Clavicle Fracture Solutions - Case Series

Treated with:
Locking Clavicle Plating System
Dual-Trak Clavicle Screw System

ACUMED®
Innovative Solutions

Case Series: Clavicle Fracture Solutions

Indication: Medial Clavicle Fracture

Products: Locking Clavicle J-Plate

Surgeon: William B. Geissler, M.D.

Patient History

The patient is a 15-year-old male, who presented with severe pain to the medial portion of the clavicle following a motor vehicle accident. He sustained a direct blow to his chest when it hit the steering wheel. Physical examination found severe tenting of the skin anteriorly near the insertion of the clavicle to the sternum. A 3D CT scan demonstrated a rare medial clavicle fracture (Figure 1). This only occurs with approximately five percent of all clavicle fractures. 3D CT scans are recommended with medial fractures as anatomic structures may obscure the view of the fracture as seen with regular X-rays.

Treatment

The fracture was addressed utilizing an Acumed® Locking 8-Hole Distal Plate (J-Plate-Figure 2). In this instance a left J-Plate was selected to stabilize the right medial clavicle fracture as it fits the medial portion of the clavicle quite nicely. The lateral flare of the plate matches the flare of the most medial aspect of the clavicle and the curvature fits the curve to the medial shaft portion of the clavicle.

Postoperative Results

The A/P radiograph shows anatomic restoration of the clavicle (Figure 3). Multiple screws were able to be placed medially into the medial head fragment and the locking/nonlocking screws were placed laterally into the shaft. This restored the anatomy and took away the prominence that the patient had preoperatively due to the amount of separation.

For the first four weeks postoperatively, the patient was placed in an arm sling. At the end of this period, the patient was allowed to participate in passive range of motion exercises including pendulum, Codman, isometric bicep, and elbow and wrist motion. Active strengthening was initiated at six weeks and a full return to activities was permitted once healing was observed radiographically.

I emphasized to the patient that he must avoid any activity involving heavy lifting, pushing or pulling. Because of the immediate pain relief, I emphasize this to all patients, but especially the younger males and athletes who tend to be more active and are more likely to stress the repair.

Figure 1: Preoperative CT Scan

Figure 2: Intraoperative Photograph

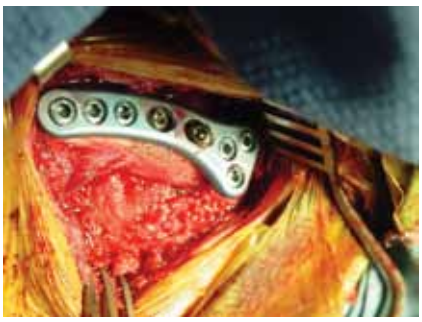


Figure 3: Postoperative Radiograph

Case Series: Clavicle Fracture Solutions

Indication: Nonunion Midshaft Clavicle Fracture with Allograft

Products: Locking Superior Clavicle Plate

Surgeon: William B. Geissler, M.D.

Patient History

This patient is a 63-year-old female who sustained a fracture of the clavicle approximately two years previous after a fall in which she experienced a direct blow to the top of her clavicle. The patient was initially treated in a sling and immobilized following the injury. Despite treatment with a sling, she continued to experience persistent discomfort.

The patient, who has a history of being a heavy smoker, did not seek medical care until recently. A physical exam showed clinical deformity of the left shoulder girdle, displaced medial and inferior when compared to the right. The medial fragment was quite palpable and tented the skin. The patient's active motion was limited to 90° of flexion, 80° of abduction with pain centered over the nonunion site. Radiograph examination confirmed that the initial fracture did not heal and resulted in an atrophic nonunion of the clavicle. In nonunions, it is important to bring the clavicle out to length. To this end, the necrotic bone needs to be excised and bone graft may be used to bring the clavicle out to length.

