Pediatric Supracondylar Humerus Fractures: ”The State of the Art”

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- No Disclosures

Outline

- Review pathophysiology of SCH fxs
- Diagnostic, management protocols
- “State of the art” in SCH fx:
  - Does NOT refer to technology (k wires!)
  - The “art” of supracondylar management remains complex decision making for severe injuries… and also for mild injuries.
  - The subtleties of management are the art of this injury

State of the "Art"

- Surgical technique/pin placement
- Treating Gartland type 2A
- Decisions for vascular abnormalities
- X-ray protocol/follow up

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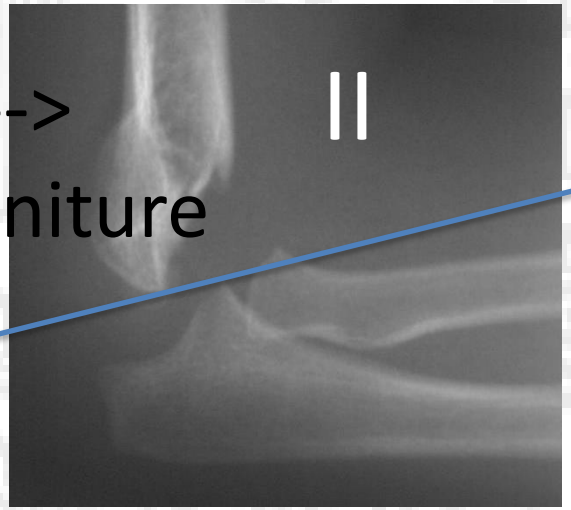
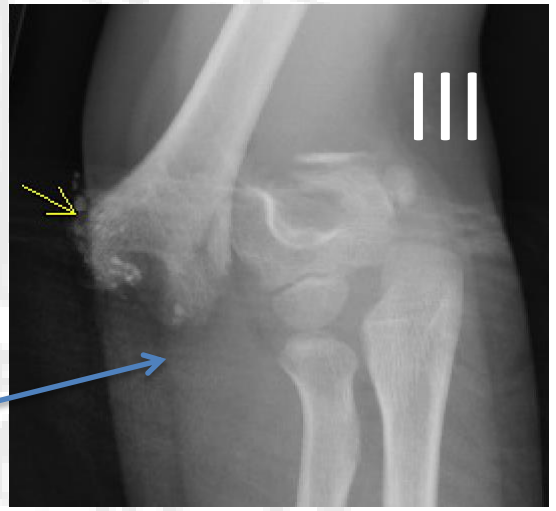
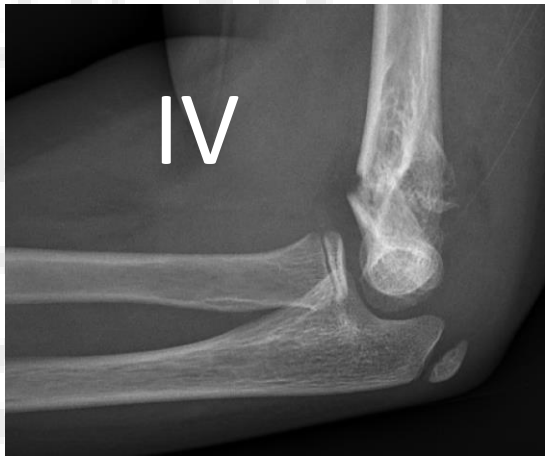
Supracondylar Humerus Fracture

- The most common operative elbow fracture of childhood (2/3 of all pediatric elbow fractures)
- Monkey bars ---> trampoline/furniture







Supracondylar Humerus Fracture: Types

97% Extension – olecranon as fulcum

- I minimal displacement, stable
- II greenstick = posterior cortex preserved
  - IIA Baumann's unchanged no rotation
  - IIB Baumann's >5° off
- III posterior cortex/complete fx(pe
  - IIIA Posteromedial displacement
  - IIIB Posterolateral displacement
- IV unstable flexion/extension

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[Holmberg, L. *Acta Orthop. Scand. Suppl.* 103:5, 1945]
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- III posterior cortex not intact (periosteum ok)
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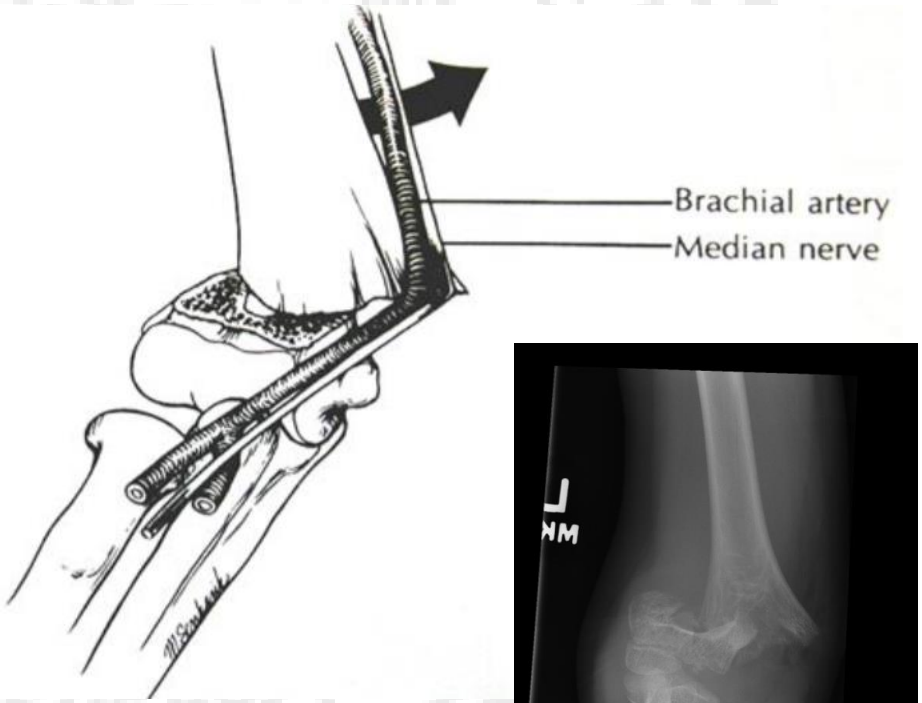
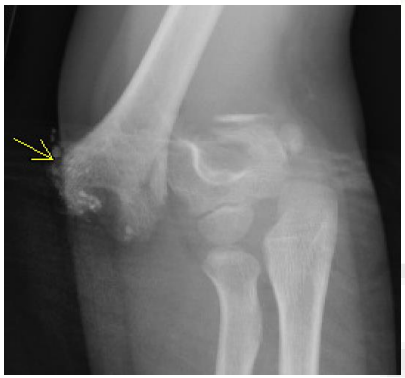
Anatomic Risks with Type 3





