



# DCMC Emergency Department Radiology Case of the Month

These cases have been removed of identifying information. These cases are intended for peer review and educational purposes only.

Welcome to the DCMC Emergency Department Radiology Case of the Month!

In conjunction with our pediatric radiology specialists from ARA, we hope you enjoy these monthly radiological highlights from the case files of the Emergency Department at DCMC. These cases are meant to highlight important chief complaints, cases, and radiology findings that we all encounter every day.

If you enjoy these reviews, we invite you to check out Pediatric Emergency Medicine Fellowship Radiology rounds, which are offered quarterly and are held with the outstanding support of the pediatric radiology specialists at Austin Radiologic Association.

If you have and questions or feedback regarding the Case of the Month format, feel free to email **Robert Vezzetti, MD** at [rmvezzetti@seton.org](mailto:rmvezzetti@seton.org).

**This Month: Arm injuries that should not be missed in kids.** In the past, we've discussed the diagnosis and treatment of supracondylar fractures. This month, we'll present arm injuries that require more than a splint and/or cast. These injuries call for immediate Pediatric Orthopedic consultation to ensure a good outcome.



FELLOWSHIP – PEDIATRIC EMERGENCY MEDICINE

## Conference Schedule: March 2017

- 1st - 9:15 Acid/Base Disorders.....Drs Berg and Higginbotham  
10:15 Ultrasound.....Drs. Levine and Gorn
- 8th - 9:15 Cardiology: Single Ventricles.....Drs Hill and Vezzetti  
10:15 Biostats: Statistics.....Dr Wilkinson
- 15th - SPRING BREAK!
- 22nd - 9:15 EMS Part 2.....Dr Remick  
10:15 Pediatric Dermatology.....Dr Levy  
11:15 Psychiatric Emergencies.....Dr Gorn
- 29th - 9:15 M&M.....Drs Irwin and Chu  
10:15 Board Review Thoracic Emergencies.....Dr Rencher  
11:15 Board review continued  
12:15 Research Update.....Dr Wilkinson

Simulations are held at the CEC at UMC Brackenridge.  
Lectures are held at DCMC Command Rooms 3&4.  
Locations subject to change.  
All are welcome!



St Patrick's Day: March 17th!



Notice the purple, green, and gold colors? Yep, Mardi Gras colors! The big party occurred on Feb 28, the day before Ash Wednesday, which is March 1st. Arguably one of the most popular times to visit the Crescent City, Mardi Gras is actually quite fun and believe it or not, family friendly (mostly Uptown, Downtown and in the suburbs...not so much in the French Quarter....)



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**Case 1:** With the weather warming up, more injuries are starting to come into the Emergency Department and your shift is not an exception. You pick up the chart and walk into the exam room. There, you find a 5 year old male who is tearful and clearly in some degree of pain. You take a quick history from his mother (and him, since he is quite vocal): they tell you that he was at preschool today and, while playing on the monkey bars, he fell, landing on his elbow. He did not have loss of consciousness and he was not reported to have hit his head. The fall, luckily, was witnessed by his teacher. He has no complaints of back pain, shoulder pain, wrist pain. He tells you his elbow hurts and if he attempts to move it, it hurts even more. You note that, aside from some mild tachycardia (which you attribute to his crying), he has normal vital signs. You do a focused exam on your patient. He does not have any obvious head trauma and his neck is nontender, without step-off or crepitus. He does not have any abdominal pain. His extremity exam is normal, except for edema and tenderness of his right elbow. His shoulder and wrist appear nontender. He has a good radial pulse and brisk cap refill. You order up some intranasal Fentanyl (2 mcg/kg) and wonder what type of imaging does this child need? Is a 2 view elbow ok, or do you need a 3 view? Should you just image the elbow or do you include the forearm?



