

Radiographic Evaluation of the Pediatric Elbow

Seema Awatramani, MD FAAP FCUCM



The Pediatric Urgent
Care Conference



How you can drive change:

- Identify the articular surfaces of the elbow
- Describe the circulation and innervation of the elbow
- Recognize the features of supracondylar fracture
- Describe the stepwise approach to interpretation of elbow x-ray
- Explain radiographic markers: the hourglass sign, anterior humeral line, radiocapitellar line

DRIVING **CHANGE2023**

Faculty Disclosures

No disclosures

The Pediatric Urgent
Care Conference



Background

- 65% of all fracture/dislocation are UE
- Elbow fractures more common in kids
- Supracondylar fractures
 - 16.6% of all childhood fractures
 - 30% of fractures from 0-7 years

The Pediatric Urgent
Care Conference



Recommended Resources

- Radiology Cases in Pediatric Emergency Medicine University of Hawaii

<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



Topic Outline

- Back to basics
- Anatomic & radiographic markers
- Xray

The Pediatric Urgent
Care Conference



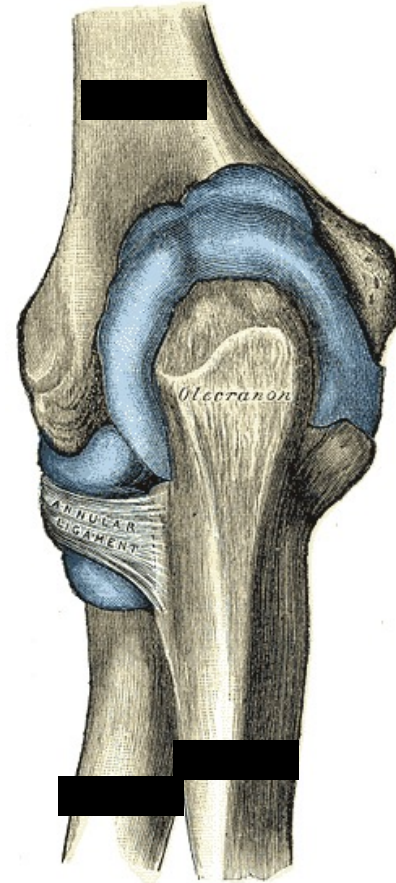
Anatomy

- Bony anatomy
 - Joint anatomy
 - Ossification
- Radiographic anatomy

The Pediatric Urgent
Care Conference



Anatomy Basics



POSTERIOR VIEW



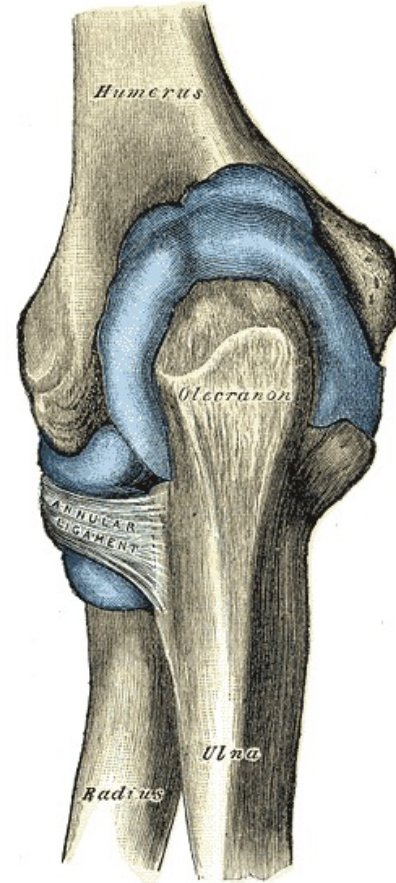
ANTERIOR VIEW

Gray's Anatomy, 40th Edition

The Pediatric Urgent
Care Conference