3A 3B

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Supracondylar Humerus Fracture: Types

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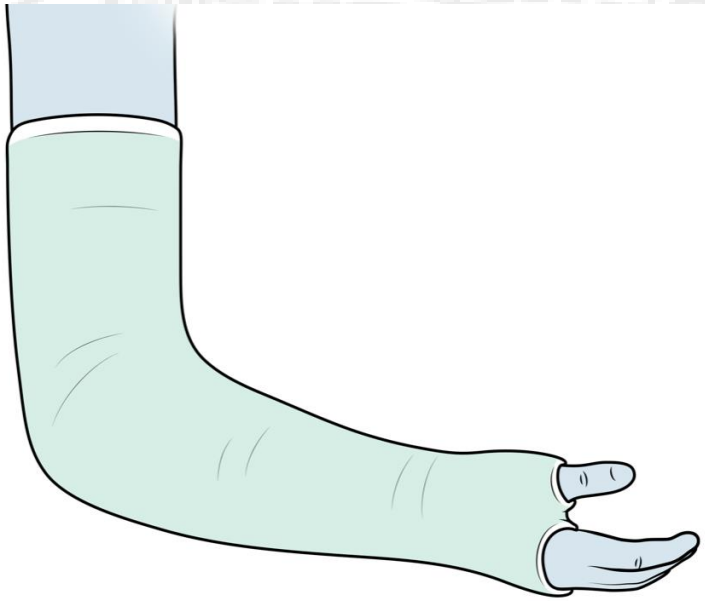
Supracondylar Humerus Fracture: Types

3% Flexion – direct posterior force

- Rarely have vascular complications
- Beware the **ulnar nerve**
- More often need to be opened
  - Particularly if ulnar nerve out

Non-operative management

- Type 1
- 3 weeks in a cast, 6 weeks activity restriction



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The ”art” of not operating on a child

- Type 2 SCH fxs have historically been pinned (to avoid hyperflexion casting, varus/extension deformity)
  - Type 2A – extension but no varus/valgus/rotational malalignment
    - Closed reduction (flexion) with sedation (more successful than without)
      - Cast at <90
    - Monitor at 1 week (to OR if loss of reduction)
    - Cast removal at 3 weeks

Type 2A

Operative management

- The rest

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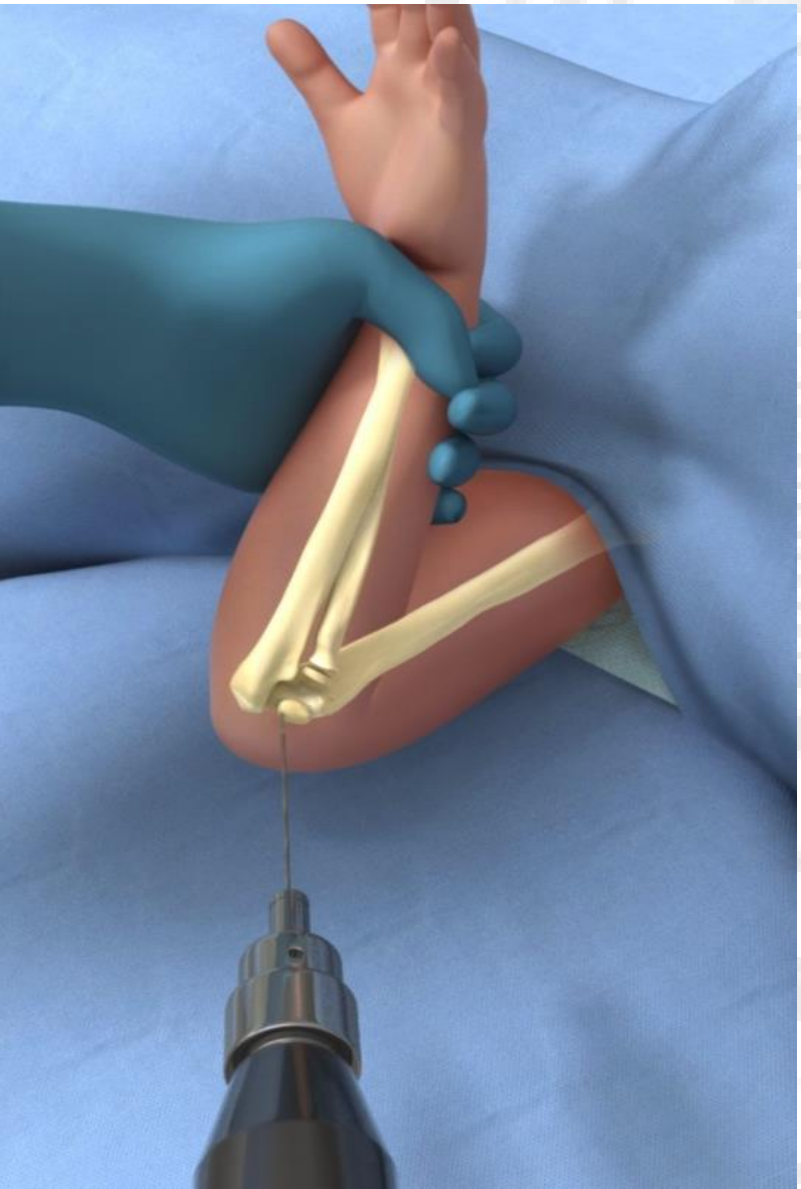
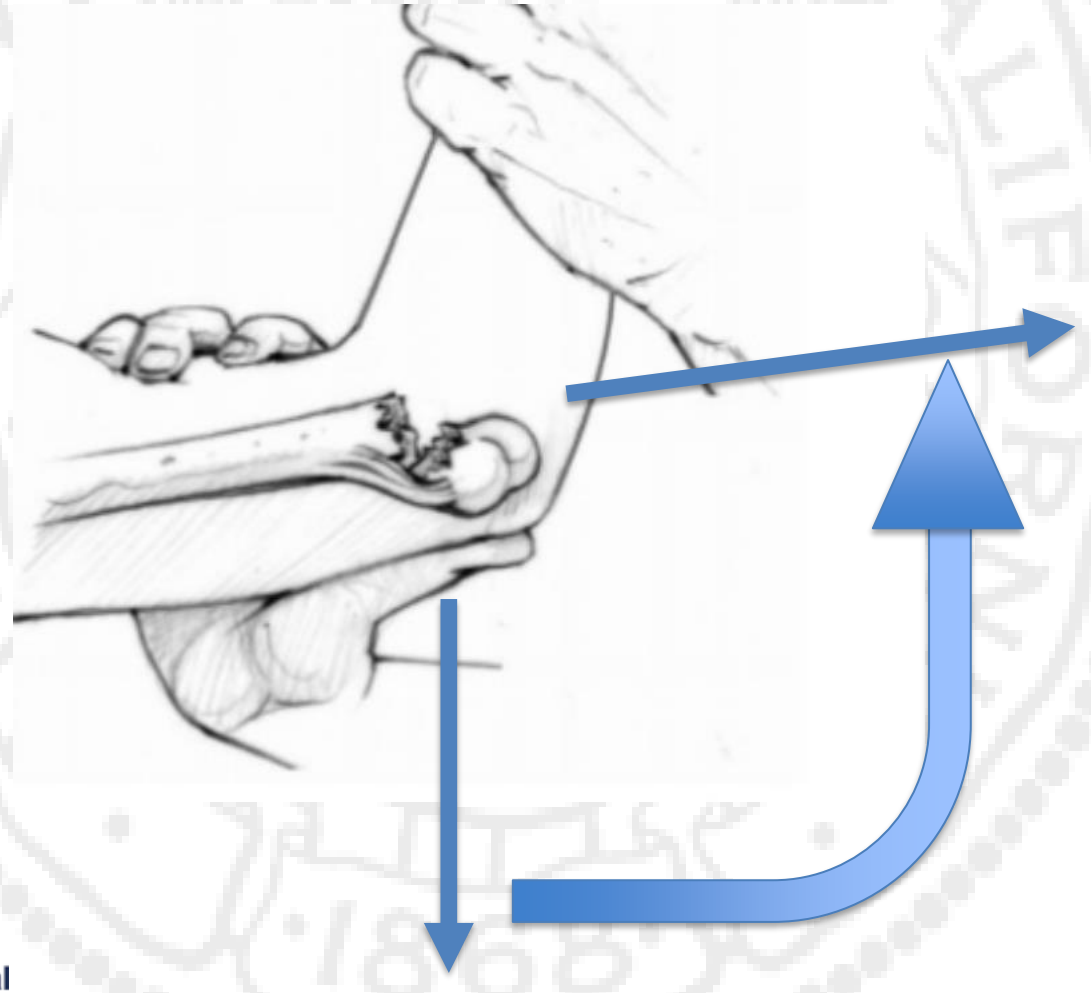
OR Set Up