Treatment

In this instance, an Acumed® 8-Hole Locking Superior Clavicle Plate was implanted and a fibula allograft was used to bridge the defect. The fibula is ideal for an allograft as its curvature fits the normal clavicle (Figure 1). Additionally, the central-portion of the graft may be filled with bone putty to help facilitate healing.

It is important to note that allograft is quite brittle and needs to be tapped after drilling when compared to normal bone. This will help decrease the chance of the allograft fracturing as the screws are being inserted.

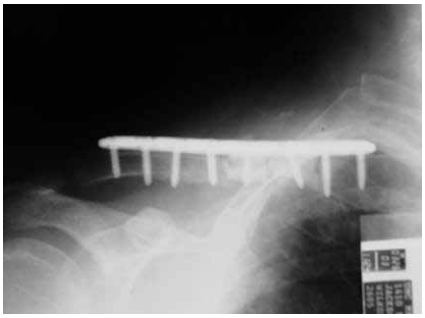
Postoperative Results

For the first four weeks postoperatively, the patient was placed in an arm sling. At the end of this period, active assisted exercises were started and active strengthening was initiated at eight weeks.

Given this patient's previous clinical history, I emphasized that she must avoid smoking as well as any activities involving heavy lifting, pushing or pulling.

Figure 1: Intraoperative Photograph

Figure 2: Postoperative Radiograph



ACUMED®

Case Series: Clavicle Fracture Solutions

Indication: Malunion of a Midshaft Clavicle Fracture

Products: Locking Superior Clavicle Plate

Surgeon: William B. Geissler, M.D.

Patient History

The patient is a 38-year-old male who sustained a fracture of the clavicle 18 months previous. The patient presented with severe prominence of the right shoulder. He could not carry a book bag due to the soft-tissue irritation and observed that his right shoulder was weaker, particularly in abduction when compared to his left shoulder.

A preoperative radiograph displayed that the previous clavicle injury had healed in a malunion. The subsequent overlap and the sharp bony prominence superiorly were the sources of the soft-tissue irritation (Figure 1).

Treatment

An Acumed® 10-Hole Precontoured Locking Superior Clavicle Plate was used to reduce the clavicle malunion after the callus was taken down. The curvature of the plate was used as a template to help restore the normal S-shaped curve of the clavicle (Figure 2). This feature is very helpful particularly in nonunions or malunions when the normal bony landmarks are not available. The key is to trust the plates to help facilitate reduction in these special circumstances.

Postoperative Results

The A/P radiograph shows healing of the clavicle malunion after it was stabilized with the Acumed® Locking Superior Clavicle Plate (Figure 3).

For the first four weeks postoperatively, the patient was placed in an arm sling. At the end of this period, the patient was allowed to participate in passive range of motion exercises including pendulum, Codman, isometric bicep, and elbow and wrist motion. Active strengthening was initiated at six weeks with an emphasis on avoiding activities involving heavy lifting, pushing or pulling. A full return to activities was permitted once healing was confirmed radiographically.

Figure 1: Preoperative Radiograph

Figure 2: Intraoperative Photograph

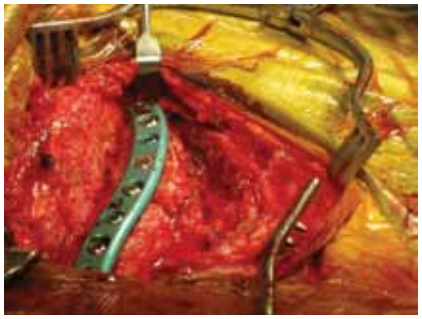


Figure 3: Postoperative Radiograph

ACUMED®

Case Series: Clavicle Fracture Solutions

Indication: Midshaft Clavicle Fracture with Superior Implant

Products: Locking Superior Clavicle Plate

Surgeon: William B. Geissler, M.D.

