A.M. Surgical CPX – Cross-Pin, Non-Bridging Fixator for Distal Radius Fractures

Sales Representative Training Manual
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A.M. Surgical CPX Overview

Developed by Dr. Mirza (Founder, A.M. Surgical) and his son Romi, the CPX is a non-bridging, cross-pin fixator used for the treatment of displaced and non-displaced extra-articular and intra-articular fractures of the distal radius.

The CPX combines cross-pin internal fixation with a non-bridging external fixator. The cross K-wire configuration, with pins in multiplanar/multiangle directions, creates a rigid fixation, which is enhanced by an external strut (CPX). The cross K-wires capture and stabilize the larger fragments while buttressing the smaller ones. The device significantly maintains fracture reduction, and it allows for early mobilization of the wrist and resumption of usual activities. It is important to note that this technique is easy to use since most orthopaedic surgeons are familiar with percutaneous pinning.
A.M. Surgical CPX Instrumentation

The CPX device is offered as an aluminum frame. The CPX is a two-part system with each part allowing for 3 k-wire fixation options. Each k-wire fixation option (3 k-wire options per part) allows the surgeon to angle each pin (through the device) up to 15 degrees of rotation around the center of the guide hole (30 degrees of angle variability).

The CPX System contains the following items:
- The CPX device
- Tightening tool
- Tissue protector
- 6, nine inch, 0.062” smooth k-wires
- Sterilization cassette
Tightening Tool:

- Two sides of tightening tool
- 0.062 side is used on “Angle Locking” and “Sidebar” screws
- 0.050 side is used to loosen and tighten the “Securing” screw

Tissue Protector:

- Protects radial sensory nerve during k-wire driving
# Pricing, Billing and Reimbursement Information

## List Prices:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>8800-04</td>
<td>Dynamic CPX</td>
<td>$2,495.00</td>
</tr>
<tr>
<td>8800-03</td>
<td>Tissue Protector</td>
<td>$125.00</td>
</tr>
<tr>
<td>8800-50</td>
<td>Tightening Tool</td>
<td>$125.00</td>
</tr>
<tr>
<td>8800-99</td>
<td>Pin Kit (x6, 9&quot; 0.062 k-wires)</td>
<td>$100.00</td>
</tr>
<tr>
<td>5600-88</td>
<td>CPX Sterilization Cassette</td>
<td>$550.00</td>
</tr>
</tbody>
</table>

- Contact A.M. Surgical management for discount approval.

  - If you are unable to sell the tray, bill for the CPX, tissue protector, tightening tool and pin kit. The surgeon will need to have a tightening tool at his office so there is potential to bill the facility for two tightening tools.

## Billing Codes/Reimbursement

See “Medicare Procedure Reimbursement” sheet for an overview of codes and baseline reimbursement.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPX (Cross-Pin Fixator) for Distal Radial Fractures</td>
<td>25606</td>
<td>Percutaneous skeletal fixation of distal radial fracture or epiphyseal separation</td>
</tr>
<tr>
<td></td>
<td>20690</td>
<td>Application of a uniplane (pins or wires in one plane) unilateral, external fixation system</td>
</tr>
</tbody>
</table>

The CPX surgery pays a surgeon more than ORIF with a plate!

This is true for simpler fractures that the surgeon may have previously plated. As the number of fracture fragments increase the billing for ORIF changes and depending on the insurance, a multi-fragment fracture treated with ORIF may pay more than the use of the CPX for that same fracture. *For simple, extra-articular fractures, the CPX should pay more.* Have the surgeon compare reimbursement values!!

  - We’ve seen CPX reimbursement for the above two codes as high as $5,500 for the surgeon.
CPX Biomechanics

- The CPX provides internal, cross-pin fixation with the added stability of an external strut.

Internal Fixation:
- A single k-wire through a fracture fragment allows rotation and translation along the axis of the wire.
- Stability of the fixation with k-wires is greatly enhanced by increasing the number of k-wires.
- Multiplanar, 3 dimensional, cross-pinning provides the greatest fracture stability – this is provided by the CPX through percutaneous cross-pin fixation.