- ? Abx
- Radiolucent arm board
- Bring patient all the way to edge of table
- Seat belt
- Head restraint
- Rotate shoulder for lateral
  - Rotate C-arm if unstable

Reduction maneuver



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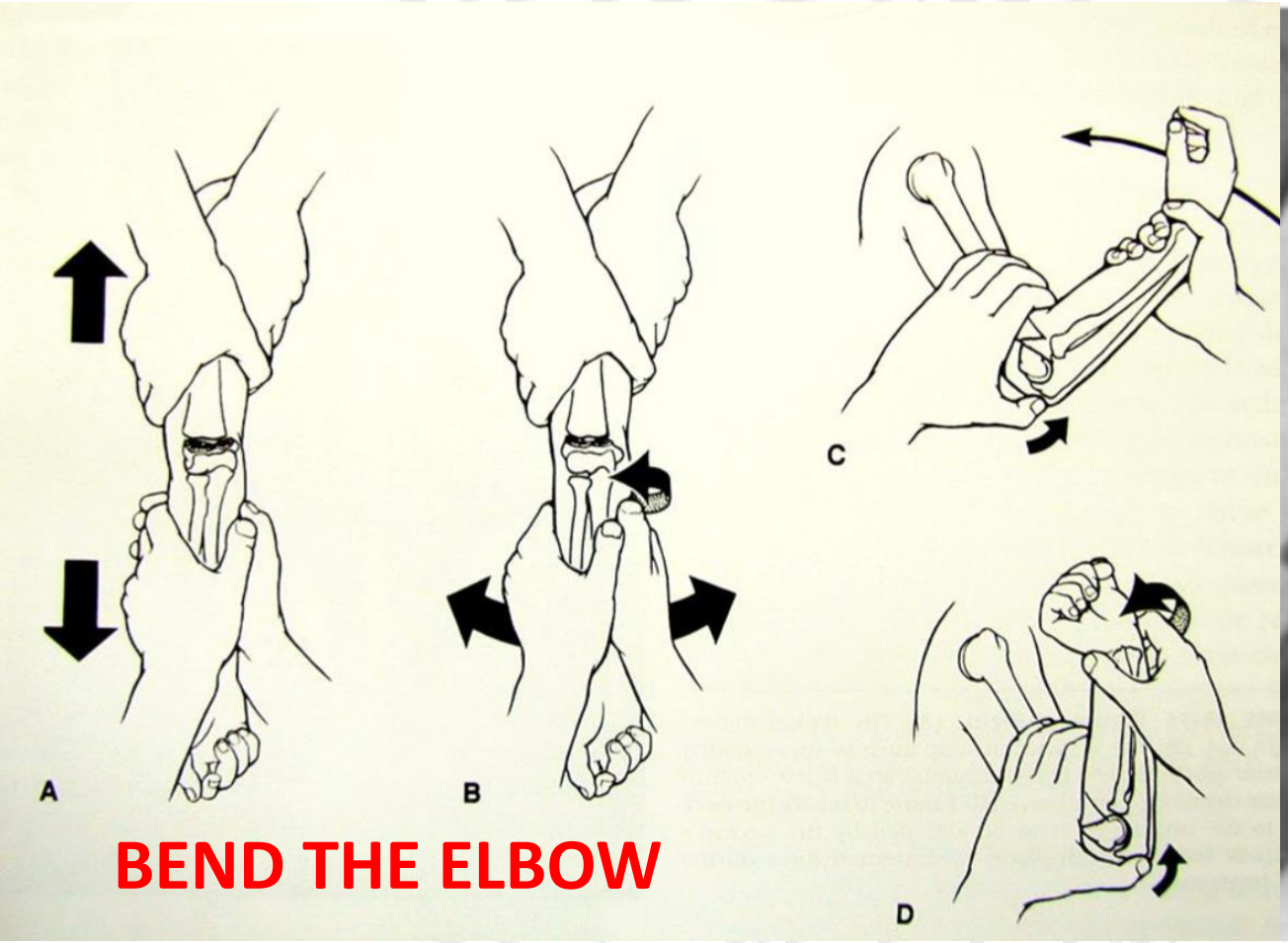
Reduction maneuver