Anatomy Basics



POSTERIOR VIEW



ANTERIOR VIEW

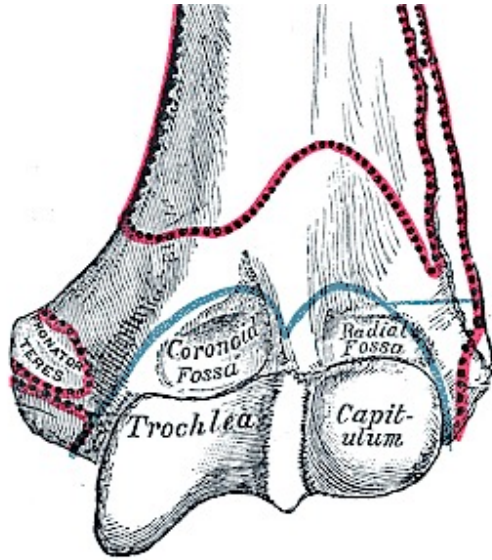
Gray's Anatomy, 40th Edition

The Pediatric Urgent
Care Conference

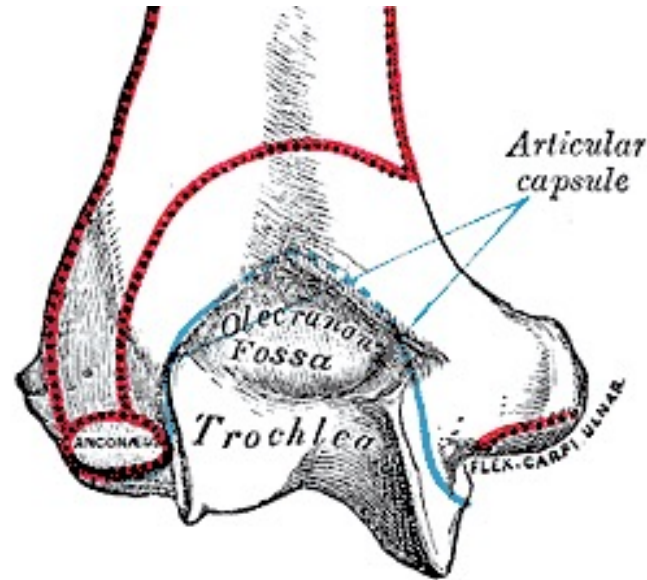


Articular Surfaces

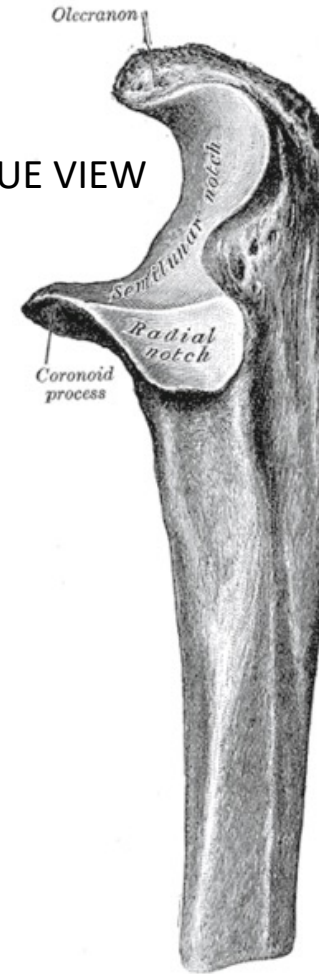
DISTAL HUMERUS
ANTERIOR VIEW



DISTAL HUMERUS
POSTERIOR VIEW



ULNA
OBLIQUE VIEW

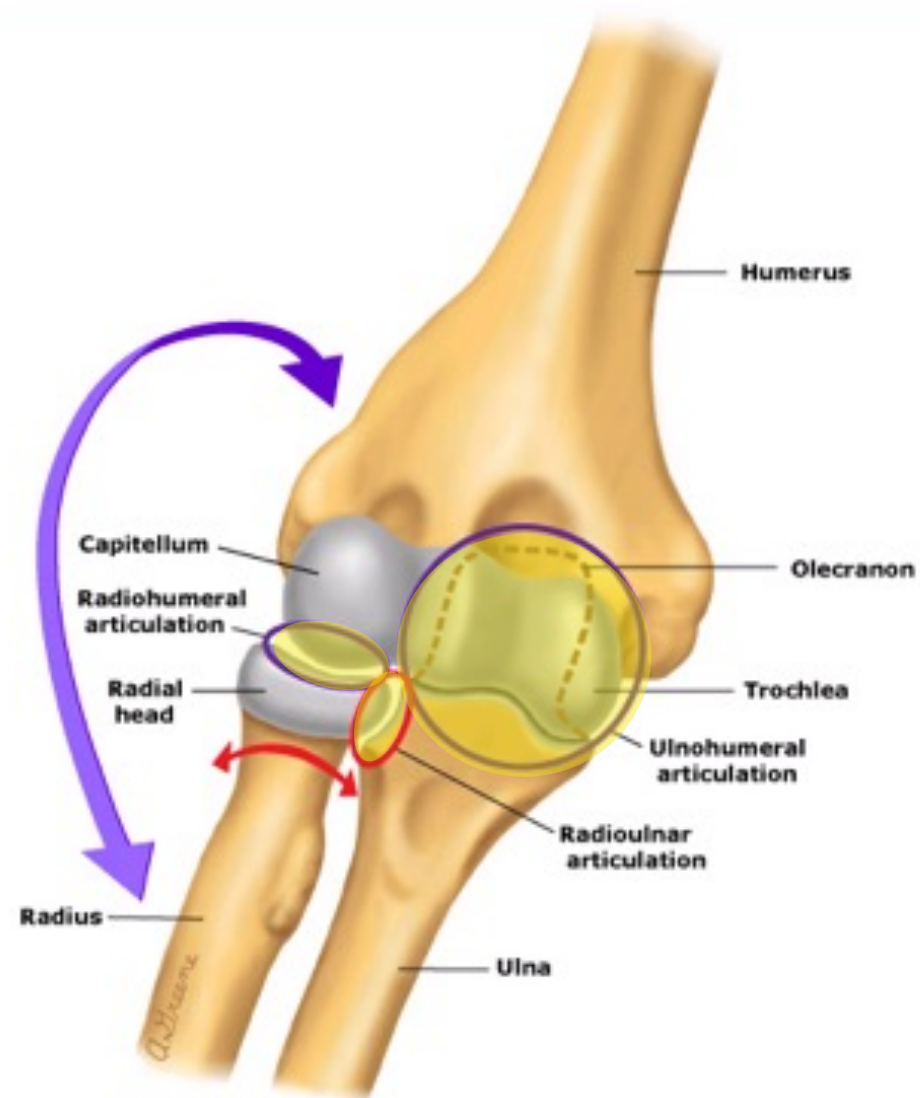


Gray's Anatomy, 40th Edition

The Pediatric Urgent
Care Conference



The Joint

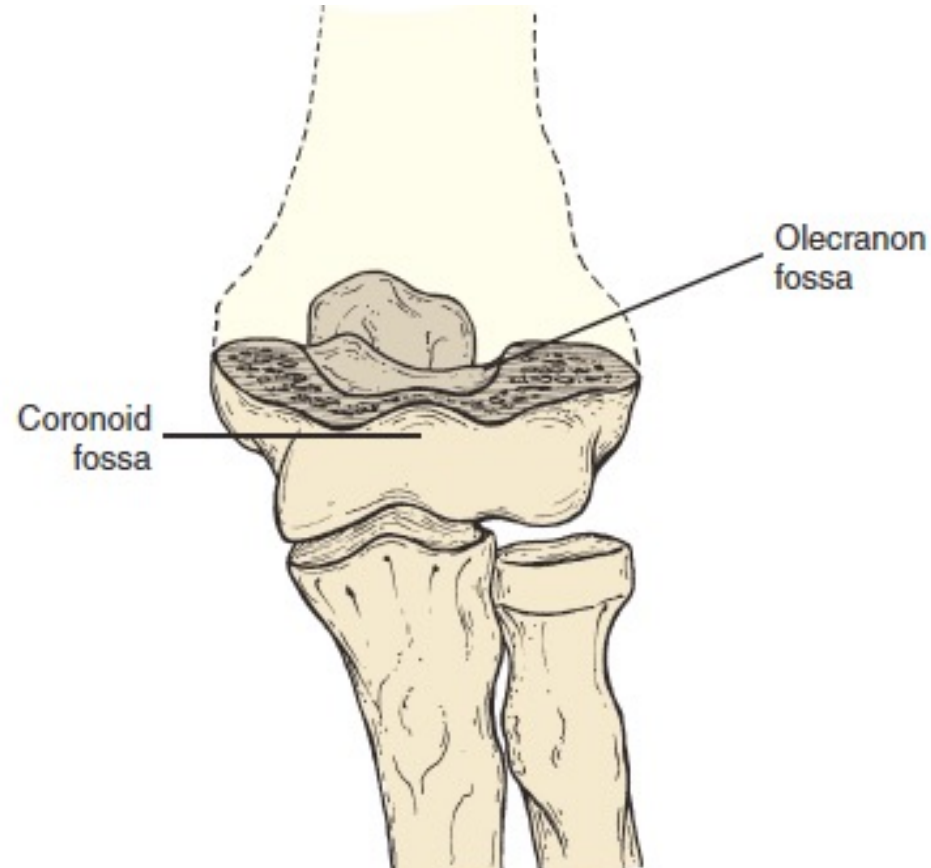


www.uptodate.com: Elbow anatomy and radiographic diagnosis of elbow fracture in children

The Pediatric Urgent
Care Conference



Supracondylar Fracture

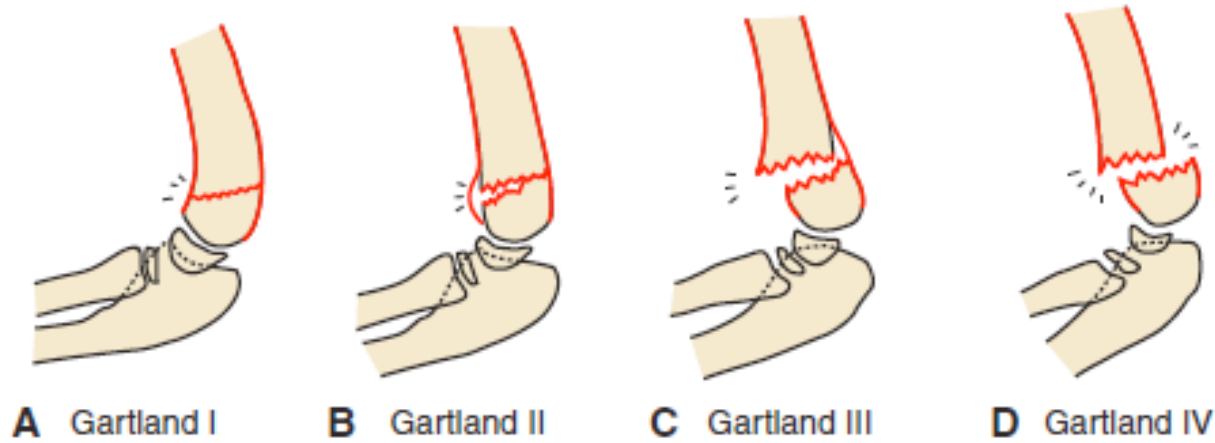


*Green NE. Fractures and dislocations about the elbow. In: Skeletal Trauma in Children, 3rd, Green NE, Swiontkowski MF. (Eds), WB Saunders, Philadelphia 2003. p.207-276.
www.uptodate.com: Evaluation and management of supracondylar fractures in children*

The Pediatric Urgent
Care Conference



Supracondylar Fracture



— = Periostern
— = Cortex

	I	II	III	IV
PE	minimal swelling TTP	pain with elbow movement some movement	no movement arm in extension much swelling ecchymosis	no movement much swelling ecchymosis more unstable
tx	posterior splint vs. sling	ortho, closed vs. reduction w/pin	ortho, closed vs. reduction w/pin	ortho, closed vs. reduction w/pin