CPX as an External Strut:
- Acts as a buttress to enhance the rigidity of the pin/ex-fix construct.
- Prevents the pins from waxing and waning during fracture healing.
- Prevents pins from backing out.

Fracture loading and its importance in bone healing

Load on the fracture site is an important component during fracture healing. Load or forces acting on the bone, which can be created by normal daily activities, helps to stimulate the cell repair process, specifically callus formation.

In traditional bridging and nonbridging external fixators, the pins are perpendicular to the long axis of the bone. This unloads the fracture and could potentially delay bone healing.

The CPX k-wires are more longitudinally oriented to the long axis of the bone and therefore they do not unload the fracture. Flexibility of 0.062 k-wires and the k-wires orientation through the CPX allows load sharing across the fragments facilitating callus formation.

Biomechanical CPX Whitepaper:
Biomechanical Study Summary:
- Six matched pairs of fresh frozen cadaveric distal radii
- 2 cm osteotomy proximal to the articular surface of radius, 1.5 fracture gap created to create unstable, extra-articular fracture
- Half received CPX (4 pins), other half Hand Innovations Volar Locking Plate
- Cadavers placed in arcrylic cement and loaded on Materials Testing Machine (MTM)
- 10,000 cycles testing axial, torsional and cantilever loads of 50 Newtons

Conclusion of Study:
- No difference in mechanical strength of the CPX and volar locking plate
- They are equivalent in biomechanical rigidity!
What does this mean for the CPX?

If a surgeon uses a plate on unstable extra-articular fractures because he desires the stability of the plate, then the CPX is just as good an option. Remove the stability factor and now the minimally invasive CPX option will provide patients with less pain and swelling after surgery and provide just as early wrist movement as the plate. The plate requires longer OR time and more extensive soft tissue dissection. It’s excessive for closed reducible fractures. The CPX also reimburses the physician better than the plate for extra-articular fractures!

CPX - Indications For Use

If the surgeon can successfully close reduce the distal radius fracture with acceptable radiological parameters then the CPX device should maintain fracture reduction.

“If you can reduce it. You can use it.”

The CPX is selected for treatment of unstable extra-articular, non-displaced intra-articular fractures as well as for the treatment of displaced reducible intra-articular fractures. Osteoporotic bone is not a contra-indication.

Contraindications include extensive soft tissue trauma, open fractures, considerable skin compromise, non-compliance, dementia or advanced Parkinson’s disease and those fractures that fail to reduce under closed means.

Close Reducing Distal Radius Fractures

- Also termed manipulation
  Involves:
  - Longitudinal traction (manual or fingertraps w/ 10lbs counter weight)
  - Ulnar deviation
  - Palmar or volar flexion
  - Pronation of the hand and wrist
Surgical Technique

1. Please refer to the Surgical Video performed by Dr. Mirza at www.amsurgical.com/video/Mirza_CPX08_FLA.html

**FIGURE 7-5**
A. Placement of the tissue protector against the radial styloid to determine with fluoroscan placement of the first K-wire.
B. Stab wound. C. Insertion of clamp into stab wound.
**FIGURE 7.7** Insertion of First K-wire. A. Freestand insertion of the K-wire through the tissue protector. B. Fluoroscan—anteroposterior view. C. Fluoroscan—lateral view.

**FIGURE 7.8** Insertion of the Second K-wire. A. Through the tissue protector, the second pin is driven proximal to distal to the lunate fossa. B. Fluoroscan of K-wire position.

**FIGURE 7.9** Fluoroscan of Anteroposterior View Showing Four K-wires.

**FIGURE 7.10** Postoperative Dressing with Volar Sling.
**Postoperative Care**

Patients are seen 3 to 5 days post-operatively for removal of the surgical dressing, pin site care and X-ray evaluation of reduction maintenance. A custom orthosis wrist/forearm support is fabricated.