**Case 2:** The next child in our cavalcade of elbow injuries is a transfer from an outside facility. It seems that this child, another 5 year old, was wrestling with her sister near the top of the stairs when she lost her balance and fell, injuring her right arm in the process. Her mother took her to the nearest emergency department, where films were obtained of the forearm, since she was complaining of both elbow and forearm pain. They revealed a fracture. Reduction was attempted by the emergency department physician there. Repeat films demonstrated minimal improvement, so a splint was placed and the child was transferred to the Dell Children's Emergency Department for definitive treatment. Your history confirms what the previous physician told you in the transfer call; the child fell while playing on the stairs. You look her over and find no head trauma, neck pain, back pain, or other obvious injury. Her right arm is in what appears to be posterior long arm splint. She is able to move her fingers well and has brisk cap refill. You examine the films from the outside facility. Should you attempt reduction yourself? Can you leave the splint alone and have the child followup with Pediatric Orthopedics in 1-2 days? Should Pediatric Orthopedics see the child now in the ED?



**Case 3:** A 12 year old female is brought in next, by his mother, who drove him to the ED. It seems she was crossing the street when she was struck by a car at a low rate of speed. The vehicle was going fast enough, though, to knock her to the ground. She landed on her left arm and now complains of left elbow pain. After making sure her vitals look stable (they are), you start to examine her. She appears to be uninjured, other than her left elbow. There is some mild edema. There is no laceration or abrasion. Her shoulder, humerus, forearm, wrist, and hand are nontender and without edema. She does have pain with palpation of her left elbow. Her range of motion is limited secondary to pain. She does have a good radial pulse with brisk cap refill. Her sensation is intact. You make sure that she has no apparent neck injury as well as perform a thorough abdominal examination; she is nontender. You also carefully examine her back and find no injury there, either. Well, that's a relief that she does not appear to have any life threatening injuries, but there is the question of her left elbow. While there is no deformity and she appears to have a minor injury, you probably ought to obtain some imaging.

## Xrays: Forearm vs Elbow Imaging

The question often arrives: If I think there is an elbow fracture, is it sufficient to image the elbow only? What's the point of ordering a full forearm series if the elbow is injured? Good question. For the most part, selected imaging is fine, especially in older patients in whom a good, reliable exam is much more likely. In younger children, such an exam may not be possible, and the area of injury may be in question. If there is any doubt as to where an injury may be located, ordering a complete forearm series (consisting of AP and lateral views, ideally with the elbow at 90 degrees) is a good choice. This will give you a nice view from the elbow to much of the proximal hand, including the wrist. If a break is found, you can always order more precise imaging (ie complete wrist of 3 view elbow) if needed. Speaking of elbows, 3 views (AP, True Lateral, and Oblique) are preferred views. Don't forget, children often have more than one fracture in more than one place (ie distally and proximally), so always keep this in mind when considering what views to obtain.

The Friday of Mardi Gras weekend has another tradition unique to New Orleans: the greasing of the poles contest. In order to prevent revelers from climbing the many metal poles outside French Quarter establishments, the poles are greased. Leave it to The Big easy to make this into a contest, which occurs outside the Royal Sonesta Hotel on Bourbon Street.



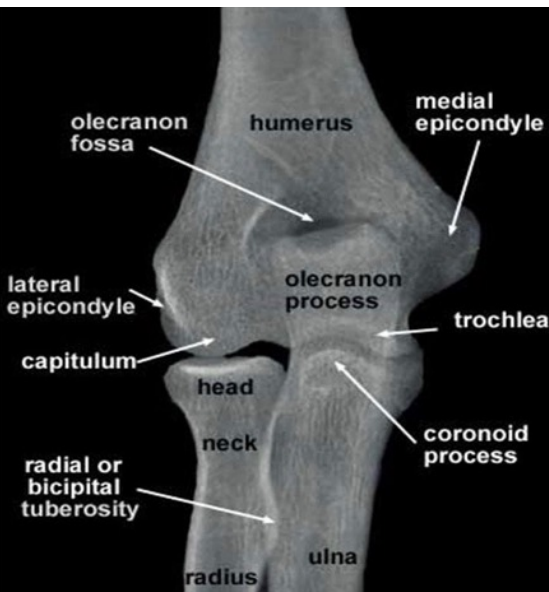


## Reading Elbow Imaging

A complete elbow series consists of three views:

1. AP
2. Lateral
3. Oblique

Aside from making sure that the films you are about to view is the correct patient, how one reads an elbow image really depends on repetition. Have a systematic method for reading images (ie soft tissues, then bones, alignment, lines, etc); reading a films the same way every time helps to up the chances that you won't miss anything.