BEND THE ELBOW

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Type 2: 2 divergent pins (or 3)

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Type 3: 3 pins (typically lateral)

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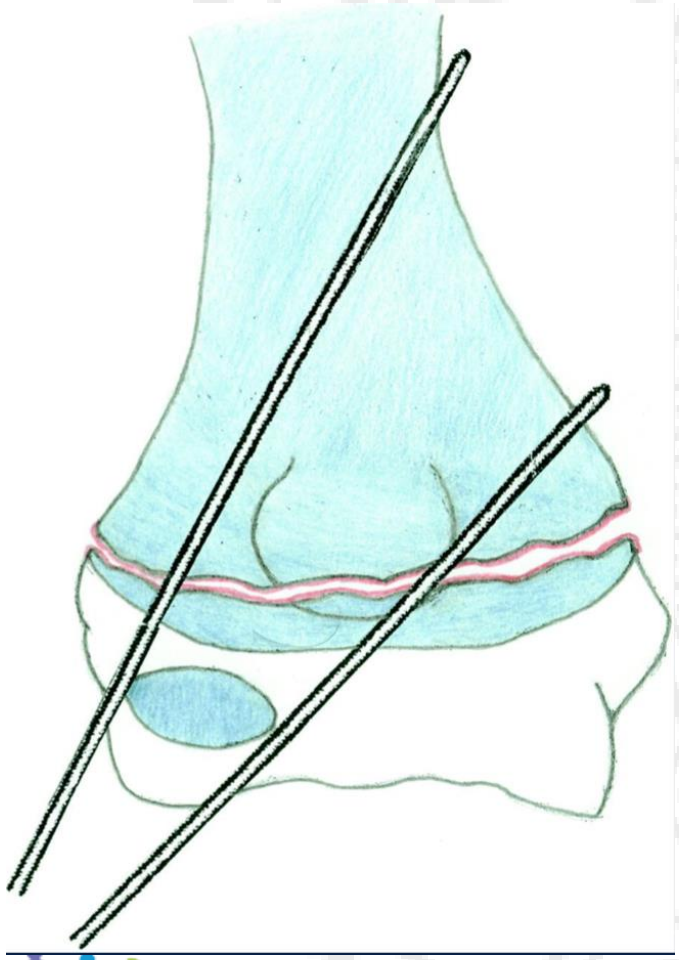
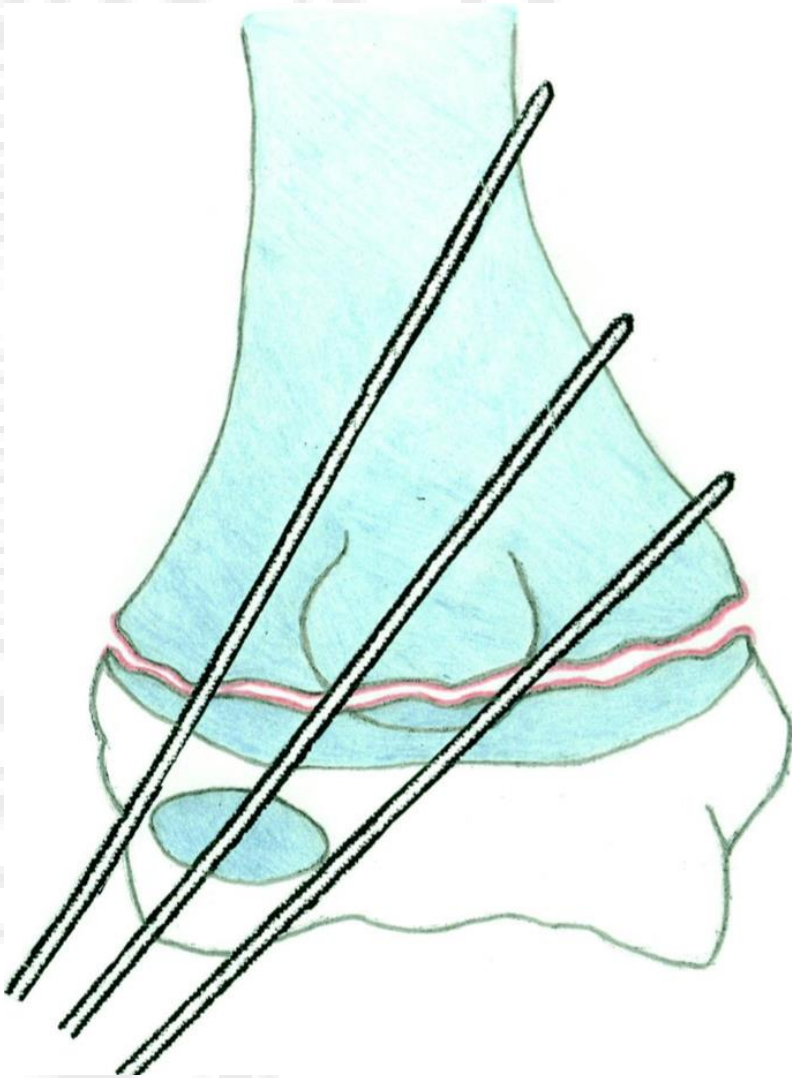
Pin selection:

062 for <20kg 5/64 (2mm) for >20kg





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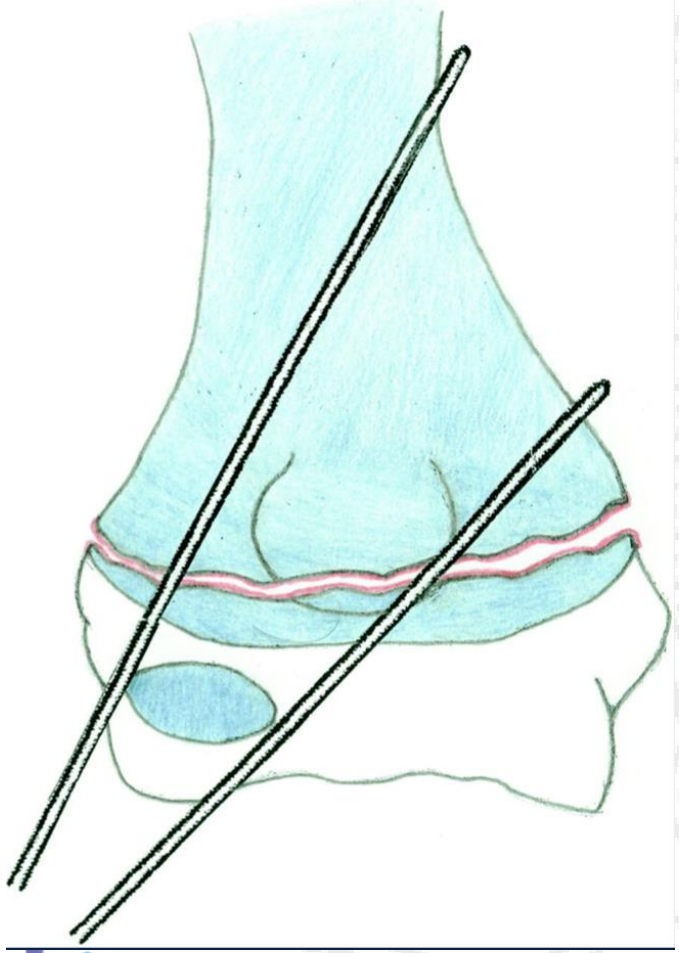
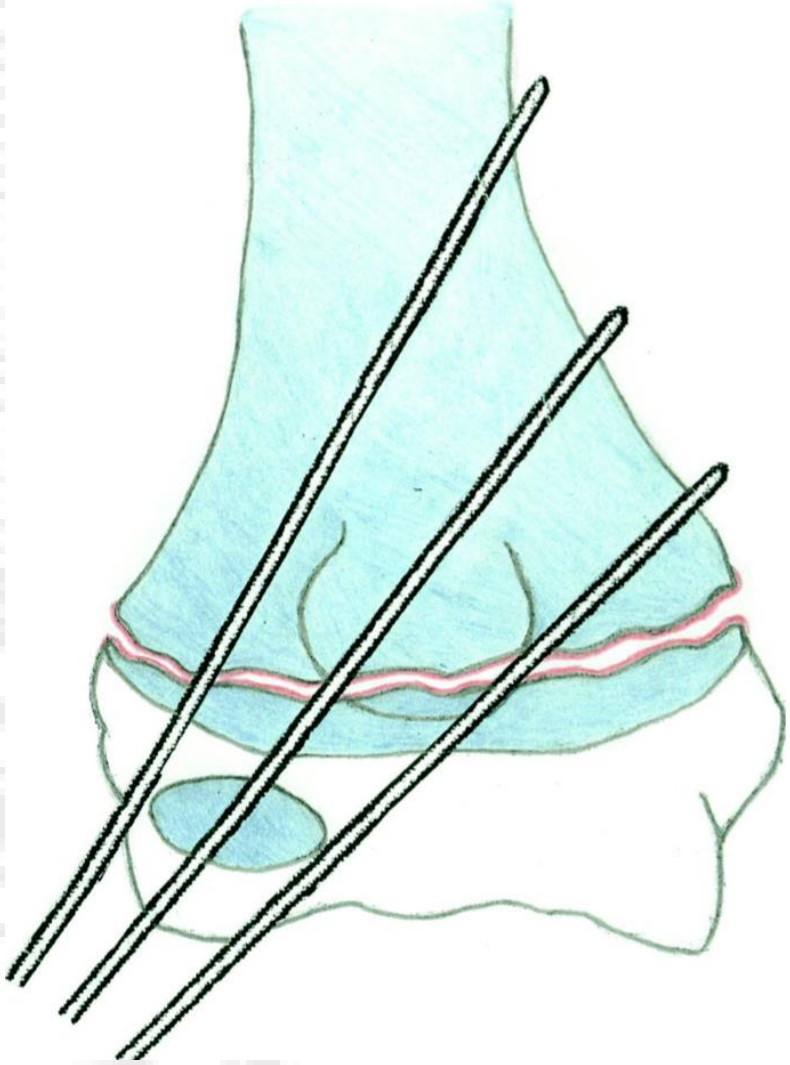
Divergence:
Spread 13mm at fracture