Commence occupational therapy three times per week after the initial follow-up to initiate active finger, wrist and forearm range of motion and activities of daily living (ADL). Patients are instructed to remove the splint six times each day to perform their home exercise program.

**Pin Site Care**

Hibiclens and gauze around pin sites. It’s recommended that the patient does not manage their pin site care. Care should be provided during therapy visits.
Selling to the Surgeon

CPX Benefits:
- Minimally invasive alternative to plating (requires stab incisions versus 5-8 cm incision in the wrist). It’s a simple surgery, as long as the fracture can be reduced.
- Multiplanar, cross-pin configuration provides rigid internal fixation with external strut to prevent pins from migrating, waxing and waning.
- Non-spanning – allows the patient early resumption of daily activities plus Range of Motion exercises during postoperative therapy.
- **Reimburses surgeon more than ORIF procedure** (See Billing and Reimbursement).
- If the surgeon cannot reduce the fracture simply convert to the plate or desired fixation technique.
- Shortens OR time compared to the application of the plate.
- Compared to traditional external fixators, pin track inection is mitigated because the CPX uses smooth 0.062” k-wires and the pins are driven on the midlateral plane which as minimal skin movement around the pins.
- A tissue protector is used to protect the radial sensory nerve.
- The pins are driven on the midlateral plane of the radius avoiding the extensor and flexor tendons.

Surgeon Targets:

1. General Orthopaedic Surgeon
   - CPX is within their surgical comfort zone, some general orthopedists are hesitant about opening up the wrist to apply a volar plate.
   - CPX offers them the opportunity to care for their patients rather than send them to a hand surgeon.
   - Sell improved reimbursement compared to the plate.
2. Hand Surgeon
   - Pay attention to hand surgeons in your territory that still percutaneous pin unstable extra-articular fractures or use external fixators.
   - Debate the surgeon who plates unstable extra-articular fractures (is the plate is overkill for these patients?).
   - Sell improved reimbursement compared to the plate.
The 30 Second Introduction:

The device is so simple. You make a few stab incisions and drive smooth 0.062” k-wires in multiple angles across the fracture site in a cross-pinning manner to create stable internal fixation at the fracture site. You then attach the CPX, which acts as an external buttress, adding rigid fixation to the pin construct. The CPX allows over 30 degrees of variable angle for each pin when passed through the device… You’re out of the extensor and flexor tendons, we use a tissue protector for the radial sensory nerve and you don’t bridge the joint. Patients begin range of motion exercises in a few days and the device comes off in 6 weeks. We use two billing codes, which combined pays more than the application of the plate. If you can close reduce the fracture, the CPX will maintain the reduction. If you can get the reduction closed, move on to a plate. It’s that simple.

Clinical Data You Must Know:

- Reviews 21 CPX cases
- No loss of reductions, pin track infections
- One RSD that resolved, one radial sensory nerve neuritis
- More than 50% of the cases were intra-articular
- **Demonstrates acceptable outcomes for a variety of fracture types treated with the CPX. Minimal complications reported.**

- Biomechanical Study: This paper reviews the biomechanical strength of the CPX compared to the hand innovations volar plate on cadaver radii.
- The results showed no significant difference in biomechanical strength of the two devices (CPX used 4 k-wires) on simulated extra-articular fractures.
- **The CPX provides equivalent rigidity as the volar plate when treating unstable extra-articular fracture.**
Common Rep/Surgeon Interactions:

Doctor: I usually just cast Colles (simple, extra-articular) fractures.
Rep Response: How often have you put a cast on to see the fracture collapse? It’s just a matter of time before the pulling forces of the brachialradialis and pronator quadratus collapse the fracture. Plus, with the CPX, patients are moving their wrist right away, which improves their activities of daily living.

Doctor: I haven’t used an external fixator in years.
Rep Response: I imagine most of your experiences with external fixators have been bridging ex-fixes? This is a novel non-bridging cross-pin device that allows patients early resumption of ADL with the fixation ability of a plate for unstable extra-articular fractures.