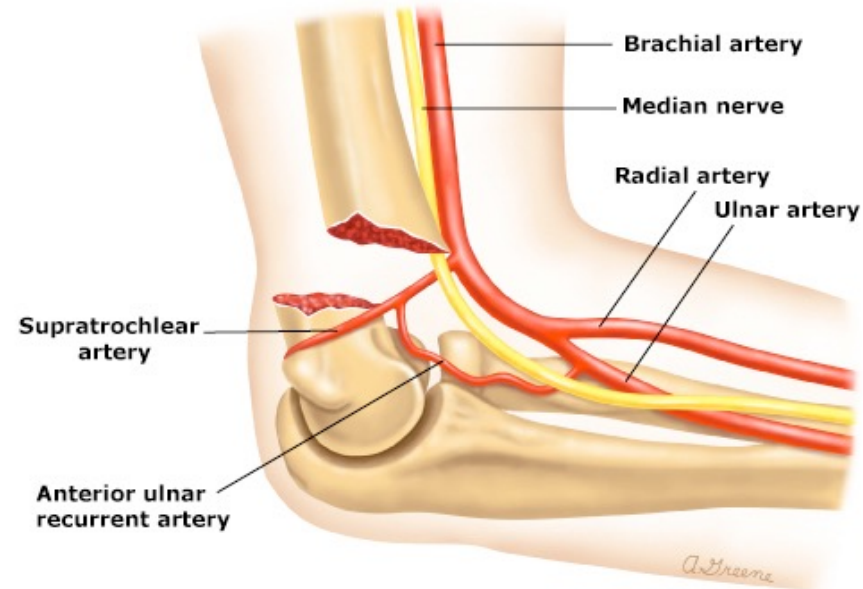
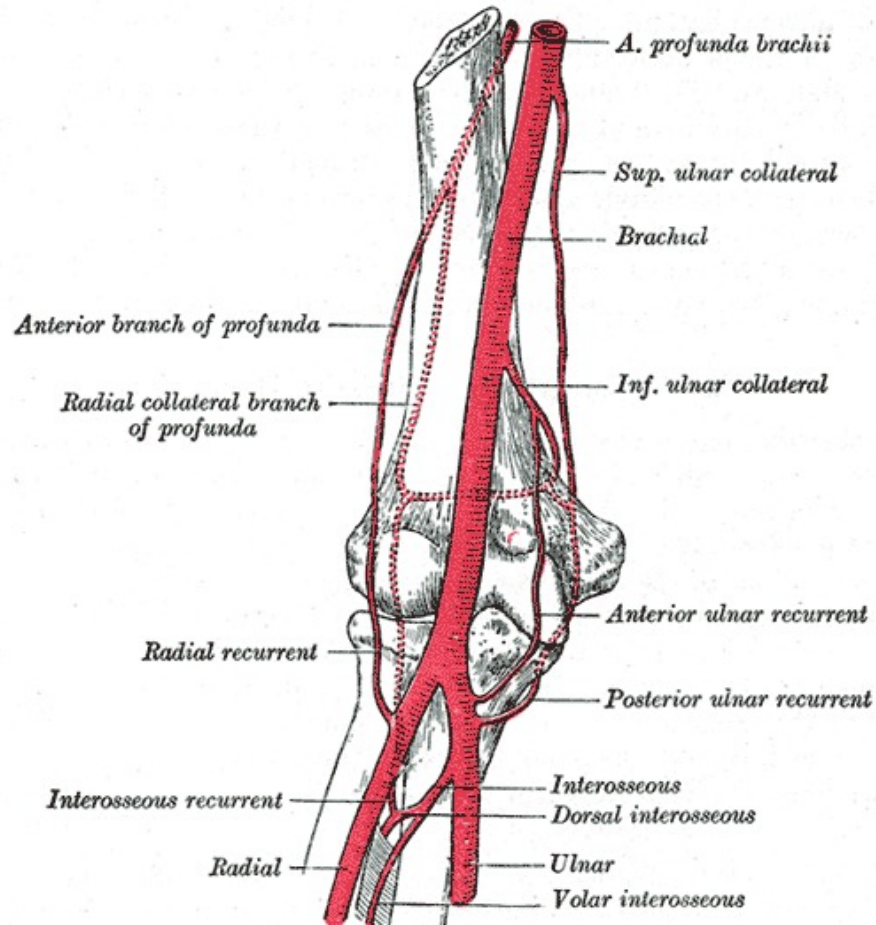
Green NE. Fractures and dislocations about the elbow. In: Skeletal Trauma in Children, 3rd, Green NE, Swiontkowski MF. (Eds), WB Saunders, Philadelphia 2003. p.207-276.