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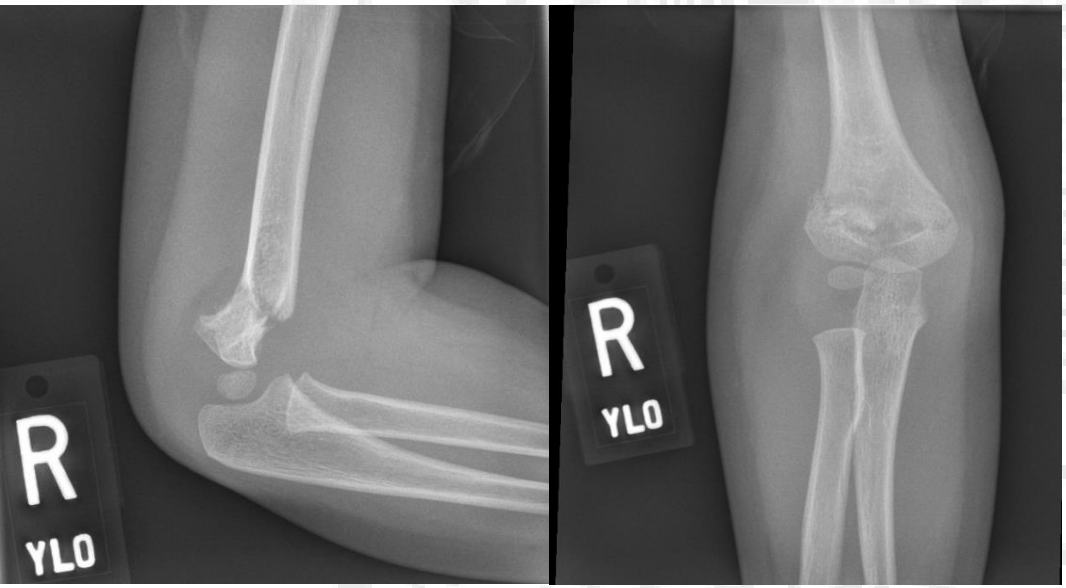
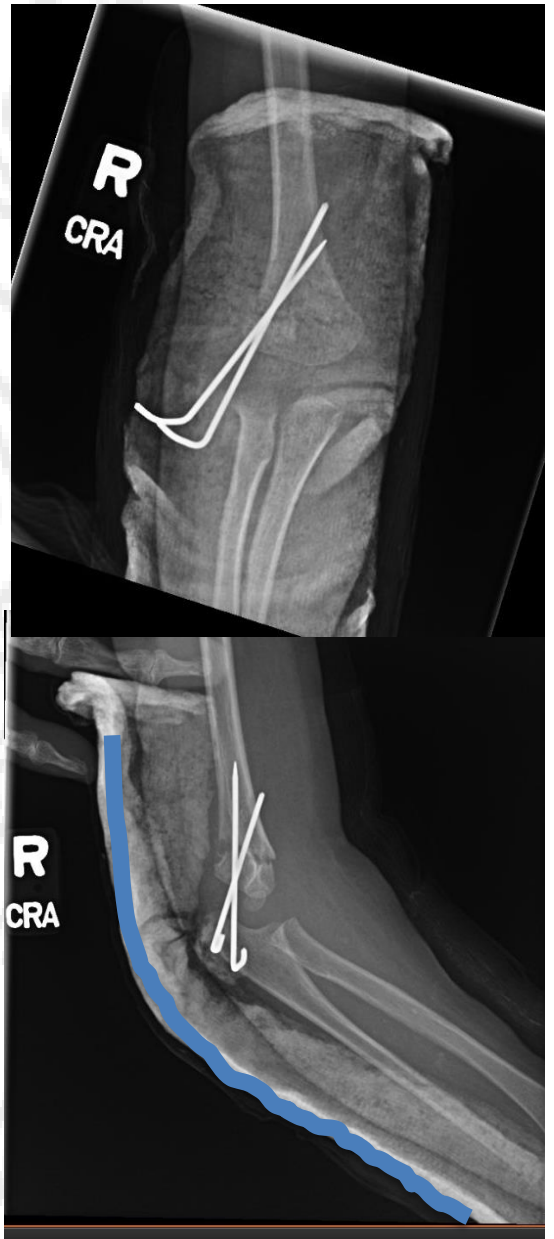
Don’t do this





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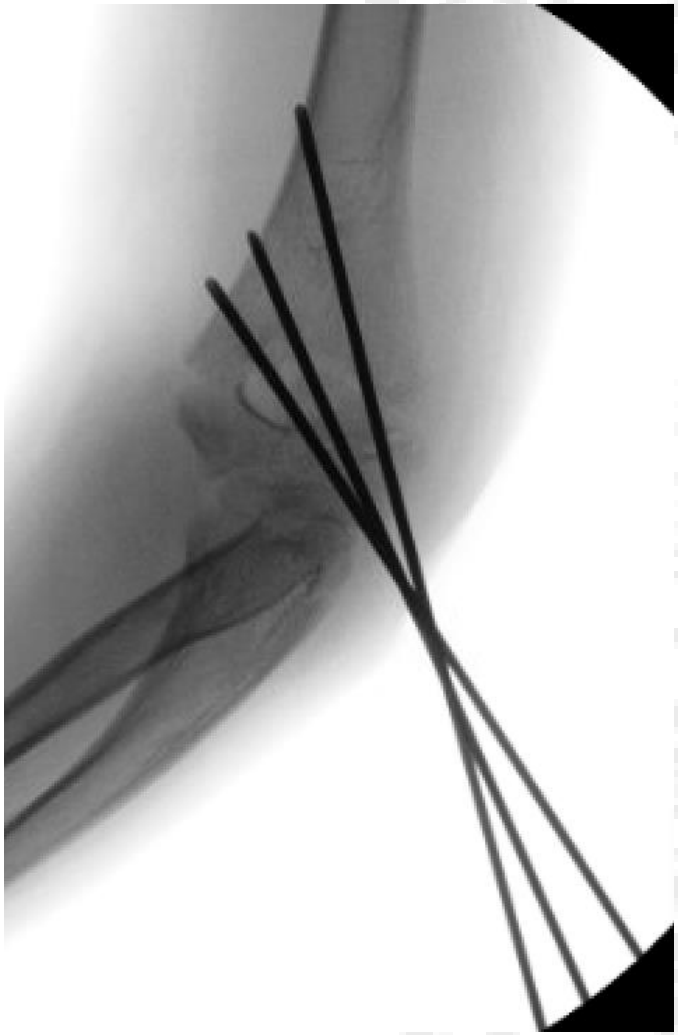
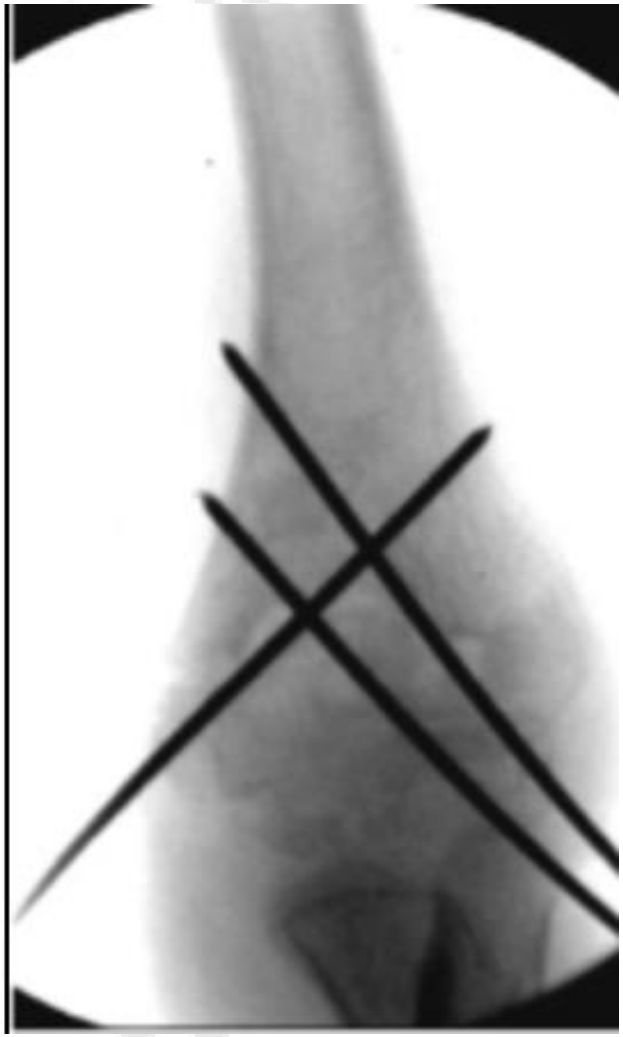
Lateral vs lateral plus medial