Doctor: With the plate, I just throw it on and never have to worry about the patient again.
Rep Response: I understand there’s a comfort factor with putting the plate on, but when you break it down, it’s still a major surgery. Besides the amount of tissue dissection, you can’t be 100% confident that the patient will be free from complications and there’s always the potential for plate removal. The biggest thing you have to worry about with the CPX is the radial sensory nerve and pin track infection. We have a tissue protector (for the nerve) and if “you” manage the pin care with hibiclens and gauze the infection potential is very low. In the April, 2009 issue of Journal of Hand Surgery, there is a study on 21 patients treated with the CPX. There were zero pin track infections. Plus, the pins are smooth 0.062” k-wires, unlike the threaded, larger diameter pins more frequently associated with infection. In 6-8 weeks the CPX comes off and then you won’t ever need to worry about that patient.

Doctor: I’ve had too many negative experiences with pin track infection.
Rep Response: Almost all the pin track infection experiences come from larger diameter, threaded, pins that are used with traditional bridging external fixators. We’re using smaller 0.062”, smooth k-wires. The wires are driven on the midlateral plane where there is less movement of skin around the wires, which helps. In the 2009 April issue of the Journal of Hand Surgery, Dr. Mirza reported on 21 CPX cases. There were no pin track infections. Dr. Mirza recommends not to have the patient care for their pin sites. He recommends Hibiclens and gauze around the pin sites.

Doctor: My patients would prefer the plate over an ex-fix.
Rep Response: I would agree if we were comparing the plate to a traditional bridging ex-fix. It’s bulky, and the patient has no wrist movement. The CPX is unobtrusive, lightweight, and allows just as much wrist motion as the plate, so we’ve seen very positive response from the patients. If you tell the patient that the CPX will come off in 6 weeks and you’ll have no remaining hardware and small scars on the side of your wrist, or you can have a plate, with the potential of removal (2nd surgery), with a larger incision… 9 times out of 10 the patient will go with the CPX. We’ve seen this response all over the country.
Frequently Asked Questions

Q: What about the radial sensory nerve?
A: The surgical approach for driving the pins is a stab incision with blunt dissection to bone. We have a tissue protector that you use while driving the pins. The nerve should not be at risk if you adhere to the surgical technique.

Q: What about pin track infection?
A: Most of the pin track infections with pinning results from the use of larger diameter pins that are threaded. With the CPX we use smooth 0.062” k-wires. Dr. Mirza reported in the Journal of Hand Surgery, (April 2009) on a 21 patient study with zero pin track infections. The patients didn’t touch the pins. His hand therapists cleaned the sites and used hibiclens and gauze for pin care.

Q: How do you manage the pin care?
A: Hibiclens and gauze. It’s recommended that the patients don’t manage their pin care.

Q: What is your postoperative protocol?
A: See Postoperative Care in this manual.

Q: Do you recommend taking the device off in the office or OR?
A: Either option. If you bring the patient to the OR for removal you are able to bill for this procedure compared to the reimbursement of an office visit.

Q: In what order do you drive the pins? When do you apply the device?
A: We typically recommend that you first drive a distal pin, at a 45° angle, at the radial styloid, between the 1st and 2nd dorsal compartments. The second pin is driven into the lunate faucet at a 45° angle making sure to cross the pins at the fracture site. The device is then separated and the pins sent through the device. Merge the device and then drive the remaining pins through the CPX. When you become comfortable with the CPX, you can freehand all your pins and then apply the device.

Q: Isn’t this equivalent to simply driving 4 k-wires percutaneously? Why should I bother with the device?
A: The CPX acts as a buttress preventing migration and the waxing and waning of the pins helping to maintain the fracture reduction. Biomechanically, the CPX, with 4 pins (two distal and two proximal) is just as rigid as a volar plate for the treatment of unstable extra-articular fractures.

Q: Do I make one distal incision and drive all pins through it and the same for the proximal pins?
A: It is possible to drive your pins through one incision, but based on the fracture type, where you drive your first pin, etc., you may need to make multiple stab incisions to drive your pins.