The images above show a normal elbow series. Remember that children have ossification centers that close at different times (there is some variation, though):

Capitulum - 1 year

Radius - 3 years

Internal epicondyle (medial) - 5 years

Trochlea - 7 years

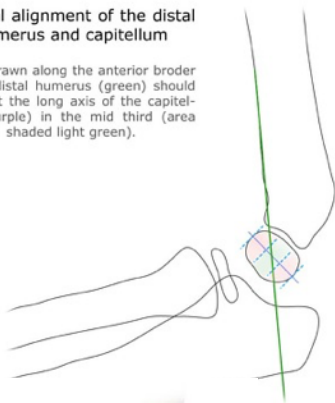
Lateral Condyle - 11 years



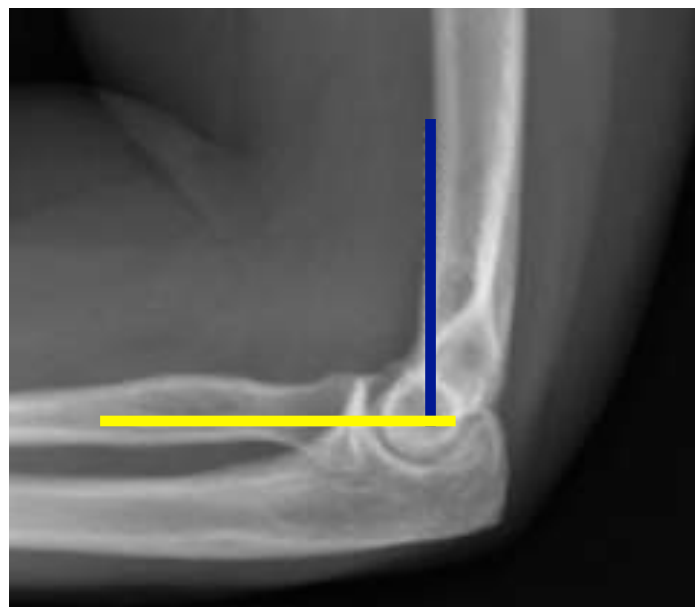
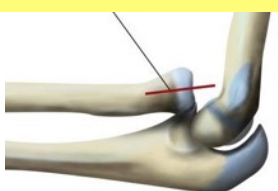
Below are images of a typical pediatric forearm series (2 view - AP and Lateral, preferably at 90 degrees). Reading forearm films follows the same principle as reading elbow films. Notice that you can get a pretty good view of the elbow on these images, so often it is worthwhile obtaining a forearm, with a dedicated elbow if needed.

Normal alignment of the distal humerus and capitulum

A line drawn along the anterior border of the distal humerus (green) should intersect the long axis of the capitulum (purple) in the mid third (area shaded light green).



**Radial Head Dislocation**



**Important Lines**  
Forearm images have several important lines to identify:

### 1. Radiocapitellar

This line is drawn down the neck of the radius and should bisect the capitulum. If it does not, then there is a radial head dislocation.

### 2. Anterior Humeral

This line should pass through the middle third of the capitulum. Consider a fracture if it does not. (In young children, it may pass through the anterior third of the capitulum).