vs.



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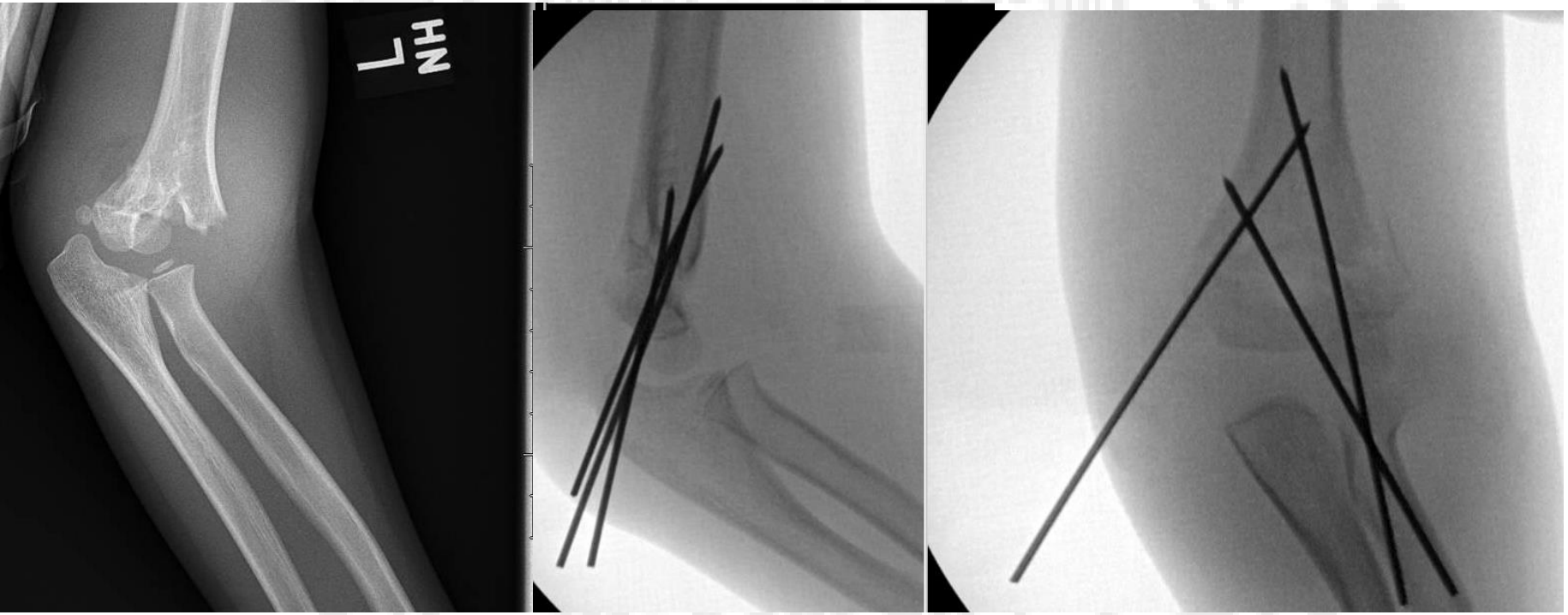
Medial comminution

- Consider a medial pin



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The “art” of the medial pin technique

- Beneficial for torsional and bending stiffness in ***medial comminution***
- ***Decreases rotational malunion***
- Low rate of ulnar nerve injury with small medial incision (0.4%) (lower than we thought)
- Lateral pins first
- Mini-open, anterior starting point on epicondyle
- Insert on oscillate while elbow in relative extension

The “art” of (NOT) opening

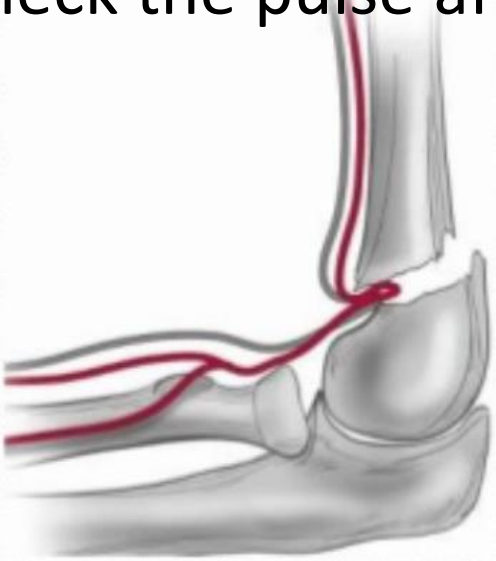
- Vast majority can be managed closed
  - Avoid opening if possible to avoid scar, destabilization, injury to neurovascular structures, stiffness
- Sometimes hand is forced to facilitate reduction (flexion, type 4, low fracture)
- Sometimes required for neurovascular exploration.

Who gets formal open exploration?

- **Dysvascular hand**
  - If not **perfectly** pink
  - Emergent closed reduction in OR
  - Provisional fixation helpful
  - Subsequent open exploration
  - Repair as needed (hand/vascular surgeon)
  - Low threshold for fasciotomies

Who gets formal open exploration?