The Pediatric Urgent
Care Conference



Circulation

- Brachial artery prone to damage
- Extensive collaterals
- Ischemia is rare



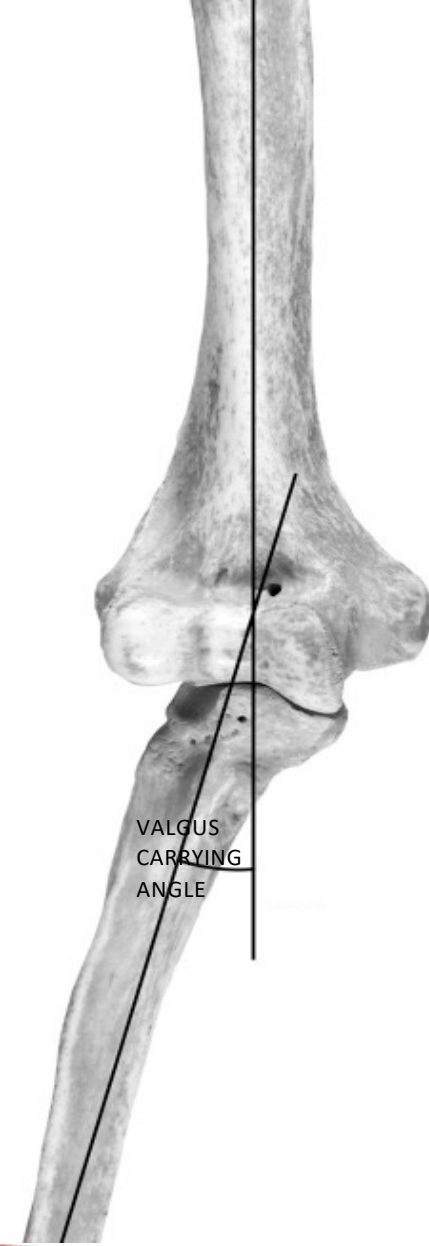
Gray's Anatomy, 40th Edition

The Pediatric Urgent
Care Conference



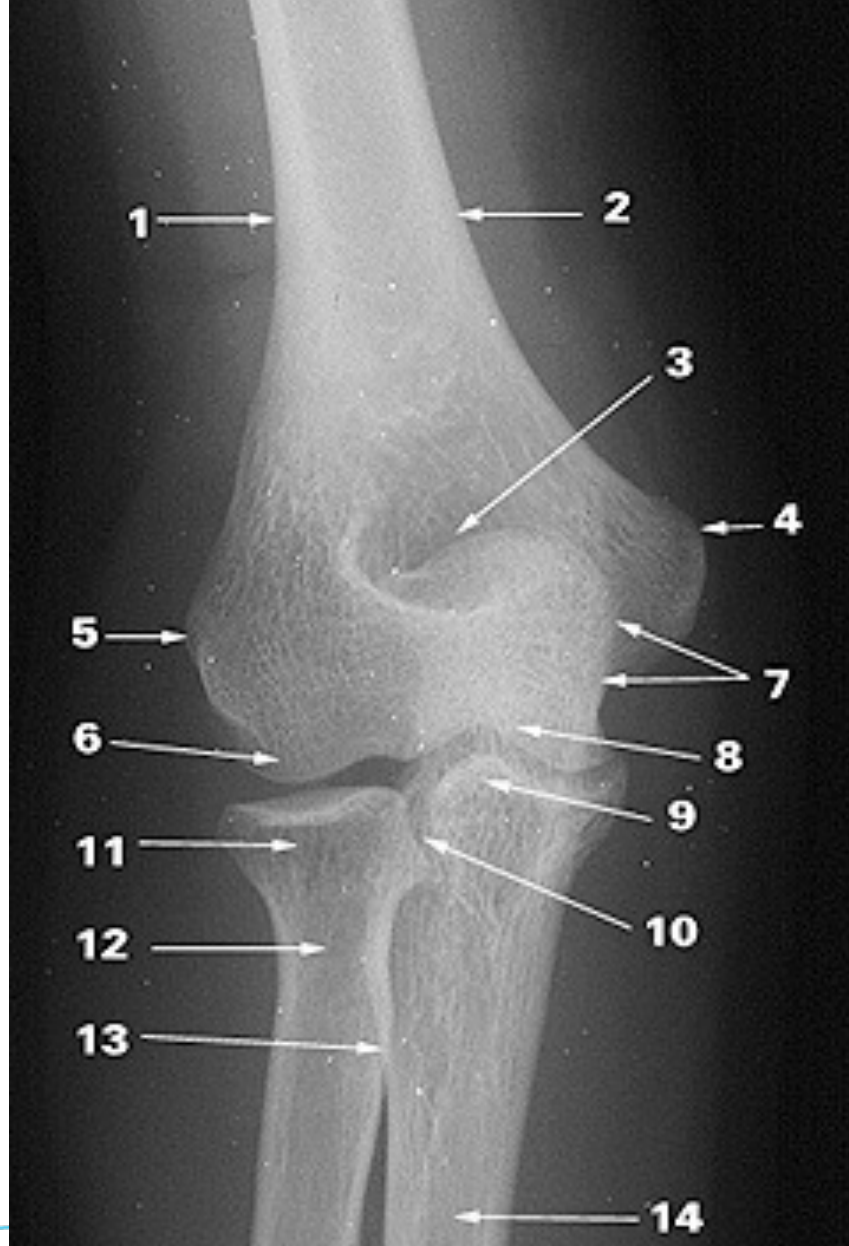
Carrying Angle

- Females > Males
- Check alignment after injury



The Pediatric Urgent
Care Conference





Putting It All Together

1	Lateral supracondylar ridge	8	Trochlea
2	Medial supracondylar ridge	9	Coronoid process
3	Olecranon fossa	10	Radioulnar joint
4	Medial epicondyle	11	Head of radius
5	Lateral epicondyle	12	Neck of radius
6	Capitellum	13	Tuberosity of radius
7	Olecranon	14	Ulna

*Radiographic Anatomy of Adult Elbow. OrthopaedicsOne
Articles. ver.4. <http://www.orthopaedicsone.com/x/lqBeAQ>.*

The Pediatric Urgent
Care Conference





Putting It All Together

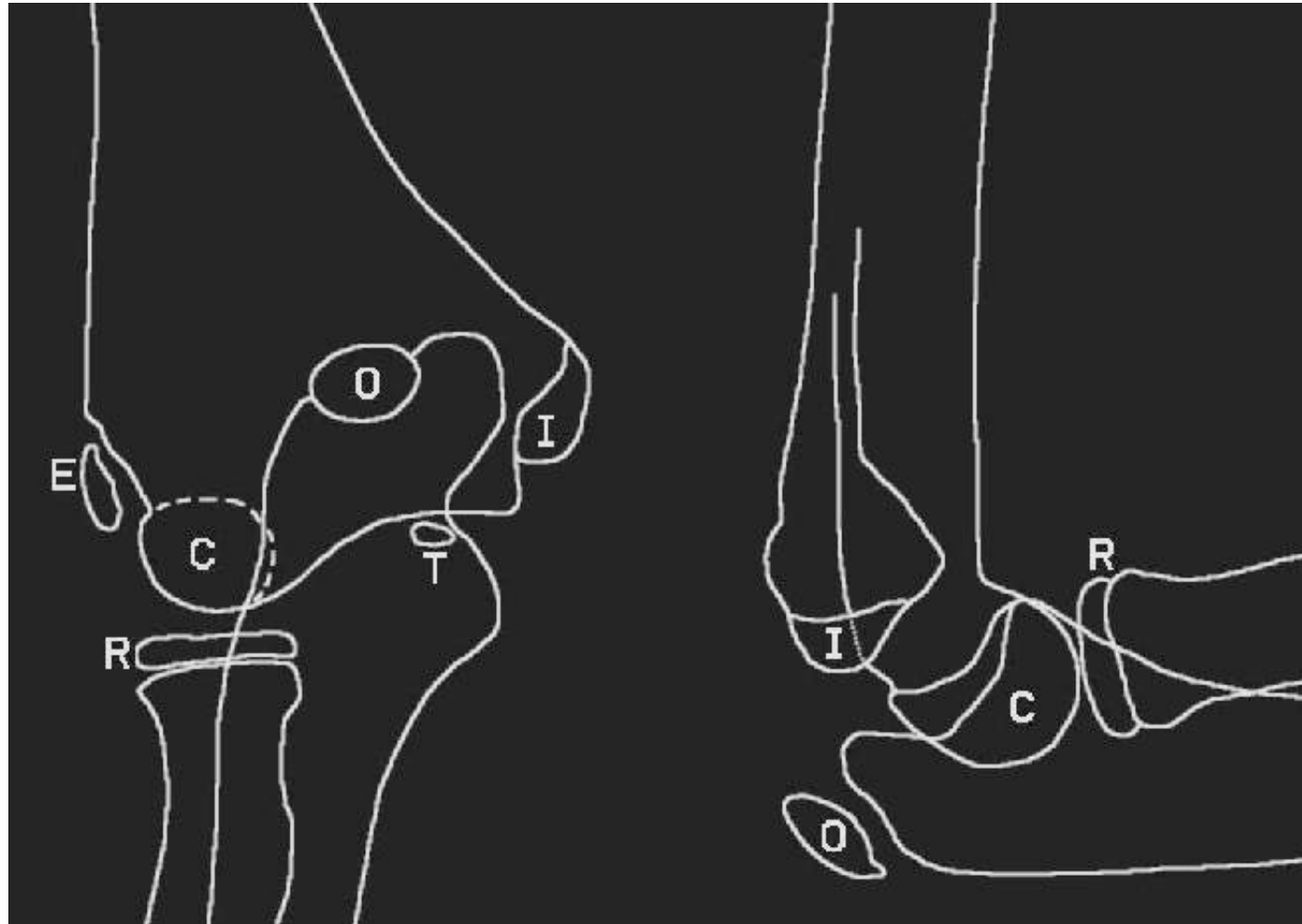
- 1 supracondylar ridge
- 2 trochlea
- 3 olecranon
- 4 trochlear notch
- 5 coronoid process of ulna
- 6 head of radius
- 7 neck of radius
- 8 tuberosity of radius

Radiographic Anatomy of Adult Elbow. OrthopaedicsOne Articles. ver.4. <http://www.orthopaedicsone.com/x/lqBeAQ>.