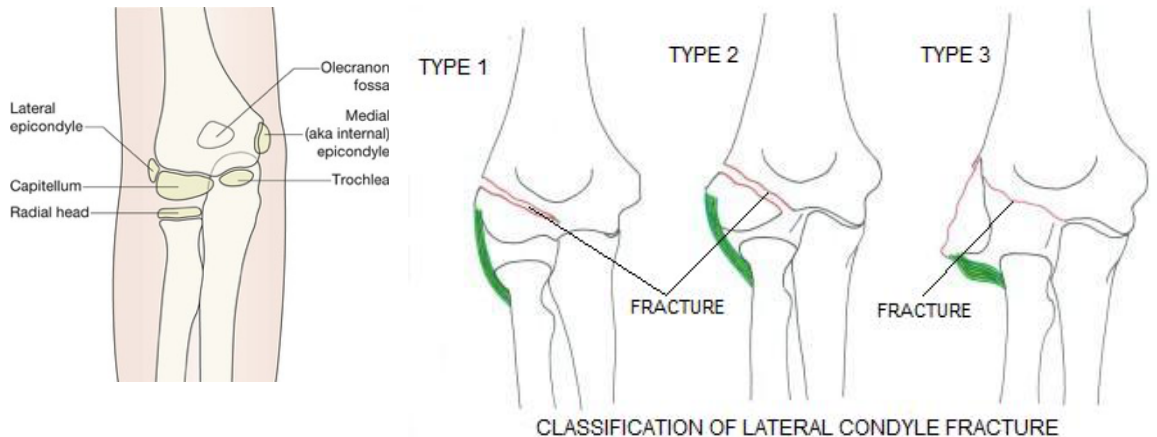
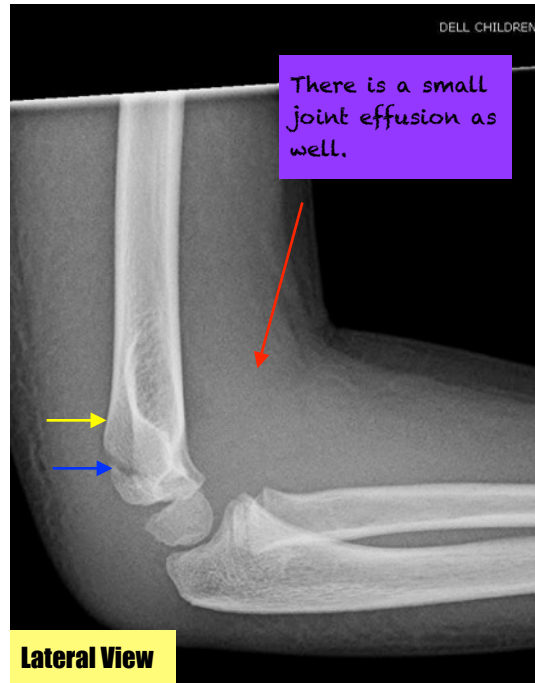
The original Mardi Gras colors were chosen by the traditional King of carnival, Rex, in 1892. Purple is for justice, green for faith, and gold for power.





Mardi Gras has pagan roots! The celebration actually dates back thousands of years, celebrating spring and fertility rites. When the Roman empire converted to Christianity, they incorporated the celebrations of Saturnalia and Lupercalia, which became the celebration of excess seen before Ash Wednesday and Lent.

Because the child's pain and edema are focused on the elbow, you obtain an elbow series (AP, Lateral, and Oblique). The images are seen to the right and below. Starting with the lateral view, the anterior humeral line and radiocapitellar line are both normal. One might argue that there is a very faint posterior fat pad (yellow arrow), so you know that there is likely a fracture there. If you look more closely, you can see a cortical defect (blue arrow). This defect is more obvious on the AP view, where the lateral condyle is fracture and minimally displaced (blue arrow). This can also be seen on the oblique view (blue arrow). So now what? Splint? Cast? Does Pediatric Orthopedics need to be contacted?



### Lateral Condyle Fractures

Pediatric lateral condyle fractures were first described in 1883, in Stimson's work *Treatise on Fractures*. It wasn't until 1955 that Milch recognized that these fractures had a significant impact on stability. He devised a classification scheme, seen above. These fractures are associated with falls on outstretched hands, but direct blows to the elbow can cause them as well. One theory postulates that the fracture fragment is pulled off then a varus stress is applied to an extended elbow with the hand in supination. Treatment may be non-operative, if the fracture is a Type I with less than 2 mm of displacement. Open reduction (using K wires) is indicated for all other fractures or if there is any concern for instability. Complications of these fractures include nonunion/malunion, cubitus varus (very common but typically very mild), and avascular necrosis of the none. Neurologic complications are quite rare.

K Wires: essentially steel pins, these wires were developed by Martin Kirschner in 1909 to hold bone fragments together.