Patient History

The patient is a 26-year-old male who fell forward over the handlebars of his bicycle sustaining a displaced left clavicle fracture. The patient complained of severe pain to his left shoulder girdle and lack of active motion in the shoulder. The patient was initially treated with a sling, but continued to experience limited range of motion and severe pain, especially during his sleep.

A physical exam marked clear deformity of the left shoulder girdle where it was displaced inferior and medial compared to the right shoulder. The patient had palpable crepitus over the middle third of the clavicle. The medial fragment was tenting the skin with marked pain and palpation.

An A/P radiograph shows a fracture of the middle third of the clavicle, overlapped approximately 2 cm with a butterfly fragment flipped 90˚ vertically (Figure 1). It has been shown in several series that fractures displaced 15 to 20 mm or more, have a poor prognosis with lower rates of both healing and patient satisfaction. This is particularly the case with an associated vertical butterfly fragment.

Treatment

Because of the amount of displacement of the fracture, the clavicle is stabilized with an Acumed® precontoured 8-Hole Locking Superior Clavicle Plate and 3.5 mm locking and nonlocking screws. In this instance, one of the oblong compression slots in the center part of the plate was left devoid of a screw and used to help lag the fracture fragments. In particular, the lag screw captured and stabilized the butterfly fragment. It is important to note the utility of the precontoured plate as a template to help facilitate reduction of the complex S-shaped curve of the clavicle (Figure 2).

Postoperative Results

The final post-op A/P radiograph shows anatomic restoration of the clavicle (Figure 3). Note how the low-profile plate design is thick in the middle and thin in the periphery to decrease soft-tissue irritation. In fractures of the middle medial third, the plate is utilized as marked. In fractures of the middle lateral third, the plate is frequently rotated 180˚ to fit the complex curves of the clavicle.

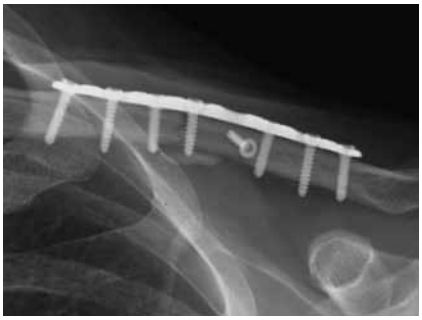
For the first four weeks postoperatively, the patient was placed in an arm sling. At the end of this period, he was allowed to participate in passive range of motion exercises including pendulum, Codman, isometric bicep, and elbow and wrist motion. At six weeks, active strengthening was initiated and a full return to activities was permitted once healing was observed radiographically.

I emphasized to the patient that he must avoid any activity involving heavy lifting, pushing or pulling. Because of the immediate pain relief, I emphasize this to all patients, but especially the young male athletes who tend to be more active and are more likely to stress the repair. Bicyclists, more than others, tend to exert a significant amount of stress upon the shoulder girdle when they shift their weight forward directly over the handlebars.

Figure 1: Preoperative Radiograph

Figure 2: Intraoperative photograph

Figure 3: Postoperative Radiograph



ACUMED®

Case Series: Clavicle Fracture Solutions

Indication: Midshaft Clavicle Fracture with Anterior Implant

Products: Locking Anterior Clavicle Plate

Surgeon: William B. Geissler, M.D.

Patient History

The patient is a petite 18-year-old female who was involved in a motorcycle accident. She fell forward sustaining a direct blow to the top of her shoulder. Given her petite stature, the patient presented with tenting of the skin, significant pain, and soft-tissue irritation.

Visual observation showed the medial fragment was tenting the skin causing severe pain and soft-tissue irritation. Physical examination confirmed inferior and medial displacement of her right shoulder girdle compared to her left. The medial and lateral fragments overlapped approximately 20 mm, causing marked clinical deformity. Additionally, the patient was experiencing crepitus and a limited range of motion. Subsequent radiographs showed the severe superior displacement of the medial fragment in relation to the lateral fragment (Figure 1).