Q: How long does the CPX stay on for?
A: On average, 6 weeks. We’ve seen them come off as early as 5 weeks and stay on as long as 8 weeks. The study in the Journal of Hand Surgery was around 7.25 weeks.
**Selling to the Facility**

- Highlight that this is a unique device (there is no other external fixator like it on the shelf) and it affords surgeons a simple, efficient way to treat distal radius fractures and that the patient and surgeon response has been excellent.

- Reduces OR time for distal radius fracture surgery. Tourniquet times have been as short as 15 minutes. (Point out that shortened OR times saves the hospital money).

- Minimal instrumentation, simple for the OR staff to learn.

- Potential for resistance because the facility may already have an “external fixator” for distal radius fractures on the shelf.
  - Explain that this is a unique non-bridging device and that nothing exists like this on the shelf.
  - The indications for the CPX are not the same as a traditional bridging fixator.
  - Patient acceptance of the CPX is excellent because of its lightweight and unobtrusive design. Plus patients are able to move the wrist, which allows them to return to their daily routine.
  - Obtain verbal or written support from the interested surgeon.

- The facility might have a contract with a buying group. The Material Manager may ask if the CPX or A.M. Surgical is part of a buying group.
  - Let them know you will touch base with A.M. Surgical to find out.
  - Try to make a case that this is a unique device and that the facility will benefit from its use. There’s always room for products outside buying group contracts. Make a case!
  - Speak with A.M. Surgical management about consigning the tray to the hospital. This might get around the need to be in a buying group.

**Please approve any discount requests with an A.M. Surgical sales manager.**
Clinical Data Resources

Download the following whitepapers at this web address: www.amsurgical.com/uploads/Rep_CPX_Whitepapers.zip

- Reviews 21 CPX cases
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- The results showed no significant difference in biomechanical strength of the two devices (CPX used 4 k-wires) on simulated extra-articular fractures.
- The CPX provides equivalent rigidity as the volar plate when treating unstable extra-articular fracture.

Slutzky/Osterman Hand Surgery Book, Chapter on the CPX
- Reviews biomechanics of the CPX
- Reviews surgical technique
- Reviews postoperative protocol

Other Papers to Review: (See A.M. Surgical Resources for Download Information)

Wolfe, A Biomechanical Comparison of Different Wrist External Fixators With and Without K-Wire Augmentation

Jupiter, Fractures of the Distal Radius Treated With a Nonbridging External Fixation Technique Using Multiplanar K-Wires

Trumble, Percutaneous Pins Versus Volar Plates for Unstable Distal Radius Fractures: A Biomechanic Study Using a Cadaver Model
Sales Representative Online Resources

Enter these links in your web browser’s URL address bar to download:

(Spaces between words contain an underscore. i.e. CPX_Brochure.pdf)

To watch A.M. Surgical CPX surgery
www.amsurgical.com/video/Mirza_CPX08_FLA.html

A.M. Surgical CPX Surgical Technique PDF

A.M. Surgical Product Pricing Sheet

A.M. Surgical Medicare Reimbursement Sheet

A.M. Surgical Clinical Whitepapers (zip file)
**Competitive Overview**

**Open Reduction Internal Fixation (ORIF) w/ Volar Fixed-Angle Plate**

- There are over 30 volar plates on the market
- Major players
  - Hand Innovations (DePuy)
  - Synthese
  - TriMed
  - Smith & Nephew
  - Acumed
- Provides rigid, internal subchondral support to the distal articular fragments
- Fixed angle refers to screws that are at fixed angles

**Advantages of VP:**
- Rigid fixation allows early ROM and return to activities of daily living
- Excellent subchondral support provided to the distal fragments, even in the presence of minimal bone stock
- Socially less visible volar scar compared to dorsal plate scar
- Approach avoids superficial radial nerve and lateral antebrachial cutaneous nerve
- Easy access to all aspects of radius
- When VP properly placed the plate can be completely covered by repairing pronator quadratus – decreasing potential for tendon interference

