

Acute Clavicle Fractures

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“...a fracture of the clavicle has been greatly underrated in respect to pain and disability.

...the ‘usual or routine treatment’ is perhaps far short of satisfying, relieving therapy.”

Carter R. Rowe, 1968

- Clavicle fractures are very common, accounting for 5-15% of all fractures and nearly half of all shoulder fractures.
- Middle third fractures are by far the most common, accounting for 80% of all clavicle fractures with lateral third fractures accounting for about 10-15% and medial third fractures accounting for about 5% ²³.
- It used to be thought that most clavicle fractures occurred as the result of a direct blow to the clavicle. However, the clavicle is typically fractured by a fall on to the lateral aspect of the shoulder ²⁴. Less commonly, it can also be fractured by a direct blow as seen in “seat belt fractures” or in sports such as lacrosse. There are reported cases of stress fractures of the clavicle, typically in overhead athletes.
- Midshaft clavicle fractures tend to occur in younger individuals while lateral third fractures tend to occur in older individuals.
- Earlier literature suggested that the rate of healing with non-operative treatment was quite high ^{19, 28} – approximately 99% were felt to heal without complication. However, no recent study has been able to reproduce these results. In fact, most recent studies have shown a nonunion rate of 15-25% ^{10, 21, 26}. More importantly, when looking at patient satisfaction, 30 - 50% of patients who had sustained a

clavicle fracture, even as long as ten years previously, felt that they had not fully recovered and were dissatisfied with the result ²¹.

- Most clavicle fractures are multiplanar injuries; that is, the fracture displacement occurs in multiple planes: angulation, shortening and medial rotation. This is due to the weight of the arm and the pull of the various muscles about the shoulder, particularly the anterior muscles such as the pectoralis.

Fracture Classification

- There are numerous classification systems for clavicle fractures ^{21, 24, 28}; however, it is really only important to describe them as displaced or nondisplaced and comminuted or simple. Lateral third fractures are usually referred to as Type II or III fractures; however, in this case, it is important only to recognize whether or not the stabilizing CC ligaments are involved. If the ligaments are involved, as would typically be the case in a fracture in the region of the coracoid, the fracture is inherently unstable, whereas fractures occurring in the lateral most aspect of the clavicle or lateral to the CC ligament insertions are inherently stable.
- It is important to note that in skeletally immature patients, lateral clavicle fractures are usually periosteal sleeve avulsions and can be treated non-operatively since they have considerable potential for remodeling, even towards the end of the growth period.

Clinical Evaluation

- Clavicle fractures typically do not present as a diagnostic dilemma since the injury is rather obvious in most cases. There is usually a clear history of some form of either direct or indirect injury to the shoulder. The patient typically presents splinting the injured side due to the pain. There is usually tenting of the skin over the fracture site; however, open fractures of the clavicle are quite rare.
- It is of utmost importance to assess for other associated injuries due to the trauma ^{4, 14, 18}. These can be classified as injuries to the surrounding bone and soft tissue, lung, vascular structures and the brachial plexus. A careful neurovascular exam should be documented in all clavicle fractures. The obvious nature of the clavicle

fracture should not detract from other boney injuries such as those to the scapula and underlying ribs.

Radiographic Evaluation

- Many physicians accept a single AP radiographic view to assess injuries to the clavicle; however, it is impossible to assess fracture displacement on a single radiograph. Unfortunately, it is not possible to obtain orthogonal views (views at right angles to each other) of the clavicle. The next best technique is to obtain an AP and 45 degree cephalic tilt AP radiograph. The contour and displacement can best be seen on the 45-degree cephalic tilt view.
- Lateral third clavicle fractures must include an axillary radiograph to assess posterior displacement of the medial fragment relative to the lateral fragment.
- It is not possible to assess accurately shortening of a clavicle fracture on plain radiographs. This is because the shortening occurs obliquely to the plane of the radiograph. In fact, short of 3D CT reconstructions with side-to-side comparisons, shortening can only be measured clinically.

Treatment

- The statement that “all clavicle fractures heal well” is probably one of the greatest fallacies in all of orthopaedics^{19, 28}. Many clavicle fractures can be treated non-operatively. However, as more and more studies have suggested a poorer outcome with non-operative treatment, it is important to recognize those that may require operative intervention^{10, 21, 26}.
- For those fractures that are nondisplaced or are minimally displaced (100% or less displacement and less than 15-20mm of shortening), patients can be treated in a sling or a figure of eight harness. Studies have suggested that there is no difference in these two treatment modalities¹; however, both have significant limitations. First, the figure of eight harness tends to be very awkward to put on and maintain. It should be adjusted frequently to keep proper tension on the brace. Secondly, the figure of eight harness itself usually lies directly over the fracture

and can actually exacerbate the discomfort rather than alleviate it. The advantage of the figure of eight harness is that it frees up both upper extremities for day-to-day activities. It can also be used quite successfully in treating medial third clavicle fractures. The primary problem with the sling is that it is typically worn with the arm internally rotated and this can exacerbate the shortening and rotation of the fracture. If used, the sling is better if the arm is held in a neutral position; i.e., with the forearm pointing straight ahead.