Treatment

In this instance, an Acumed® 8-Hole Locking Anterior Clavicle Plate was utilized for several reasons (Figure 2). First, the oblique fracture pattern facilitated the use of an anterior plate for lack of fixation superiorly. Second, given the shape of the patient's clavicle, an anterior approach allowed for greater screw purchase. Third, the anterior-posterior plane is ideal for lag screw fixation through the anterior placed clavicle plate. Finally, as the patient was very thin, anterior placement of the plate decreased the potential for soft-tissue irritation from a book bag or purse over the top of her shoulder.

Postoperative Results

The A/P Radiograph confirms reduction of the clavicle fracture with the Acumed® Locking Anterior Clavicle Plate (Figure 3). The medial fragment is now aligned with the lateral fragment, as opposed to the severe step-off that the patient had preoperatively.

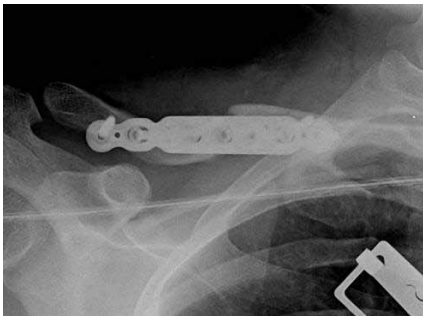
For the first four weeks postoperatively, the patient was placed in an arm sling. At the end of this period, she began passive range of motion exercises including pendulum, Codman, isometric bicep, and elbow and wrist motion. Active strengthening was initiated at six weeks and a full return to activities was permitted once healing was observed radiographically.

I emphasized that she must avoid any activity involving heavy lifting, pushing or pulling. Because of the immediate pain relief, I emphasize this to all young patients and athletes who tend to be more active and are more likely to stress the repair.

Figure 1: Preoperative Radiograph

Figure 2: Intraoperative photograph

Figure 3: Postoperative Radiograph



ACUMED®

Case Series: Clavicle Fracture Solutions

Indication: Lateral-third Clavicle Fracture

Products: Locking Distal Clavicle Plate 3.5 mm

Surgeon: William B. Geissler, M.D.

Patient History

The patient is a 28-year-old female who sustained a markedly displaced clavicle fracture in a motor vehicle accident where the seat belt came over the top of her shoulder. She was initially treated with a sling, but was unhappy with the appearance of the medial displacement of the left shoulder girdle compared to the right.

She complained of severe pain with motion to her shoulder and crepitus with range of motion. Physical examination to the left shoulder showed marked medial displacement of the left shoulder girdle as compared to the right.

An A/P radiograph demonstrated the severe overlap of the medial fragment as compared to the lateral fragment (Figure 1). The fracture was located at the junction of the lateral middle third of the clavicle.

Treatment

Surgeons have the option of selecting distal plates with either 3, 4 or 8-Hole options in the lateral flare depending on the amount of comminution of the lateral fragment. In this instance, the lateral fragment was fairly large and the Acumed® 3.5 mm Locking Distal Clavicle Plate offering four lateral locking holes was selected. An intraoperative photograph shows using the plate as a template to facilitate reduction of the comminuted fracture (Figure 2). The plate was used to help bring the fracture out to length for an anatomic reduction. After utilizing the plate as a template to help secure the reduction, the plate was filled with 3.5 mm locking and nonlocking screws. Sutures were then passed from medial to lateral around the coracoid and the plate to take stress off of the lateral fixation.

Postoperative Results

The A/P radiograph shows the clavicle restored to its original length and anatomic restoration of the curvature (Figure 3).

For the first four weeks postoperatively, the patient was placed in an arm sling. Following this period, she was allowed to participate in passive range of motion exercises including pendulum, Codman, isometric bicep, and elbow and wrist motion. Active strengthening was initiated at six weeks with an emphasis that she avoid activities involving heavy lifting, pushing or pulling. She was permitted a full return to pre-injury activities after healing was confirmed radiographically.