**Disadvantages of VP:**
- Potential injury to median nerve and palmar cutaneous branch of median nerve
- When VP is improperly placed plate causes flexor pollicis longus to be at risk of irritation or rupture
- Learning curve and fracture pattern can be challenging to surgeon
- Challenging cases result in longer OR times
- Overpenetrated screw tips can lead to irritation and rupture of extensor tendons
- When surgeon uses variable angled plates, placement is imperative in order to avoid intra-articular malunion, and each screw must be individually evaluated making sure they don’t penetrate the articular surface.
- Plate may need to be removed resulting in second surgery
- Cosmetically unappealing scar but less visible than dorsal scar
Volar Plate STUDY
Complications following internal fixation of unstable distal radius fracture with a palmar locking plate. Journal of Orthopedic Trauma, Arora et al, 2007;21:316

114 patients with average age of 57 years
52% AO type C fractures, 12 month follow-up minimum
Compared to contralateral side:
- 82% wrist extension
- 72% wrist flexion
- 70% grip strength
- DASH score of 13
Complications:
- 27%
- 2 flexor pollicis longus ruptures
- 2 extensor pollicis longus ruptures
- 4 cases of extensor tenosynovitis
- 9 cases of flexor tenosynovitis
- 3 cases of carpal tunnel syndrome
- 5 cases of complex regional pain syndrome

Nutek, NBX

Description:
- Non-bridging external fixator
- K-wires placed in fragment specific locations with multiple pin options
- Priced at $1770 against competitive bid with CPX involved

Pros:
- Non-bridging
- Minimally invasive

Cons:
- Dorsal driving of k-wires, potential for extensor tendon irritation or rupture
- Bulky for the patient
**Intramedullary Nail**

![Intramedullary Nail Diagram]

- Micronail, Wright Medical

**Description:**
- Intramedullary Nail
- Fixed angle subchondral supports (screws) lock to an intramedullary stem
- Orientation of stem is set by locking metadiaphyseal screws

**Advantages of IM Nails over Volar Plate:**
- Less surgical dissection, maintains soft tissues and blood supply to promote fracture healing
- Elimination of tendon irritation over the surface of the device (intramedullary)

**Disadvantages of IM Nails:**
- Still some degree of surgical approach, not without morbidity
- Studies have shown that degree of loading that IM Nail can bear during early motion rehabilitation appears to be less than the volar locking plate
- Possible tissue irritation with placement of interlocking screws
- Possible screw penetration into the distal radioulnar joint

**Recent Micronail Study:**

- 10 Patients with AO type A and C distal radius fractures treated with Micronail
- average follow-up 21 months

**Results:**
- 2 cases did not maintain reduction w/ loss of volar tilt greater than 5 degrees, both A3 fractures
- DASH score was 8 excellent, 1 good, 1 poor
- 2 cases of transient superficial radial sensory neuritis
- 3 cases of screw penetration into the DRUJ, 1 leading to symptomatic DRUJ
- No infections, tendon injury or hardware failure
Traditional Bridging External Fixators

- Major Players
  - Stryker
  - EBI
  - Agee WristJack

Description:
- 3.5mm pins are placed in metacarpals and radial shaft
- Relies on ligamentotaxis to maintain reduction of fracture

Advantages:
- Less surgical dissection/time required than dorsal or volar plating
- Within surgeon’s comfort zone
- No need for permanent hardware implantation
- Minimal soft tissue and bony complications

Disadvantages:
- Ligamentotaxis may not maintain reduction of radiological parameters
- Can lead to permanent wrist and finger joint stiffness
- Pin tract infection and possible diaphysis fracture (large diameter pins, 3.5mm)
- Loading of the fracture is bypassed which can lead to delayed unions and non-unions
- Inability to begin motion therapy until several weeks after surgery
- Cumbersome for the patient, no wrist movement
Distal Radius Fracture Classification

