Case report 1

A 20-year-old female sustained a painful left-shoulder disability following a motorcycle crash accident. She injured her left shoulder with direct impact to the ground and had no associated neurovascular injuries. At our Emergency Department, she was conscious with a facial abrasion. The radiographic exam there disclosed an unstable fracture of the distal clavicle. A Zanca view showed a decreased coracoclavicular distance as compared to the uninjured shoulder. The medial clavicular fragment was inferiorly displaced without bone contact (Fig. 1A).

In this case, we felt that surgical intervention was indicated. A transverse incision was used, and the medial clavicular fragment was found to be inferiorly displaced. As we reduced this fragment, we found that the coracoclavicular ligament was torn. After reduction, internal fixation was completed with insertion of a bicortical threaded Knowles pin of adequate length (Fig. 1B).

Pendulum exercise was started immediately after surgery, and a sling was used for protection for 4 weeks. The fracture united smoothly by 3 months after surgery. This pa-

Figure 1A. 20-year-old female with distal clavicular fracture. Zanca view demonstrates an inferiorly displaced fracture.

Figure 1B. 20-year-old female with distal clavicular fracture after open reduction and internal fixation with a pin. Union was achieved without obvious complications.

Distal clavicular fractures were classified by Neer in 1963. A type II fracture leads to a high rate of delayed union, or nonunion, with undesirable symptoms. Type II distal clavicular fractures usually exhibit superior displacement of the clavicle. We report two cases of distal clavicular fracture with inferior displacement and posterior displacement. Open reduction and internal fixation was performed in both patients, resulting in excellent functional outcome. As far as we know, this is the first report for these fracture patterns.
tient had good function of her shoulder joint after completing rehabilitation. She returned to her work as usual and had an excellent recovery without any complications or mobility problems.

Case report 2

A 24-year-old male sustained a painful right-shoulder injury following a motor vehicle collision. There were no associated injuries found during the initial assessment, and physical examination disclosed no neurovascular injuries.

Radiographic examination included anteroposterior, axillary, and suprascapular Y views of the shoulder. These revealed posterior displacement of the medial fragment of the clavicle (Figs. 2A, 2B, and 2C).

Based on these findings, we felt that surgery was indicated. We performed open reduction with a longitudinal approach. Total rupture of the coracoclavicular ligament was identified. After reduction, internal fixation was achieved by one circular, heavy, nonabsorbable Mersilene tape suture through the coracoclavicular region in a looping fashion. Under a sling for protection, a pendulum exercise program was started after surgery. A gradual overhead exercise and strength rehabilitation program was then scheduled. The patient achieved an excellent functional outcome despite this injury. He returned to his preinjury status, including work, in six months. Radiographic followup at six months showed osseous union (Fig. 2D). There were no associated complications after surgery.
Discussion

Neer recognized the unique behavior of distal clavicular fractures and reported a separate classification for them in 1963 (1, 2). In a type I fracture, the coracoclavicular ligament is intact. In a type II fracture, the coracoclavicular ligament detaches from the medial fragment, but the trapezoid ligament remains connected to the distal fragment. A type III fracture is intra-articular and extends into the acromioclavicular joint. In 1982, Rockwood created two distinct subsets of Neer's type II fracture of the distal clavicle: type IIA, in which both the conoid and trapezoid ligaments remain attached to the distal segment; and type IIB, in which the conoid ligament is torn and the medial segment is unstable (3). Both of these typologies describe superior displacement of the medial fragment; neither of them mention examples of inferior displacement of the medial fragment. In our report, we describe two cases of inferior displacement of the medial fragment of a distal clavicular fracture. Both cases were treated surgically, with good radiographic and functional outcomes. As far as we know, no similar cases have been reported in the literature.

Figure 3. 20-year-old female with distal clavicular fracture. She demonstrated inferior displacement of the medial fracture fragment, with tears of both the trapezoid and the conoid components of the coracoclavicular ligament.

In a study of the mechanism of clavicular injuries, Stanley et al (4) questioned 122 patients who had had a clavicle fracture and asked them to describe their mechanism of injury as a fall onto an outstretched hand, a fall onto the shoulder, a direct blow to the shoulder, or some other mechanism. In 87% of patients, the mechanism described was a fall onto the shoulder. Seven percent of patients described a direct blow to the shoulder, and only 6% described a fall onto an outstretched hand. There was no correlation between fracture location and mechanism of injury. Most authors discovered that direct trauma is the main cause of clavicular failure (5).

Neer recognized and classified distal clavicular fractures as an entity distinct from other clavicle fractures because of their unique behavior (1, 2, 6). Treatment recommendations for this type of fracture are more controversial for this fracture type than for the midclavicle. In Neer's original series of clavicle nonunions, he discovered that, although distal clavicular fractures were uncommon, they accounted for one-half of the nonunions (6).

Figure 4. 20-year-old female with distal clavicular fracture. She demonstrated inferior displacement of the medial fracture fragment, with tears of both the trapezoid and the conoid components of the coracoclavicular ligament.

In his study of fracture patterns, Neer found that the type I fracture was more common by a 3:1 margin, resulted from more trivial trauma, and usually healed readily. If late symptoms developed, they were usually secondary to fracture extension into the acromioclavicular joint (type III) and subsequent post-traumatic arthrosis. Type II fractures, alternatively, are unstable injuries. Type II fractures are secondary to four displacing forces: 1) the weight of the arm; 2) the pull of the pectoralis major, pectoralis minor, and latissimus dorsi; 3) scapular rotation, which affects the distal segment but not the proximal; and 4) the trapezius muscle, which draws the medial segment posteriorly and superiorly.

Our patients were unusual because their fracture sites were located lateral to the coracoclavicular ligament (conoid ligament at least), but they both had an unstable presentation. The unstable presentation was the remarkable displacement of the medial fracture fragment, even without bone contact in the first case (Fig. 3).

Our second case exhibited posterior displacement of the medial clavicle—a pattern not described in either Neer's or Rockwood's classification systems (Fig. 4).

Rockwood's widely accepted classification system (7), based on the original work of Tossy et al in 1963, is an expanded classification system based on the anatomic severity of the injury. Posterior displacement of the clavicle is classified as type IV, and inferior displacement (although it
is extremely rare) is classified as type VI. We felt that our patients had injuries similar to an acromioclavicular dislocation. Posterior dislocation of the distal end of the clavicle, or type IV AC dislocation, is relatively rare. The clavicle is displaced posteriorly into or through the trapezius muscle as the force applied to the acromion drives the scapula anteriorly and inferiorly. Posterior clavicular displacement may be so severe that the skin on the posterior aspect of the shoulder becomes tented. The literature concerning posterior AC dislocations consists mostly of small series and case reports (8). Inferior dislocation of the distal clavicle, or type VI AC dislocation, is an exceedingly rare injury (9). The coracoclavicular ligament, however, is intact in a subacromial dislocation and completely disrupted in a subcoracoid dislocation. In our case of inferior displacement, the coracoclavicular ligament was found to be ruptured during surgery.

If we classified our patients using Neer’s type I, we wouldn’t have chosen operative treatment for them. That would have been unfortunate for them, because a malunion or nonunion would have been highly likely. Neer found that these lesions usually resulted from more significant trauma and had a high rate of associated injuries to the adjacent ribs and coracoid, a delayed time until union, and a high rate of nonunion. Specifically, of the 12 patients treated with closed reduction, none of the fractures were united by 16 weeks, and four went on to nonunion. Other authors have commented on the high rate of symptomatic nonunion for the type II distal clavicle fracture (10-13).

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