Figure 1: Preoperative Radiograph

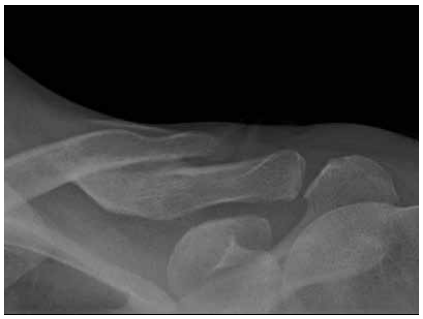


Figure 2: Intraoperative Photograph

Figure 3: Postoperative Radiograph

ACUMED®

Case Series: Clavicle Fracture Solutions

Indication: Displaced Midshaft Clavicle Fracture

Products: Dual-Trak Clavicle Screw

Surgeon: John M. Itamura, M.D.

Patient History

The patient is a young male laborer who experienced a low energy fall off the second rung of a ladder and sustained a displaced midshaft clavicle fracture to his right shoulder. Upon thorough examination, the fracture was noticeably displaced and with very little comminution, qualifying it as an ideal case for an intramedullary approach. Two weeks after the initial fall, the patient was scheduled for surgery.

Treatment

The patient was placed in the supine position, in the middle of the bed with a bump placed under the fractured clavicle. This positioning assisted overall radiographic requirements as all relevant anatomic structures were captured in the imaging without any disruption from the bed side rails. Additionally, there were fewer worries about contaminating the X-ray. The bump placed under the shoulder facilitated reduction as the shoulder blades fall backward and the clavicle comes forward.

Next, a spinal needle was inserted into the posterior AC joint. A 2.8 mm Drill was aimed just medial to make the exit point as lateral as possible and assure that the needle would not exit into the joint. When preparing the medullary canal, a 2.8 mm Drill was used to set the desired path; this is especially important in younger patients with dense bone such as this one. The utilization of the 2.8 mm Drill allowed better control of the exit point versus following the path of least resistance and the possibility of exiting too early and too medially. More importantly, this maximized the length of screw and provided three points of fixation. The use of the 2.8 mm Drill was utilized in the medial fragment as well. This was especially helpful with oblique fragments where it can be difficult to get into the canal.

When exiting the lateral fragment and skin with the Clavicle Tap Drill, a #11 blade knife was used as it saves OR time by making a clean cut in comparison to #15 or #20 blades. For enhanced control, the use of a T-Handle Chuck was chosen over power to better control torque leverage and to reduce the possibility of splitting the bone in patients with a smaller anatomic structure. When tapping the medial fragment, special attention was applied to not perforate the cortex as this would have made the potential of future implant removal more difficult. The reasoning behind this method was for the tip of the screw to touch the anterior cortex but not to penetrate through. With an intramedullary technique, the lateral entry point can be very difficult to find. To address this, after using the Clavicle Step Drill, the Insertion Tool was passed through the lateral fragment, and the nose of the screw was placed into the concave end of the tool.

It was crucial to get a good oblique X-ray of the Hex Driver and Dual-Track Clavicle Screw interface to ensure the screw is flush with the bone. In these instances, care was taken to make sure the hex driver tip was fully engaged in the screw. Had the Hex Driver been removed prematurely, locating the screw head again can be more challenging. With oblique X-rays it was confirmed the outer cortex is visible, along with the Hex Driver and the screw head.

Postoperative Results

The patient was placed in a sling for comfort and sent home the same day. Due to the rigid fixation, the patient was able to initiate ADL's immediately. Upon the eight week follow-up, the patient was back to work. In the surgeon's opinion such a quick return may not be achieved with a plate due to the longer healing process of plate fixation versus IM fixation.

Discussion and Conclusion

The procedure itself was quite efficient in terms of operative time and tissue disruption. This approach was preferred, as it was a much quicker procedure and there was no need to worry about scar immobilization.

