Treatment of Displaced Distal Clavicle Fractures With a Single Cortical Screw

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Abstract: The authors retrospectively evaluated the effects of a single cortical screw in the open reduction and internal fixation of displaced distal clavicle fractures. Fifteen patients without associated acromioclavicular joint dislocation were treated by open reduction and internal fixation with a single cortical screw (4.5-mm diameter, 60-mm length) between 2004 and 2011. Mean follow-up was 39.2 months (range, 13-84 months). Reduction with a fracture gap of less than 1 mm and solid union were achieved in all cases. Delayed superficial infection developed in 1 patient. All other patients had good to excellent final Constant-Murley functional results.

Displaced distal clavicle fractures are notorious for high rates of nonunion following treatment, which can lead to pain and impaired function of the shoulder girdle and upper limb.1,3 Thus, open reduction and internal fixation is recommended most often to treat this unstable injury. Numerous methods of fixation are suggested, but many require an extensile exposure and involve high costs.1-3 Intramedullary fixation with a Knowles pin has been used to reduce and fix distal clavicle fractures and has resulted in good reduction in some cases.4 Extra-articular5 and transacromial6 Knowles pin fixation has also been reported to produce excellent results. However, hardware complications exist, including loss of reduction, distal skin irritation with infection, and lateral pin migration.7 Since 2004, the current authors have been using a single cortical screw to treat displaced distal clavicle fractures in select patients. In this study, the authors present this technique and evaluate the results retrospectively.

MATERIALS AND METHODS

Between 2004 and 2011, fifteen cases of displaced distal clavicle fractures were managed with open reduction and internal fixation with a single cortical screw (4.5-mm diameter, 60-mm length) after obtaining informed consent from all patients. Indications included transverse or short oblique fractures and intact distal fragment between 10 and 25 mm in length. Associated separation of the acromioclavicular ligaments was carefully checked clinically and radiographically before treatment because 20% of displaced distal clavicle fractures may have disruption of the acromioclavicular ligaments.8 Patients with open fractures, pathological fractures, previous surgeries on the affected clavicle or shoulder, gross neurovascular injury, intra-articular comminution, or associated acromioclavicular joint injuries were excluded. All surgeries were performed by the same orthopedic surgeon (C.-K.H.).

The study group comprised 11 men and 4 women with a mean age of 47.2 years (range, 20-78 years) at injury. All patients have complete data from the final evaluation. Five patients injured their left side and 10 injured their right side. All cases were managed within 1 week of injury and were evaluated preoperatively with plain radiography, including 1 chest posteroanterior view and 1 shoulder anteroposterior view. Plain radiographs are sufficient to confirm the diagnosis and to provide information regarding fracture classification.9 Other associated injuries were managed as needed without surgical intervention.
All patients used an arm sling for 4 weeks postoperatively. Active shoulder range of motion was allowed as tolerated immediately postoperatively. Follow-up examinations were performed 2 weeks postoperatively and then every month until union was confirmed by radiographs. Functional evaluation using the Constant-Murley score and subscapularis test was performed on an outpatient basis before screw removal.

**Surgical Technique**

All fractures were treated while the patient was under general anesthesia in a beach-chair position. First, a horizontal incision approximately 4 cm in length was made between the acromioclavicular joint and the medial end of the palpated fracture site. It is important to minimize disturbances to the coracoclavicular ligament and acromioclavicular joint capsule during dissection and prevent dispersion of the fragments in the capsule envelope. With minimal periosteal stripping, the fracture ends and superior acromioclavicular ligament of the joint capsule were exposed (Figure 1). Reduction was performed under direct visualization with a reduction clamp.

The intramedullary cavities of both fragments were then predrilled with a 3.2-mm drill bit through the distal fragment to the proximal fragment from the entry point posterior to the acromioclavicular joint capsule in an anteromedial direction. A 4.5-mm-diameter, 60-mm-long AO/ASIF cortical screw was inserted under reduction from the entry point in the posterolateral corner of the distal fragment. Without penetrating the proximal fragment, the screw head was pressed tightly against the posterolateral periosteum (Figure 2).

The coracoclavicular ligaments were not repaired because the acromioclavicular ligament was spared and remained intact throughout the procedure. Fixation stability was tested against free shoulder joint range of motion without displacement after fixation. The wound was irrigated and closed with appropriate sutures. The final position of the screw is shown in Figure 3.