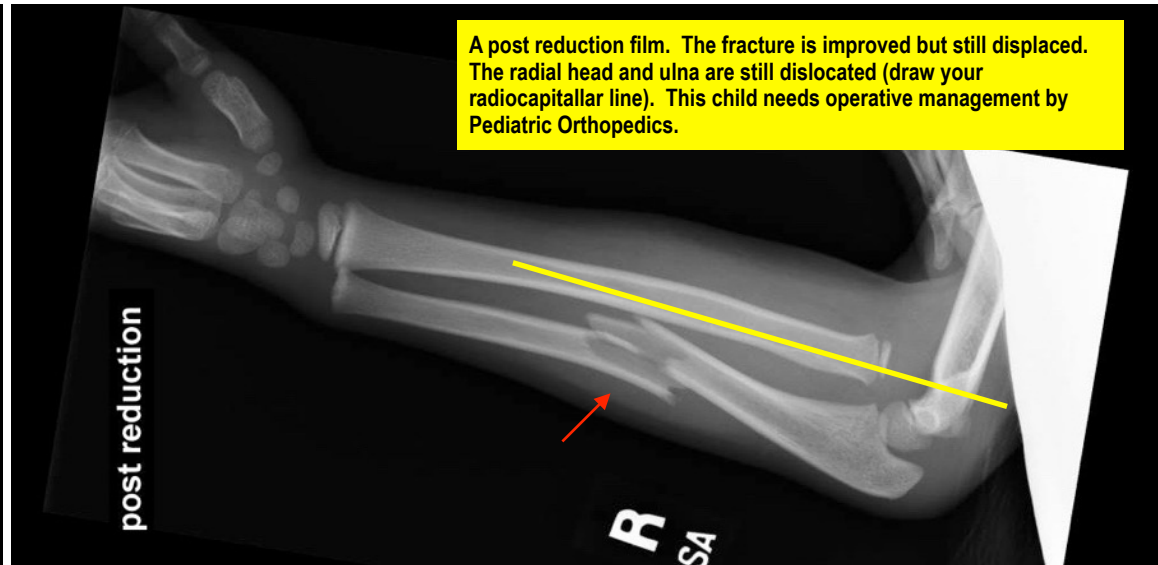


Mardi Gras is not just one parade. The Carnival season lasts from Epiphany to until Mardi Gras Day (Tuesday before Ash Wednesday). This is a long time to party! The season in New Orleans is kicked off by the Phunny Phorty Phellows streetcar ride down St Charles Avenue on 12th night. Their motto is: "A little nonsense now and then is relished by the wisest men."





While imaging is often repeated when a child is sent to a tertiary care center for treatment, its never hurts to look at what you already have. Sometimes repeat imaging may not be needed. In cases where you know there is a fracture severe enough that someone attempted reduction already, it is reasonable to leave the child in a splint and image through that. In this case, we've got some picture so let's look at them:

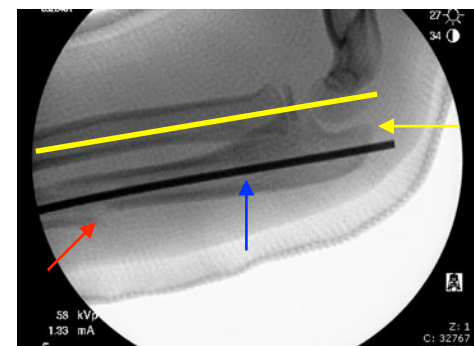
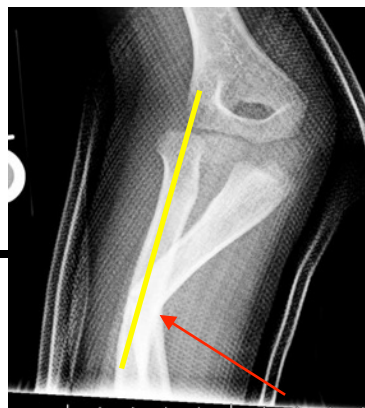


A post reduction film. The fracture is improved but still displaced. The radial head and ulna are still dislocated (draw your radiocapitellar line). This child needs operative management by Pediatric Orthopedics.