A = Extra-articular fracture

A1

A2

A3

A1 Extra-articular fracture, of ulna, radius intact
   .1 styloid process
   .2 metaphyseal simple
   .3 metaphyseal multifragmentary

A2 Extra-articular fracture, of radius, simple & impacted
   .1 without any tilt
   .2 with dorsal tilt (Pouteau-Colies)
   .3 with volar tilt (Goyrand-Smith)

A3 Extra-articular fracture, of radius, multifragmentary
   .1 impacted with axial shortening
   .2 with a wedge
   .3 complex
$B = \text{Partial-articular fracture}$

**B1**

"Chauffeur's"  
"Die Punch"

1. medial
2. lateral
3. condylar

**B2**

"Dorsal Barton's"

1. proximal
2. lateral
3. medial

**B3**

"Volar Barton's"

1. proximal
2. lateral
3. medial

---

B1 Partial articular fracture, of radius, sagittal
- 1. lateral simple
- 2. lateral multifragmentary
- 3. medial

B2 Partial articular fracture, of radius, dorsal rim
- 1. simple
- 2. with lateral sagittal fracture
- 3. with dorsal dislocation of the carpus

B3 Partial articular fracture, of radius, volar rim
- 1. simple, with a small fragment
- 2. simple, with a large fragment
- 3. multifragmentary
C = Complete-articular fracture

C1 Complete articular fracture, of radius, articualr simple, metaphyseal simple
   .1 posteromedial articular fragment
   .2 sagittal articular fracture line
   .3 frontal articular fracture line

C2 Complete articular fracture, of radius, articular simple, metaphyseal multifragmentary
   .1 sagittal articular fracture line
   .2 frontal articular fracture line
   .3 extending into diaphysis

C3 Complete articular fracture, of radius, multifragmentary
   .1 metaphyseal simple
   .2 metaphyseal multifragmentary
   .3 extending into diaphysis
Goals of Distal Radius Fracture Treatment

- The main goal of distal radius fracture treatment is to achieve satisfactory reduction of the fracture back to normal articular congruity
- This reduction must be maintained (stabilized) until the bone heals

Radiological Parameters of Distal Radius Fractures

Restoration of the following radiological parameters (articular congruity) is important in achieving normal functional outcome for the patient.

Radial Length:

- Measured on the AP x-ray view
- Distance between a line drawn at the tip of the styloid process, perpendicular to the long axis of the radius, and a second perpendicular line at the level of the distal articular surface of the ulnar head.
- Normal = 11-12mm, range 8-18mm

Palmar or Volar Tilt:

- Measured on the lateral x-ray view
- Line is drawn connecting the distalmost point of the dorsal and volar cortical rims of the radius. The angle that this line creates with a line drawn perpendicular to the longitudinal axis of the radius reflect palmar tilt.
- Normal = 11-12 degrees, range 0-28 degrees.
**Radial Inclination:**

- Measured on the AP x-ray view
- Angle formed by a line drawn from the tip of the radial styloid to the ulnar corner of the articular surface of the distal end of the radius and a line drawn perpendicular to the longitudinal axis of the radius.
- Normal – 22-23 degrees, range 13-30 degrees.

**Ulnar Variance:**

- Measured on the AP x-ray view
- Vertical distance between one line drawn parallel to the surface of the lunate facet of the radius and a line drawn parallel to the articular surface of the ulnar head.
- Hulten noted that 61% of his cases had neutral variance
- Fractured radius will commonly have ulnar head distal in measurement (positive variance)
Surgical Anatomy and Common Terminology

Surgical Anatomy:

Distal Radius

- Radial Styloid

- Lateral process of the radial styloid
- During the CPX surgery, 0.062” k-wires are driven at a 45 degree angle through the radial styloid penetrating the medial cortex of the radius.
Lunate Facet

- Articular surface of the radius, that articulates with the lunate bone.
- The proximal pins that are driven during the CPX surgery are aimed towards the lunate facet but the pins should never penetrate through the articular surface.