**RESULTS**

All 15 fractures were classified as Neer type II fractures: 5 type IIA and 10 type IIB. In the 15 procedures performed, mean intraoperative blood loss was less than 20 cc (range, 5-20 cc), with a mean operative time of 26 minutes (range, 20-48 minutes). Mean hospital stay was 3 days (range, 2-5 days). All 15 cases achieved union with congruent reduction at a mean of 11 weeks (range, 6-16 weeks). Mean follow-up was 39.2 months (range, 13-84 months). One case of superficial wound infection was noted at final follow-up. All patients had good or excellent functional results, with an overall mean Constant-Murley score of 96 (range, 92-100) at final follow-up and a score difference of less than 12 compared with the healthy side of shoulder. Final radiographic evaluation showed anatomic congruent
reduction (less than 1 mm displacement) and solid union in all cases. The radiographs of a 20-year-old woman are shown in Figure 4. All 5 associated injuries healed without sequelae.

No iatrogenic neurovascular injury developed in this series. No subcutaneous hematoma, distal skin irritation, or screw migration were observed. All patients had a negative supraspinatus test with intact rotator cuff function. One (6.6%) postoperative complication of superficial wound infection was treated successfully.

**DISCUSSION**

Distal third clavicle fractures often result from a direct, high-energy force, such as motor vehicle collisions, in younger patients and falling accidents in elderly patients. The distal fragments are usually small and comminuted, and it is difficult to achieve secure fixation and early mobilization. Conservative treatment of these fractures often fails.9

Several surgical methods have been reported for stabilizing this unstable fracture, especially with the development of the locking or hook plate system.3,10 Hook plating techniques handle these small fragments well but may cause general complications, such as infection, loss of reduction, hematoma, nonunion, and specific complications, including acromial fracture at the hook, hook cutout, rotator cuff tear, and subacromial impingement.3 Removal is suggested immediately after bony union in cases of acromial osteolysis or fracture.7 Other possible complications include subclavian vessel and supraclavicular nerve penetration and skin erosion.9 The extensile soft tissue stripping and weakness of bone after removal are also concerns with plating techniques.

In a study by Fann et al.6 transacromial intra-articular Knowles pin fixation was reported with satisfactory results, but acromioclavicular joint arthrosis may cause concerns. Therefore, this approach may be reserved for patients with acromioclavicular joint instability.11 In another study, transacromial extra-articular Knowles pin fixation indirectly fixed the fracture with suture augmentation; however, a high rate (32%) of lateral pin migration was observed.5 In a study by Jou et al.4 intramedullary extra-articular fixation of the fracture from the posterolateral corer of the clavicle with a Knowles pin was successful in 12 patients, but 2 (16.7%) patients developed distal skin irritation. The lag effect of Knowles pins also limits pin tightening and makes immediate range of motion risky.

Cortical screws with a 4.5-mm diameter are robust enough to withstand the forces generated across the fracture site during union. Furthermore, the screw diameter is larger than that of a Knowles pin, so the fixation is more rigid. Mean length of the distal clavicle fragment was approximately 28.5 mm.4 In the current study, all of the distal fragments were smaller than 3.0 cm. Thus, a 4.5-mm-diameter, 60-mm-long cortical screw may provide more secure fixation than a 3.2-mm Knowles pin. The cortical screw head is smaller than the hub of a Knowles pin. The low profile of the screw head solves the problem of distal skin irritation noted with Knowles pins, but it is still palpable. Furthermore, its blunt tip improves proximal skin irritation, especially in slender female patients.

The advantages of intramedullary fixation include a smaller incision, reduced soft tissue stripping with a shorter operative time, and the relative protection of the supraclavicular nerves. The screw’s all-threaded structure, with no lag effect, allows for immediate and full passive range of motion and provides enough load-sharing mechanical strength during union. In the current series, no hardware migration or breakage was observed, which may be a disadvantage of intramedullary fixation.12

The cortical screws are inexpensive and available in most orthopedic units.

The strengths of the current study include the follow-up duration and the use of a patient-oriented outcome. The limitations of this study include a small case number and its retrospective nature. A study involving a larger series is warranted.

**CONCLUSION**

In displaced distal clavicle fractures without intra-articular comminution or associated acromioclavicular joint dislocation, a single cortical screw with a 4.5-mm diameter is useful and effective in reduction and fixation. The medical cost is low and the procedure is minimally invasive, with a small amount of blood loss and a short hospital stay.