The film to the left is a good example of imaging that, while technically suboptimal, is sometimes all you can get. This occurs with some frequency at general emergency departments but will also happen in pediatric emergency departments as well. Sometimes you can't get a great view of an injury, but in this case, it's pretty obvious what is going on. The child has a comminuted oblique fracture of the ulna (red arrow); there is also displacement of the radial head and the ulna itself (yellow arrow). These features are consistent with a Monteggia's fracture, and a pretty bad one at that! Monteggia's fractures were first described in the early 18th century by Giovanni Batista Monteggia, who, by the way, contracted syphilis after cutting himself during an autopsy! These fractures are typically caused by hyperpronation of the forearm while falling onto the arm. There are 4 types, depending on the degree of radial head dislocation. They can be managed by closed reduction, but often require surgical management with pinning. The sooner treatment is initiated, the better the outcomes. Pediatric orthopedics should always be involved in the management of these children.



Here is an intraoperative image of the child. Notice that the radial head and ulna are now aligned and K wires have been placed to stabilize the ulna fracture. These fractures, especially more severe ones, are notoriously difficult to reduce and stabilize, so operative management is typically needed. Reduction should be done by Pediatric Orthopedics.



Here is another image of a Monteggia's fracture. Note the radial dislocation and the ulnar fracture. Also, notice that this child is in a splint. This again illustrates that sometime you can't get the best pictures, but get what you meaningfully can. Patient pain control if very important, so don't forget to use intranasal medications or, if in place, IV medication.





**Case 3**

You decide to obtain imaging of the child's elbow. Again, you consider imaging the whole forearm, but since she is an older child with a reliable exam, you decide to image the elbow, at least for now. The images are seen below:

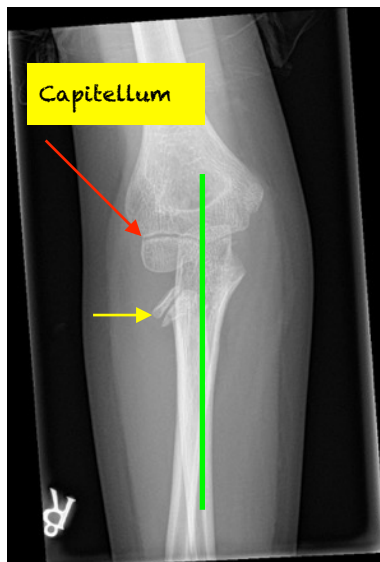


Notice anything? There is a cortical defect of the neck of the radius. This is consistent with a radial neck fracture (red arrow).

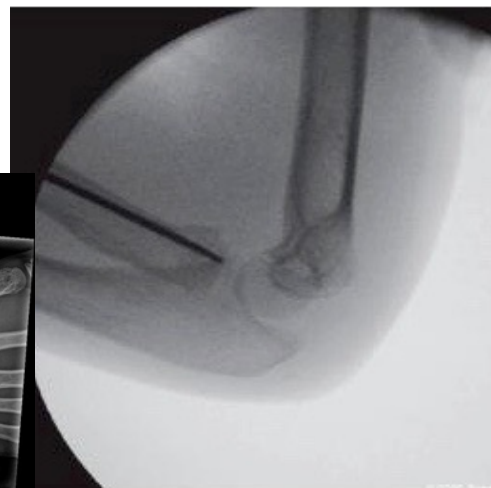
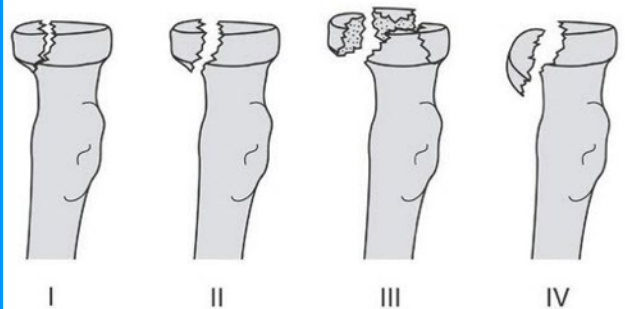
**Radial Neck Fractures**

These are not common injuries, accounting for approximately 5% of pediatric elbow injuries. Most of these fractures are mildly angulated, so immobilizations all that is required in the majority of cases. However, when surgical reduction is indicated, these fractures have a notoriously poor outcome. Which option to utilize is determined by how angulated the fracture is. Greater than 30 degrees typically calls for surgical reduction (closed vs open). Unfortunately, higher complication rates are reported with open surgical reduction.