DRUJ – Distal Radio Ulnar Joint

- This joint is responsible for pronation and supination of the forearm.
- Triangular fibrocartilage complex (TFCC) is the major soft tissue stabilizer of the DRUJ.
- Joint congruity can be damaged from distal radius fracture (fracture creates deficiency of the sigmoid notch (radius articulating surface of DRUJ to ulnar head)).
- Unstable DRUJ can lead to joint pain, stiffness, weakness.
Pronator Quadratus (Muscle)

- Square shaped muscle on the distal forearm that acts to pronate (turn so the palm faces downwards) the hand
- When the muscle contracts, it pulls the lateral side of radius towards the ulna
- Only muscle that attaches to ulna at one end and radius at the other

Brachioradialis (Muscle)

- Flexes the forearm at the elbow
- Capable of pronation and supination
- Attached to the radial styloid by way of the brachioradialis tendon
Dorsal Compartments

- The CPX surgical approach requires the distal k-wires be driven through the radial styloid at a 45 degree between the 1st and 2nd dorsal compartments

Terminology:

**ADL** (Activities of Daily Living)
- Basic tasks of everyday life, such as eating, drinking, buttoning a shirt, doing laundry, etc.

**Cancellous Bone**
- porous of spongy bone
- interior of bone

**Cortical Bone**
- dense bone that forms the surface, outer surface of distal radius
- higher compressive load than cancellous

**CRPS** (Complex Regional Pain Syndrome or Reflex Sympathetic Dystrophy)
- chronic pain condition in which high levels of nerve impulses are sent to an affected site
- Symptoms vary in severity and length and can include “burning” pain, joint swelling and stiffness, and motor disability
How is CRPS related to the CPX?
Damage to the superficial radial nerve during surgery can lead to CRPS. However, A.M. Surgical provides a tissue protector for driving pins during surgery reducing the risk for damage to the superficial radial nerve.

**Comminuted**
- Fracture in which bone is broken into multiple fragments

**Diaphyseal**
- Shaft of the radius.

**Displaced**
- A distal radius fracture that does not maintain anatomical congruity.
- Displaced extra-articular distal radius fractures typically have a dorsal (Colles) or volar (Smith’s) shift.

**Epiphysis**
- End of the radius.

**Extra-Articular**
- Describes a distal radius fracture that occurs outside the joint space.

**Intra-Articular**
- Describes a distal radius fracture in which the fracture occurs at the articular surface of the distal radius.

**Ligamentotaxis**
- Restores skeletal length of the distal radius and improves fracture alignment through longitudinal traction.
- Soft tissue envelope around distal radius helps to restore fracture alignment
- Most external, bridging fixators rely on ligamentotaxis to maintain fracture reduction.

**Logitudinal Traction**
- Manually pulling the fracture fragments apart to realign by pulling longitudinally.
- Traction can also be achieved through the use of finger-traps and suspended counterweight (10lbs typically).

**Metaphysis**
- portion of bone between the epiphysis and diaphysis
- Most extra-articular distal radius fractures are considered a metaphyseal fracture.

**Non-Displaced**
- Typically a simple distal radius fracture that maintains anatomical congruity
**ORIF** (Open Reduction Internal Fixation)
- This describes the surgical technique to apply a distal radius plate to a distal radius fracture by way of a 5-8cm incision (volar approach).

**Radial Deviation**
- Joint motion where wrist moves towards thumb (radial).

**Reducible**
- A fracture is reducible when the anatomical congruity (compared to the uninjured wrist) can be satisfactorily achieved.

**ROM (Range of Motion)**
- Degrees of joint motion.

**Ulnar Deviation**
- Joint motion where thumb moves toward ulna (ulnar).

**Unstable Distal Radius Fracture**
- Will have a tendency to lose reduction if simply casted.
- Barton’s, Radial Styloid, and Smith’s fractures are often unstable.
- Dorsal tilt is greater than 20 degrees implies instability.
- Radial height reduces by 5mm or more.
- More than 2mm of articular step off.

**X-Ray – AP View**
- Anterior Posterior

**X-Ray – Lateral View**