- An attempt at closed reduction of clavicle fractures is not only painful but also probably futile. At best, patients will remain in the position they present with on first evaluation. Repeat exams and radiographs are justified to make sure a minimally or non-displaced fracture remains so.
- In the case of lateral third fractures, a Kenny Howard brace, which forces the clavicle downward and the shoulder/arm upward, can be tried; however, compliance with this brace is very poor. Ironically, patients who do comply with wearing of this brace can be at risk for skin breakdown under the brace.
- There are certain cases where operative intervention is indicated^{10, 21,26}:

1. Neurovascular injury or compromise that is progressive or that fails to reverse with closed reduction of the fracture

2. Severe displacement caused by comminution with resultant angulation and tenting of the skin severe enough to threaten its integrity and that fails to respond to a closed reduction

3. An open fracture that will require operative debridement

4. Multiple trauma, when mobility of the patient is desirable and closed methods of immobilization are impractical or impossible

5. A "floating" shoulder, with a displaced clavicular fracture and an unstable scapular fracture, with compromise of the acromioclavicular and coracoacromial ligaments.

6. Factors that render the patient unable to tolerate closed immobilization, such as the neurological problems of Parkinsonism, seizure disorders, or other neurovascular disorders

7. The very rare patient for whom the cosmetic lump over the healed clavicle would be intolerable

- A relative indication for operative intervention is displacement of the fracture fragments more than 100% (the width of the clavicle) and shortening more than 20mm. Most poor outcomes after non-operative treatment of clavicle fractures occur in patients who have more this much displacement. In addition, patients who have a butterfly fragment that is flipped 90 degrees on the 45-degree cephalic tilt radiograph tend to have poorer outcomes and should be considered for operative intervention ²¹.

Operative Treatment

- There are two primary forms of operative treatment of midshaft clavicle fractures: plate and screw fixation and intramedullary fixation. Due to the significant forces placed on the clavicle, most other types of fixation, such as circlage wires, are inadequate, and should not be considered.
- One type of fixation that is contraindicated in clavicle fractures is smooth wire fixation. For some reason, smooth wires have a very significant tendency to migrate and the literature is replete with cases of smooth wires migrating from the shoulder to almost unimaginable locations such as the lung, abdomen, and spine ^{15, 17, 20, 29}.
- Both intramedullary fixation and plate fixation have been shown to have good outcomes in treating clavicle fractures. The choice is more related to the experience and comfort level of the surgeon in regards to operating in this area. The primary advantage of plate and screw fixation is that most orthopaedic surgeons are comfortable with using this technique. The primary disadvantage is that this type of surgery has to be performed through a rather large, non-cosmetic incision with the risk of compromise of the bone's blood supply due to soft tissue stripping. Removal of the plate and screws requires a second major procedure that can leave the clavicle with multiple stress rises and can place the patient at risk for later re-fracture ³.
- The primary advantage of intramedullary fixation is that it can be accomplished through a small, cosmetic incision and the hardware can later be removed under

local anesthesia. The primary disadvantage of this type of fixation is that most surgeons are unfamiliar with this technique and that fact that there is less rotational control of the fragments with the intramedullary fixation ⁹.

- Lateral third clavicle fractures represent a special dilemma: most occur in older patients from standing height falls; however, the nonunion rate from non-operative treatment is rather high ^{25, 27}. Some surgeons suggest that many of these nonunions are relatively asymptomatic; however, most surgeons feel that operative intervention is indicated due to the high nonunion rate ^{5, 7, 13, 30}.
- Fixation of lateral third fractures can be difficult due to the location of the fracture and the difficulty in getting enough adequate purchase with the fixation devices. Plate and screw fixation is very difficult to achieve unless the plate extends out on to the acromion ¹⁶. Because of this, most surgeons prefer suture circlage or coracoclavicular screw fixation ^{2, 30}. Pin or smooth wire fixation through the acromion and into the clavicle can be used; however, this is rather weak fixation and carries the risk of damage to the acromioclavicular joint and smooth pin migration ⁸. With suture fixation, sutures are passed around the coracoid the around or through the medial clavicle fragment to achieve and hold the reduction. Although relative easy to do, there is a risk of the sutures sawing through the clavicle or coracoid if non-absorbable sutures are used. Absorbable sutures can be used; however, these may weaken and fail before adequate healing has taken place. With coracoclavicular screw fixation, a screw is passed through the medial fragment into the coracoid. This is a very strong form of fixation when properly placed; however, it is technically more difficult and the screw should be removed once healing is achieved, necessitating a second operative procedure.
- Late treatment of lateral third nonunions usually consists of excision of the distal fragment. The medial fragment must be stabilized with a ligament transfer due to the earlier injury to the CC ligaments. Failure to do so can result in significant instability of the clavicle.
- Intraarticular distal clavicle fractures can be treated with rest until there is evidence of radiographic and clinical healing. If the patient has later symptoms,

they can be treated with a simple distal clavicle resection. Stability of the remaining clavicle should be assessed at the time of surgery.

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