The images below show a radial neck fracture (yellow arrow) along with a radial head dislocation (green line). Don't forget to check the radiocapitellar line when looking at forearm films! In this case, you can see the dislocation from the AP view. Be sure to look at all the views you have!

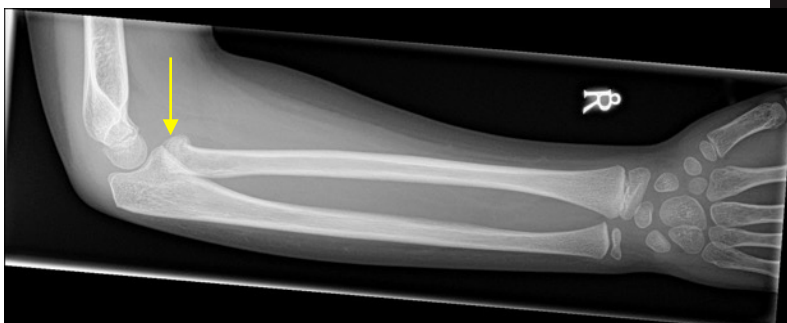


While there is a classification system for these fractures, most of the time radiologists will state that there is a fracture, not necessarily the grade of fracture.



Here is an intraoperative image of surgical reduction and pinning with K wires of a radial neck fracture.

Complications include malunion, nonunion, neuromuscular injury (the posterior interosseous nerve), and persistent pain.





The more views, the better. It's really hard to find the fracture in

Texas also has Mardi Gras celebrations, the largest of which takes place in the city of Galveston. Fun time, but not the same as New Orleans!



This fracture is difficult to see sometimes but should not be missed. This child is a 4 year old who was playing at the park when he fell, landing on his arm. He was noted to have tenderness of his distal forearm, above his wrist. Look carefully, and you can see a non displaced ulnar fracture (red arrow); the radius is also fractured, but this is a bowing fracture (blue arrow). These fractures are found almost exclusively in children, because of the degree of elasticity found in children. Most often there is another associated fractured treatment depends on how severe that fracture might be. In some patients, comparison views of the opposite forearm may be needed to confirm the fracture. If there is an isolated bowing fracture, then usually immobilization is all that's needed; if the bow is more than 20 degrees, then reduction is often performed.

### Case Resolutions

**Case 1 -** This child was taken to the operating room for pinning of his lateral condyle fracture by Pediatric Orthopedics. He was placed in a cast for 6 weeks, and did well after that.

**Case 2 -** This child had her fracture reduced and pinned, as well as the dislocations reduced in the operating room. She too was casted and carefully followed by Pediatric Orthopedics.

**Case 3 -** This child's fracture was splinted and then casted with Pediatric Orthopedic followup. No reduction was needed.

### Teaching Points

1. When evaluating a child with an elbow injury, consider the mechanism of injury. For example, if the child is involved in a motor vehicle accident, be sure to do a complete evaluation of the cervical spine, back, and abdomen, in addition to areas that are obviously injured.
2. Which part of the extremity to image depends on the age of the child (reliable history/exam or not), mechanism, and suspicion of other possible injuries. Obtaining a forearm view is a good first step in evaluating elbow injuries; this will allow you to get a good view of the elbow as well as evaluate the extremity for other injuries (especially the wrist) that may not be clinically apparent. Dedicated elbow views are very useful in evaluating a clinically obvious or highly suspected elbow injury.
3. Getting three views (AP, Lateral, and Oblique) is preferred. Sometimes, though this is not possible. In situations like that, obtain the best images you can while keeping the child comfortable.
4. Lateral condyle fractures are notoriously unstable and often are treated with pinning by Pediatric Orthopedics. The sooner this is accomplished, the better the outcome, so get the subspecialist involved in a child's care early.
5. Monteggia's fractures consist of two injuries and should be treated by a Pediatric Orthopedist. It is not suggested to attempt reduction in the Emergency Department without consultation with the subspecialist.
6. Radial neck fractures are not common, but they do occur. It is helpful to obtain multiple views in these patients. Most will heal well without reduction. When in doubt about any injury, consult Pediatric Orthopedics!

### REFERENCES

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