The Pediatric Urgent
Care Conference



Ossification Centers



<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



Ossification Centers

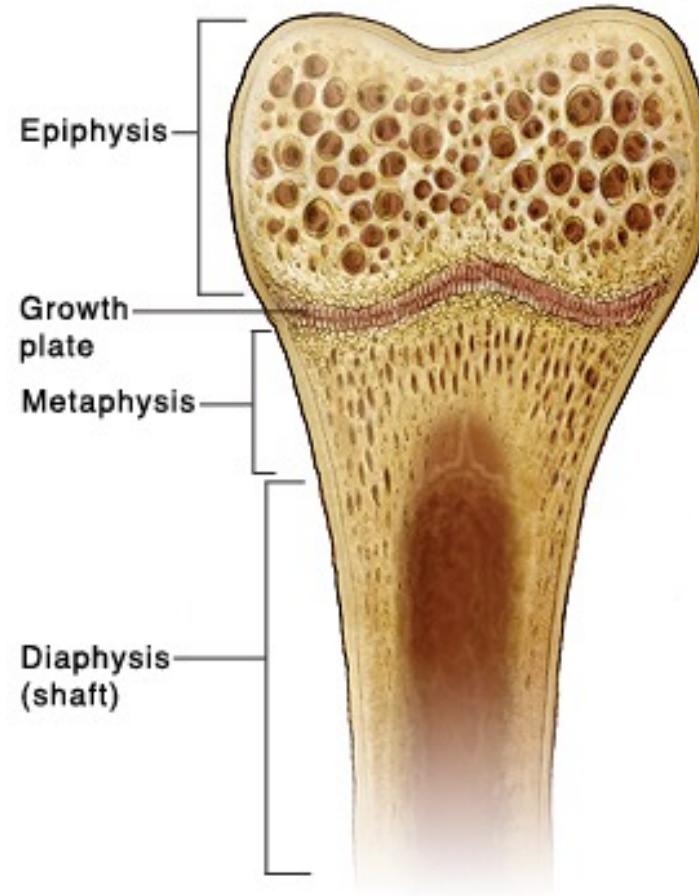


<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



The Growth Plate

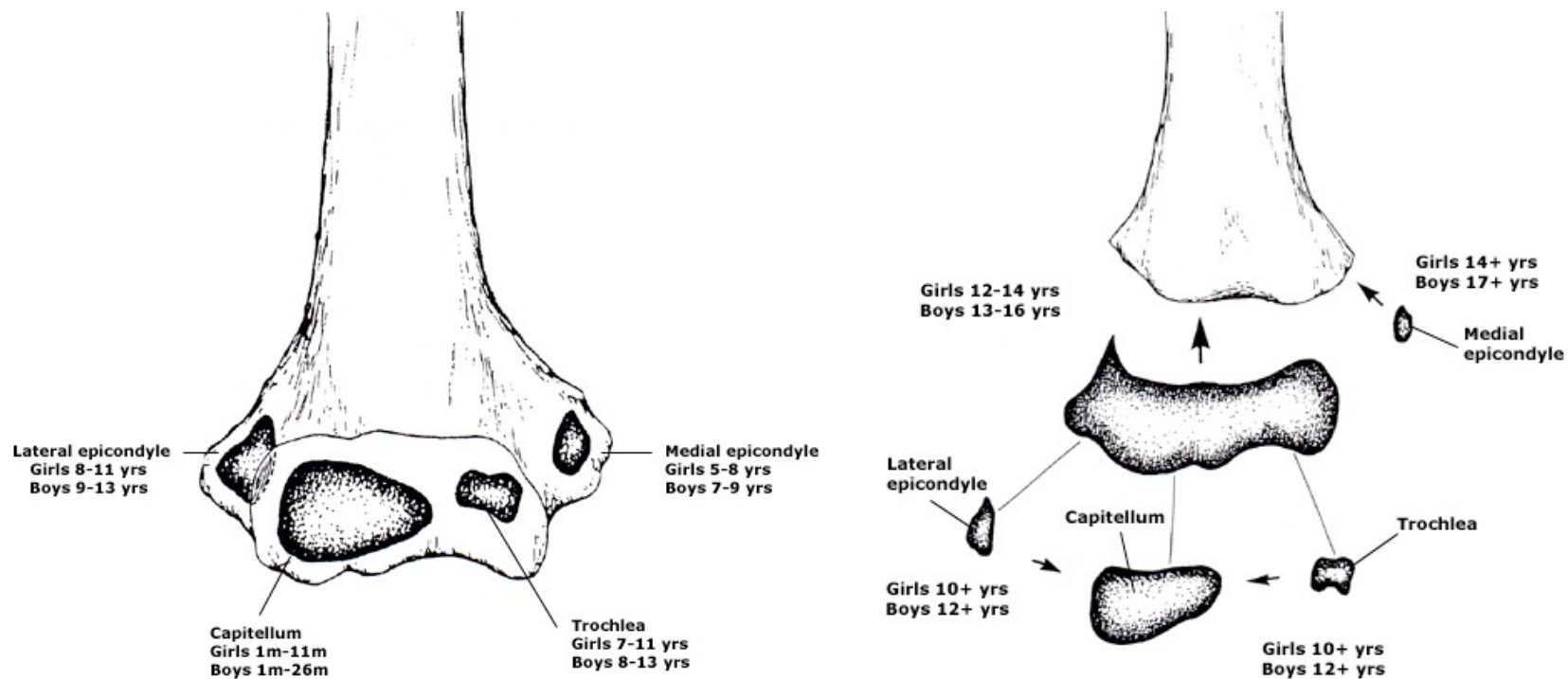


www.uptodate.com: Elbow anatomy and radiographic diagnosis of elbow fracture in children

The Pediatric Urgent
Care Conference



Ossification Centers



www.uptodate.com: Elbow anatomy and radiographic diagnosis of elbow fracture in children

The Pediatric Urgent Care Conference



By **PM** Pediatric Care

Ossification Centers

	Location	Age
C	capitellum	1
R	radial head	3
I	internal (medial) epicondyle	5
T	trochlea	7
O	olecranon	9
E	external (lateral) epicondyle	11