Figure 1: Preoperative Radiograph

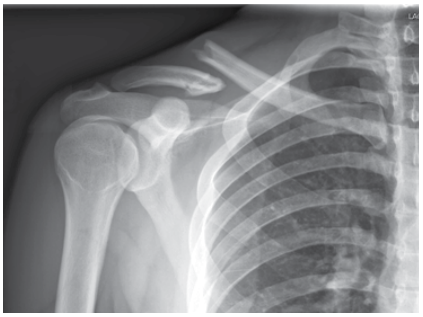


Figure 2: Postoperative Radiograph

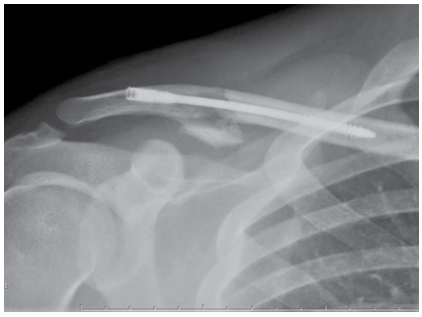
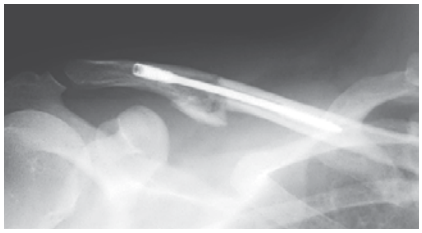


Figure 3: Postoperative Follow-Up Radiograph



ACUMED®

Case Series: Clavicle Fracture Solutions

Indication: Displaced Midshaft Clavicle Fracture

Products: Dual-Trak Clavicle Screw

Surgeon: Robert Orfaly, M.D.

Patient History

The patient is an 18-year-old female who fell onto her left side after losing her balance on a snowboarding jump. She suffered an isolated injury to her left shoulder girdle with radiographs demonstrating a displaced midshaft clavicle fracture.

Treatment

Under general anesthetic, the patient was placed in the beach chair position with the left arm prepped to beyond the sternal notch. The C-arm was brought in from the contralateral side. A small bump under the left scapula assisted in fracture reduction and obtaining appropriate images.

The fracture was evaluated to be at the isthmus of the clavicle in its midportion. The lateral concavity was felt to have greater potential effect on screw placement than the medial convex bow and a medial entry point was therefore chosen. In some cases, this determination can be made once the fracture site is exposed through a primary incision and the medullary region is reamed. In this case, the fracture could be approximated but not fully reduced with closed manipulation.

A 3 cm incision was made in Langer's lines over the tip of the medial fracture fragment. The skin was mobilized from the underlying fascia with care to protect the sensory nerves. The rent in the deltotrapezial fascia created by the fracture was extended medially and laterally in order to allow reduction clamps to be placed on each fragment.

While reaming the medial fragment, fluoroscopy was used to confirm passage through an adequate length of bone. The anterior cortex was penetrated approximately 1.5 cm from the sternoclavicular joint and the tap was passed through a 1 cm medial incision. The fragments were tapped and the cannula was placed through the medial wound.

Since the fracture was minimally comminuted and the patient had good bone quality, the step drill was passed down to the first groove to allow the Dual-Trak Clavicle Screw to compress the fracture on insertion. Given the obliquity of the approach through the anterior cortex, the Insertion Tool was passed through the fracture site after removing the tap to guide placement of the screw into the medial fragment. The fracture was then reduced and held with a clamp as the screw was advanced laterally under fluoroscopic control. Excellent compression was achieved and the lateral threads were seen to fully engage within the lateral fragment. The clamp was removed and the wounds were closed in the usual manner.

The patient's arm was placed in a sling for comfort and the patient was sent home that same day.

Figure 1: Preoperative Radiograph

Figure 2: Postoperative Radiograph

Figure 3: Postoperative Follow-Up Radiograph

Notes

Notes

CASE SERIES AUTHORS

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