial-end clavicle fracture or patients who underwent fixation for a symptomatic, painful nonunion were consecutively recruited from one surgeon's (D.G.D.) prospectively maintained database between 2001 and 2014. A medial clavicle fracture was defined as one that occurred in the anatomic medial third of the clavicle, as defined by Allman.[1] A fracture was considered to be displaced if it was displaced by >10 mm.[24] A patient was deemed to have a nonunion if a period of 6 months had passed and the patient had persistent pain on palpation, with no radiographic evidence of bone healing (as seen on a radiograph and computed tomography [CT] scan). Both adolescent and adult patients were included, and all patients had closed fractures. No patients had an associated sternoclavicular joint dislocation. Descriptive and demographic data collected included age, sex, and mechanism of injury. Preoperative assessment included physical examination, radiographs, and CT scans with 3-dimensional reconstructions for preoperative planning and to assess the proximity of the fracture to neurovascular structures.

Surgical intervention consisted of a direct approach to the deformity and exposure of the fracture edges (Fig. 1). The fracture was reduced primarily with bone clamps and fixed with either transosseous sutures or a plate and screws. The transosseous suture technique was used primarily for physeal injuries and involved drilling 3 or 4 paired 2-mm burr holes on each side of the fracture. One hole was placed through the superior cortex of the metaphysis, and the second paired hole was placed through the superior cortex of the physis. A suture was then passed through each hole, and these were then tied with the knot lying superior to the fracture site. For patients undergoing fixation with plate and screws, a variety of constructs were used, depending on the fracture anatomy and preoperative CT scans. All plates were placed on the superior border of the clavicle, with unicortical locking screws being used on the medial fragment and bicortical cortex screws on the lateral fracture fragment. Unicortical anteroposterior interfragmentary screws were used as deemed necessary on the basis of the anatomy of the fracture.

Postoperatively, patients were immobilized in a shoulder immobilizer for 2 to 4 weeks. After 2 weeks, patients were able to gradually use the arm as comfort allowed if it was a well-fixed and stable fracture. After 6 weeks, active range of motion was allowed in all cases and an increase in overhead activity if sufficient healing had occurred. Normal activity, including sport, was not allowed until full union had occurred, and this ranged from 6 weeks to 4 months. No physiotherapy was required.

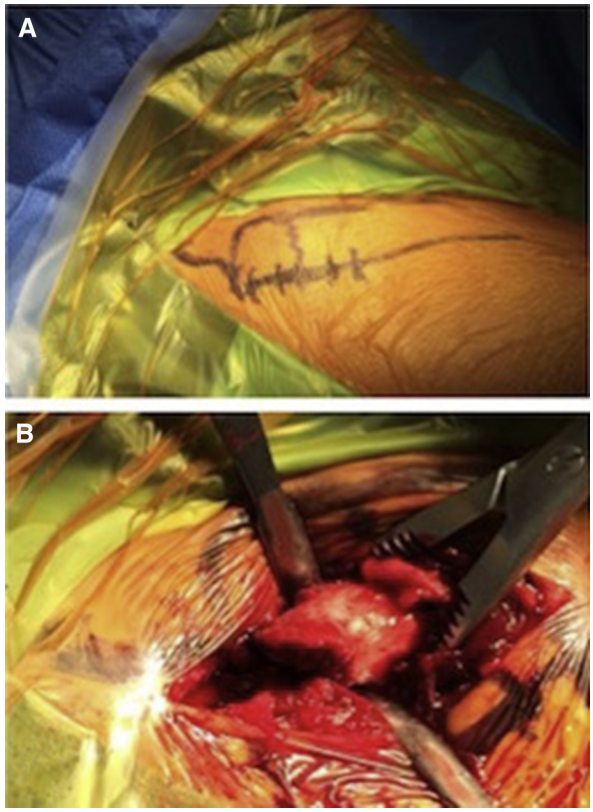

Figure 1 Operative technique. (**A**) The patient is positioned in the beach chair position, and the medial clavicle and fracture are marked. (**B**) An approach from the inferior edge of the clavicle is used to expose the fracture, and the fracture is reduced with bone clamps.

Postoperative follow-up was carried out at the 2-week, 6-week, 12-week, 6-month, and 12-month appointments or until full bone union had occurred. The primary outcomes were the achievement of bone union (assessed at follow-up by physical examination and radiographs) and Disabilities of the Arm, Shoulder, and Hand (DASH) scores recorded at 12 months postoperatively. Any postoperative complications were recorded at each follow-up visit, and patients were also asked whether they had returned to sport, whether there was any irritation over the plate or sutures, whether their shoulder felt normal, and whether they would have the same operation again if they had sustained the same injury on the contralateral side. The minimum follow-up time for inclusion in the study was 12 months.

Results

There were 24 patients identified between 2001 and 2014 who underwent open reduction and internal fixation of an acute, displaced medial-end clavicle fracture and 3 who underwent fixation of a nonunited medial clavicle fracture,