<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



by **PM** Pediatric
Care

Ossification Centers

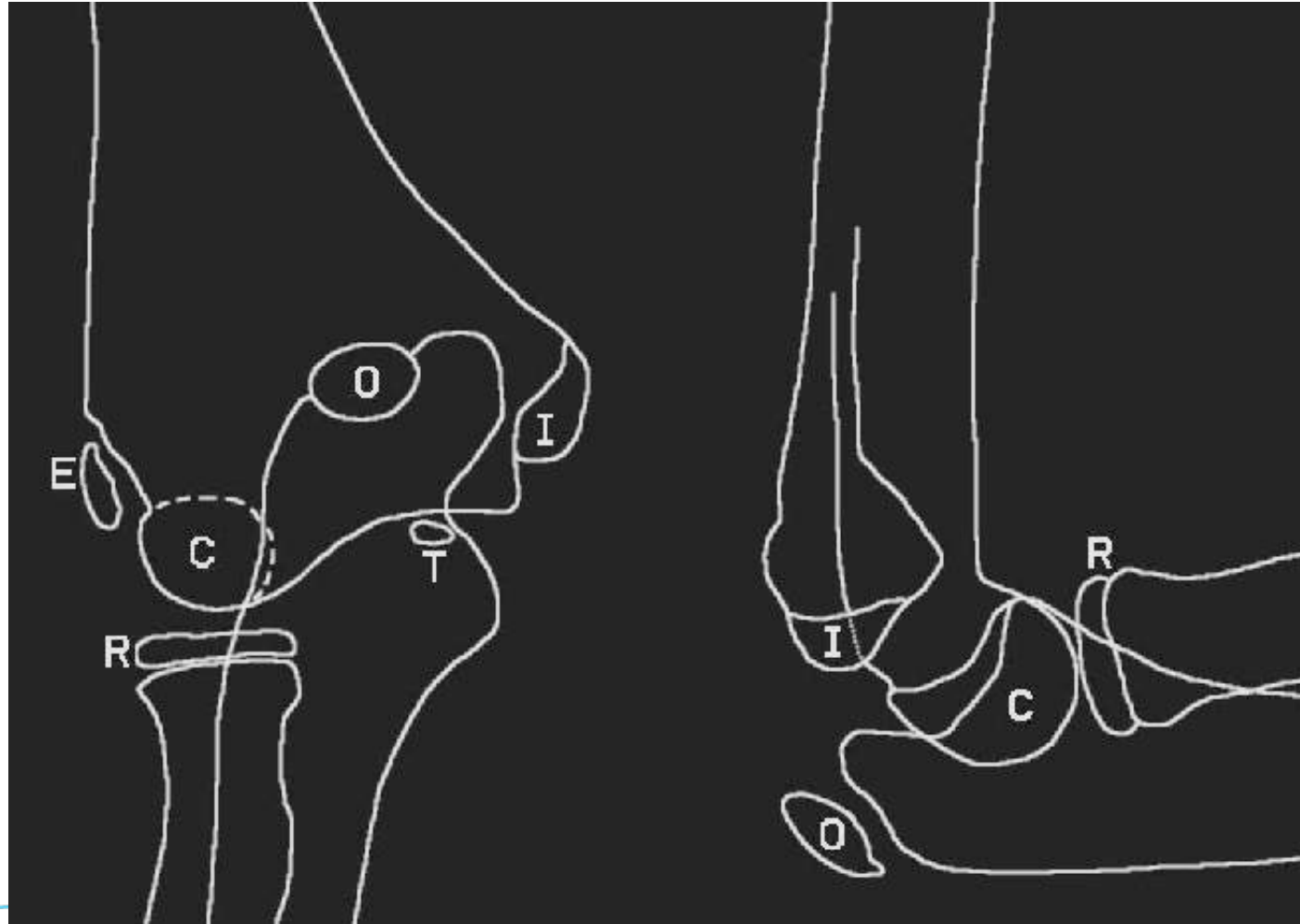


<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



Ossification Centers



<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



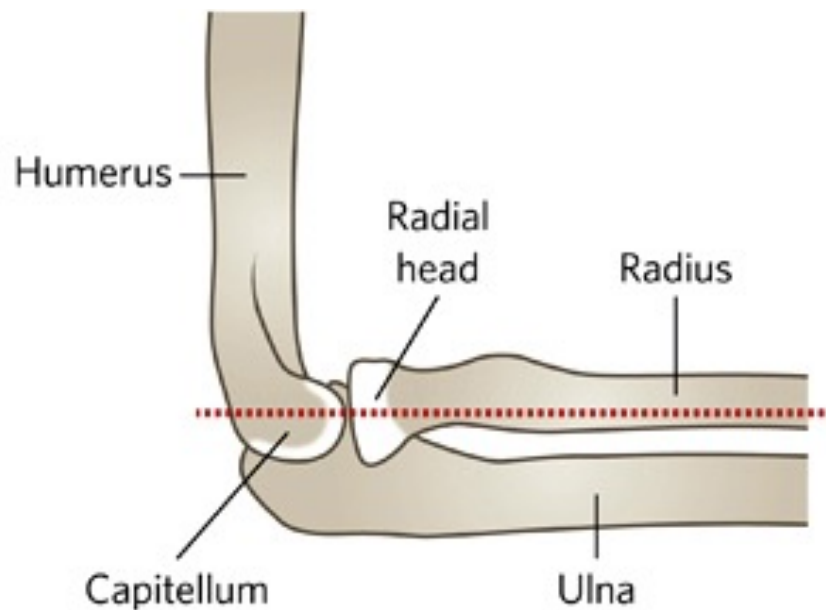
Radiographic Anatomy

- AP: epicondyles and articular surfaces
- Lateral: humerus to forearm, fat pads
- Oblique: coronoid, radio-ulnar joint

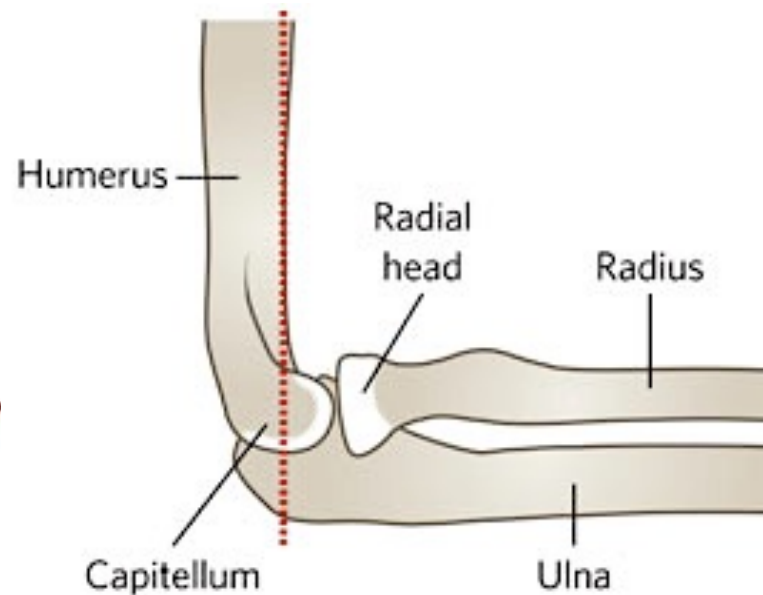
The Pediatric Urgent
Care Conference



Radiographic Lines



RADIOCAPITELLAR LINE



ANTERIOR HUMERAL LINE

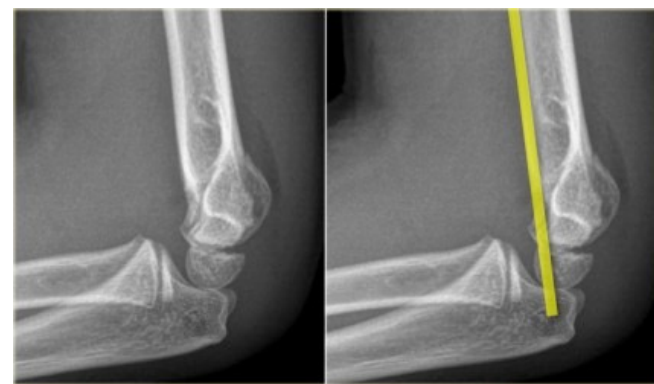
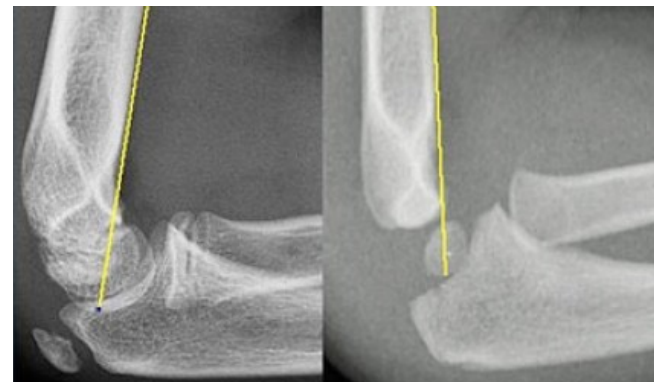
http://www.rch.org.au/clinicalguide/guideline_index/fractures/Supracondylar_fracture_of_the_humerus_Emergency_Department/

The Pediatric Urgent
Care Conference



by **PM** Pediatric
Care

Radiographic Lines



RADIOCAPITELLAR LINE

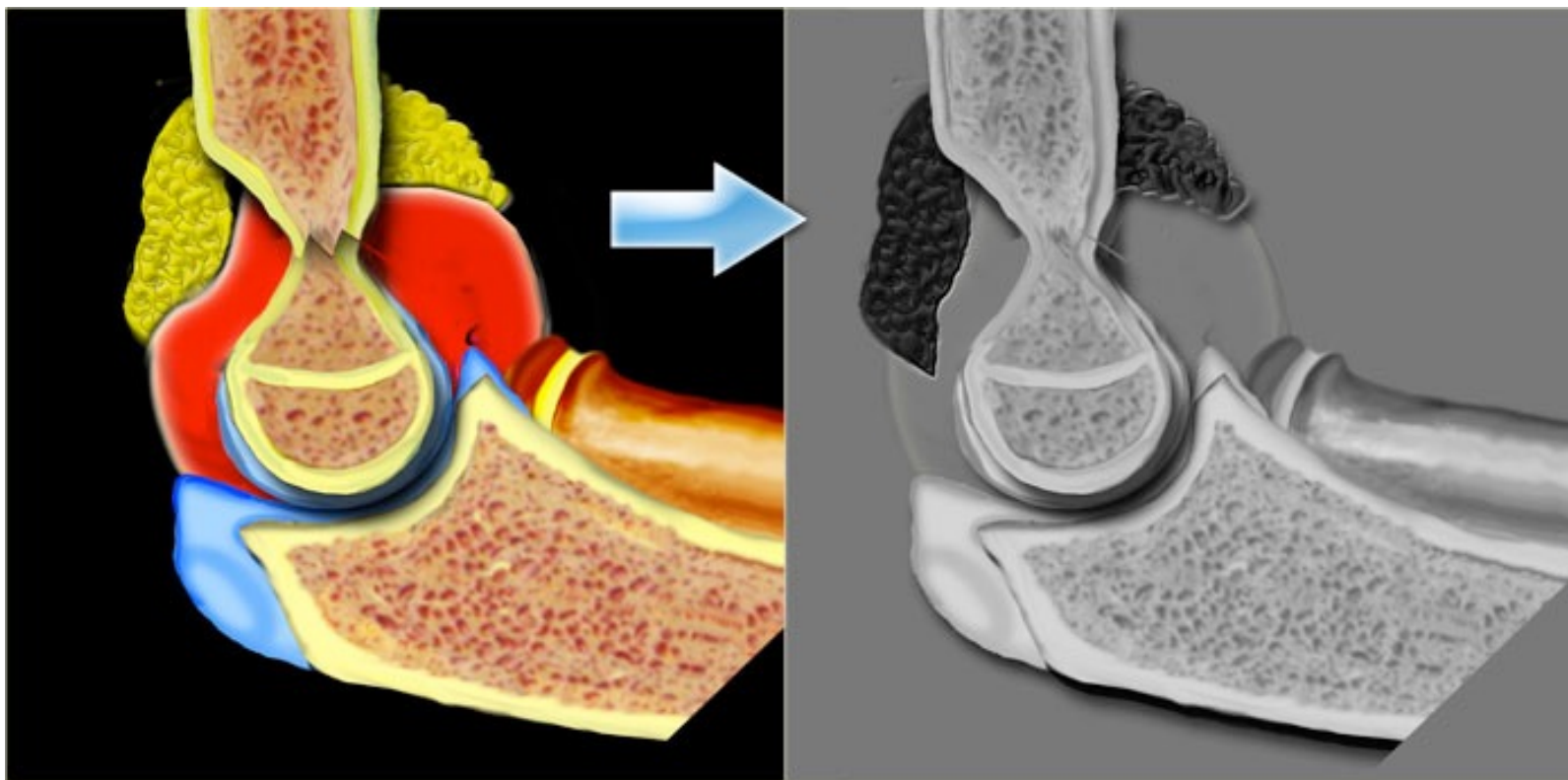
ANTERIOR HUMERAL LINE

<http://www.radiologyassistant.nl/en/p4214416a75d87/elbow-fractures-in-children.html>

The Pediatric Urgent
Care Conference



Fat Pads



<http://www.radiologyassistant.nl/en/p4214416a75d87/elbow-fractures-in-children.html>

The Pediatric Urgent
Care Conference

PUCC @ UCA
by **PM** Pediatric
Care

Hourglass Sign



NORMAL



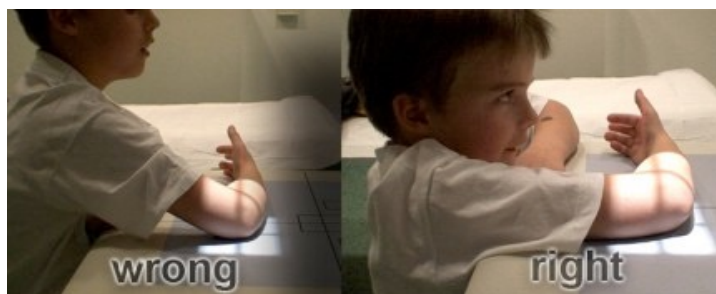
ABNORMAL

<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

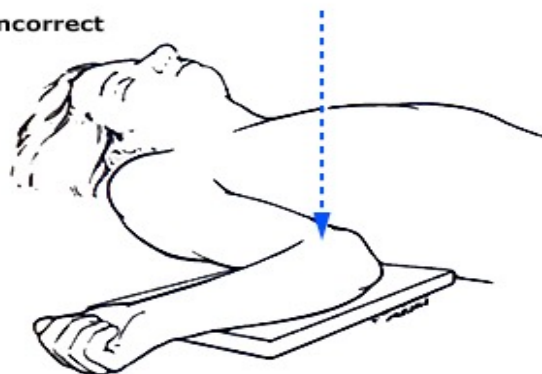
The Pediatric Urgent
Care Conference



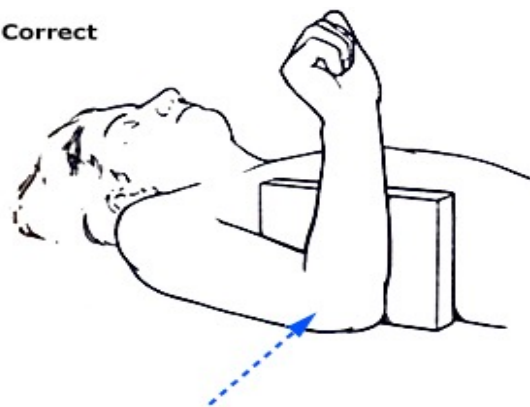
Proper Positioning



Incorrect



Correct



<http://www.radiologyassistant.nl/en/p4214416a75d87/elbow-fractures-in-children.html>

Green NE. Fractures and dislocations about the elbow. In: *Skeletal Trauma in Children*, 3rd, Green NE, Swiontkowski MF. (Eds), WB Saunders, Philadelphia 2003. p.207-276
www.uptodate.com: Evaluation and management of supracondylar fractures in children.

The Pediatric Urgent
Care Conference



Effusion vs. Fracture?

- Fat pad = joint effusion
- Fat pad without fracture = occult fracture?

Skaggs DL, et al; The posterior fat pad sign in association with occult fracture of the elbow in children. J Bone Joint Surg Am. 1999 Oct;81(10):1429-33.

Donnelly LF, et al, ; Traumatic elbow effusions in pediatric patients: are occult fractures the rule? AJR Am J Roentgenol. 1998 Jul;171(1):243-5.

Pudas T, et al; Magnetic resonance imaging in pediatric elbow fractures. Acta Radiol. 2005 Oct;46(6):636-44.

Al-Aubaidi Z, et al.; The role of fat pad sign in diagnosing occult elbow fractures in the pediatric patient: a prospective magnetic resonance imaging study. J

Pediatr Orthop B. 2012 Nov;21(6):514-9.

Major NM et al; Elbow effusions in trauma in adults and children: is there an occult fracture? AJR Am J Roentgenol. 2002 Feb;178(2):413-8.

de Beaux AC et al; Elbow fat pad sign: implications for clinical management. J R Coll Surg Edinb. 1992 Jun;37(3):205-6.

The Pediatric Urgent
Care Conference



The Checklist

	Summary Outline
1	Anterior fat pad
2	Posterior fat pad
3	Anterior humeral line
4	Radial head contour
5	Radiocapitellar line
6	Ossification centers
7	Hourglass sign
8	Distal humerus
9	Ulna/Olecranon
10	Clinical correlation

<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



Sample Case 1



<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

CHECKLIST

- ✓ Anterior fat pad
- ✓ Posterior fat pad
- ✓ Anterior humeral line
- ✓ Radial head contour
- ✓ Radiocapitellar line
- ✓ Ossification centers
- ✓ Hourglass sign
- ✓ Distal humerus
- ✓ Ulna/Olecranon
- ✓ Clinical correlation

The Pediatric Urgent
Care Conference



Dx:
Joint Effusion
Supracondylar Fracture

<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



Sample Case 2



<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

CHECKLIST

- ✓ Anterior fat pad
- ✓ Posterior fat pad
- ✓ Anterior humeral line
- ✓ Radial head contour
- ✓ Radiocapitellar line
- ✓ Ossification centers
- ✓ Hourglass sign
- ✓ Distal humerus
- ✓ Ulna/Olecranon
- ✓ Clinical correlation

The Pediatric Urgent
Care Conference



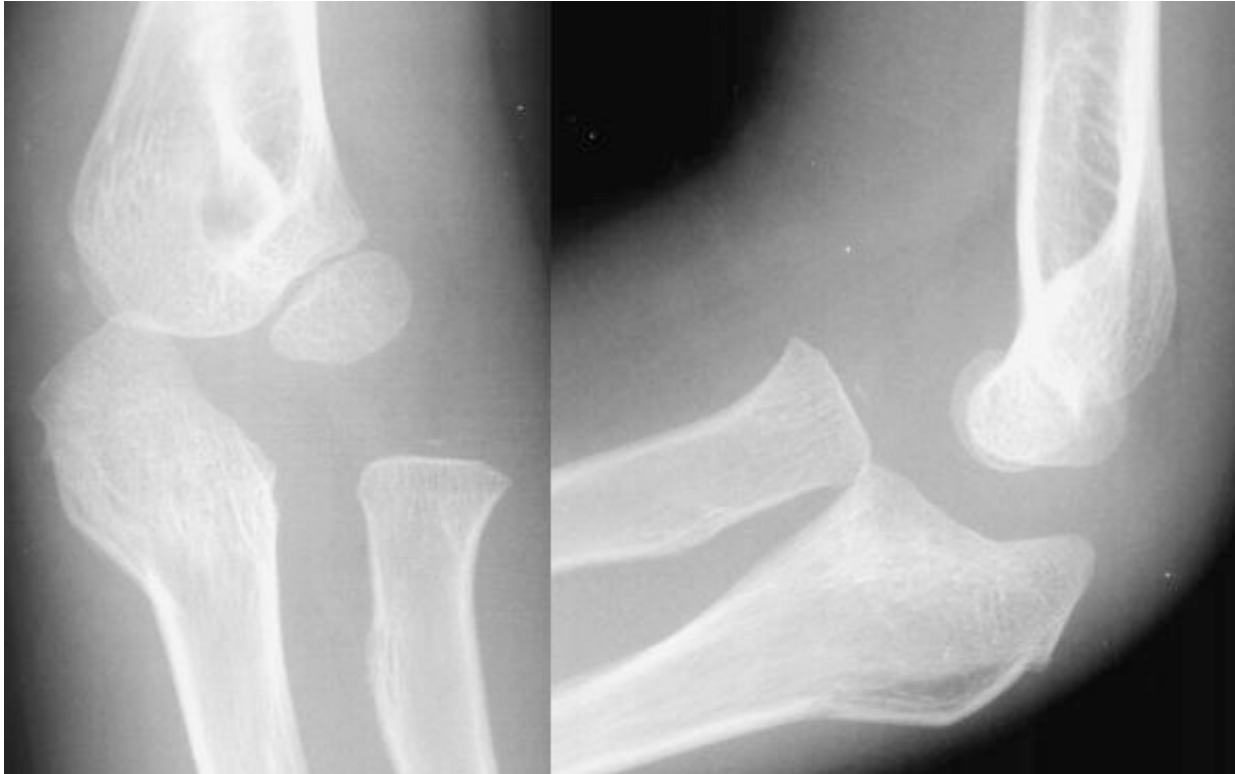
Dx:
Joint Effusion
No visible fracture

<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



Sample Case 3



<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

CHECKLIST

- ✓ Anterior fat pad
- ✓ Posterior fat pad
- ✓ Anterior humeral line
- ✓ Radial head contour
- ✓ Radiocapitellar line
- ✓ Ossification centers
- ✓ Hourglass sign
- ✓ Distal humerus
- ✓ Ulna/Olecranon
- ✓ Clinical correlation

The Pediatric Urgent
Care Conference



Dx:
Joint effusion, olecranon
fracture and radial head
dislocation
Monteggia injury

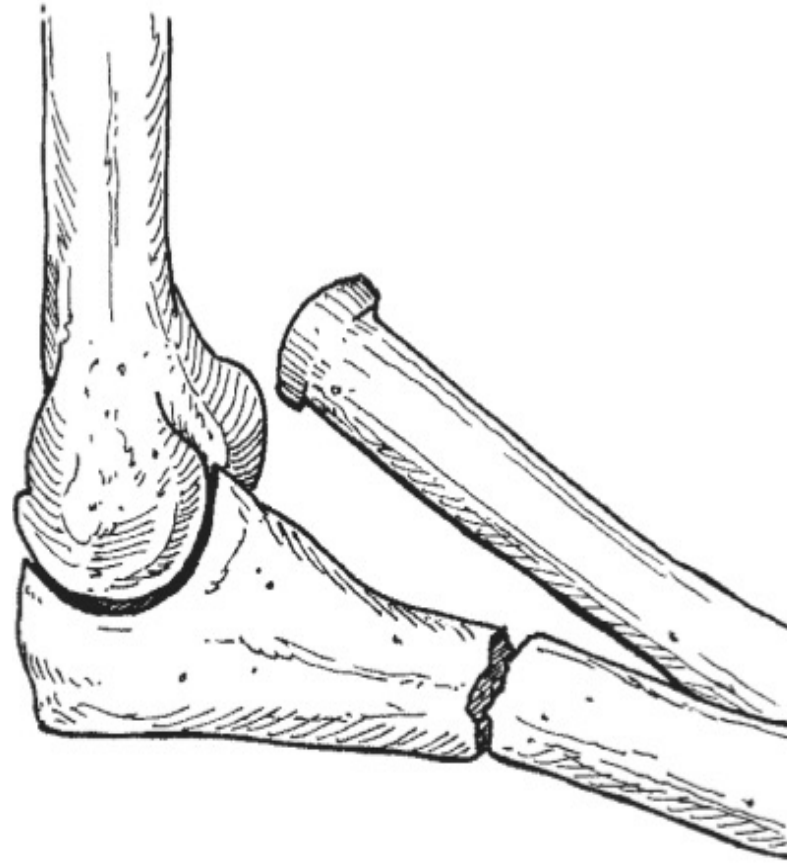
[http://www.hawaii.edu/medicine/
pediatrics/pemxray/pemxray.html](http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html)

The Pediatric Urgent
Care Conference



Monteggia Injury

- Proximal ulnar fracture accompanied by a radial head dislocation
- FOOS(Arm) in pronation
- 2% pediatric elbow fractures



The Pediatric Urgent
Care Conference



Sample Case 4



<http://emedicine.medscape.com/article/415822>

CHECKLIST

- ✓ Anterior fat pad
- ✓ Posterior fat pad
- ✓ Anterior humeral line
- ✓ Radial head contour
- ✓ Radiocapitellar line
- ✓ Ossification centers
- ✓ Hourglass sign
- ✓ Distal humerus
- ✓ Ulna/Olecranon
- ✓ Clinical correlation

The Pediatric Urgent
Care Conference



Dx:
Medial Epicondylar
Fracture
Small Joint Effusion

<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



Sample Case 5



CHECKLIST

- ✓ Anterior fat pad
- ✓ Posterior fat pad
- ✓ Anterior humeral line
- ✓ Radial head contour
- ✓ Radiocapitellar line
- ✓ Ossification centers
- ✓ Hourglass sign
- ✓ Distal humerus
- ✓ Ulna/Olecranon
- ✓ Clinical correlation

<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



Dx:
Joint Effusion
Supracondylar Fracture

<http://www.hawaii.edu/medicine/pediatrics/pemxray/pemxray.html>

The Pediatric Urgent
Care Conference



- Diagnoses of elbow sprains in children should be made with caution, as occult elbow fractures are very common and consequential
- A true lateral must be obtained to rule out effusion
- Using the sequence of appearance of ossification centers can aid to distinguish bone fragments from epiphyses
- Mastering elbow x-rays are possible with a step-wise approach

Questions?

DRIVING **CHANGE2023**
THE URGENT CARE CONVENTION



"I see your tennis elbow doesn't seem to be bothering you anymore."

The Pediatric Urgent
Care Conference

PUCC @ UGA
by **PM** Pediatric
Care

DRIVING **CHANGE 2023**
THE URGENT CARE CONVENTION

Thank You!

The Pediatric Urgent
Care Conference

PUCC @ UCA
By **PM** Pediatric
Care



Polling Questions

Question 1: *Which supracondylar fracture types involve displacement between the proximal and distal segments?*

- A: Gartland 4
- B: Gartland 4, 3
- C: Gartland 4, 3, 2
- D: Gartland 4, 3, 2, 1

The Pediatric Urgent
Care Conference





Polling Questions

Question 2 – *Which ossification center is from the ulna?*

- A: capitellum
- B: olecranon
- C: trochlea
- D: internal epicondyle

The Pediatric Urgent
Care Conference





Polling Questions

Question 3: *Which is an accurate description of the fat pads in a normal x-ray?*

- A: anterior and poster fat pads are linear and present
- B: anterior and poster fat pads are absent
- C: anterior fat pad is linear and present only
- D: posterior fat pad is linear and present only

The Pediatric Urgent
Care Conference





Polling Questions

Question 4: *An x-ray of a child has the capitellum, radial head, and medial epicondylar ossification center present. What is the approximate age of the child?*

- A: 1 yo
- B: 2 yo
- C: 5 yo
- D: 7 yo

The Pediatric Urgent
Care Conference





Polling Questions

Question 5: Which of the following structures is within the articular capsule of the elbow?

- A: medial epicondyle
- B: lateral epicondyle
- C: trochlea
- D: olecranon

The Pediatric Urgent
Care Conference



Session Evaluation

- Your feedback is valuable, take a moment to complete the survey for this session.
- To claim CME, you must complete a separate survey available after the convention.

* How likely are you to recommend this **content** to a colleague?

Not likely at all Neutral Extremely likely

0 1 2 3 4 5 6 7 8 9 10

What did you find most valuable about this **content**?

What would have made this **content** better?