- **Unacceptable reduction**
  - Especially in setting of neurologic or vascular deficit
  - Worry about neurovascular entrapment
  - Always check the pulse after reduction!



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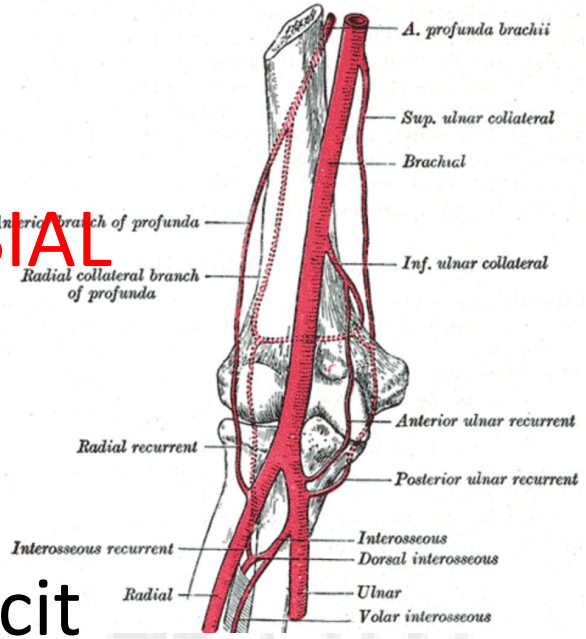
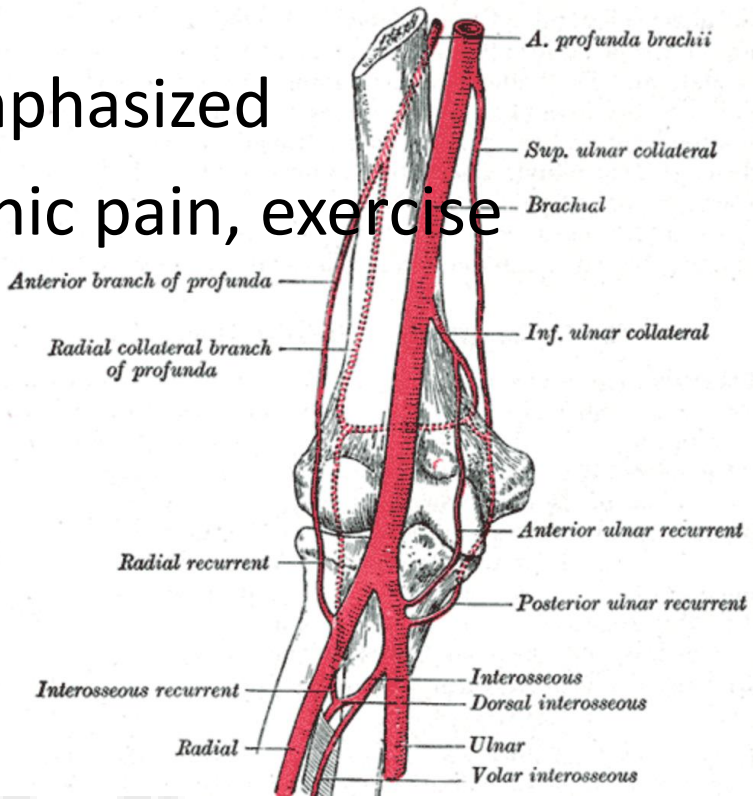
The “Art” of Knowing When to Open



- **Pink pulseless**: CONTROVERSIAL
- Literature supports:
  - Explore everyone
  - Explore if preop nerve deficit
  - Explore if pulse not back 30 minutes after reduction
  - Close observation in hospital ~24 hours (most bad things happen early)

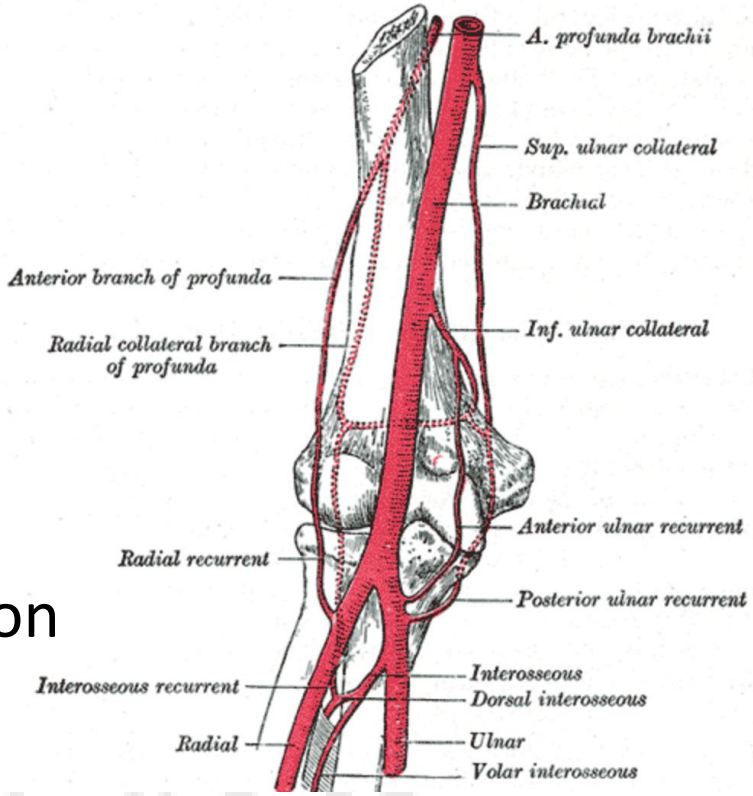
Options for pink pulseless

- Why explore everyone?
  - Because there may be a high rate of real arterial injury
  - "Vasospasm" may be over emphasized
  - Fear of cold intolerance, chronic pain, exercise intolerance, late ischemia



Options for pink pulseless

- Why not explore everyone?
  - More stiffness
  - Risk to neighboring structures (tricky anatomy!)
  - Destabilize fracture/periosteum
  - Worsen ischemia by damaging **collateral flow**
  - May be a high rate of re-occlusion and residual stenosis of brachial artery even if repaired
    - (Rates of restenosis up to 60%)
  - Long term outcomes are excellent



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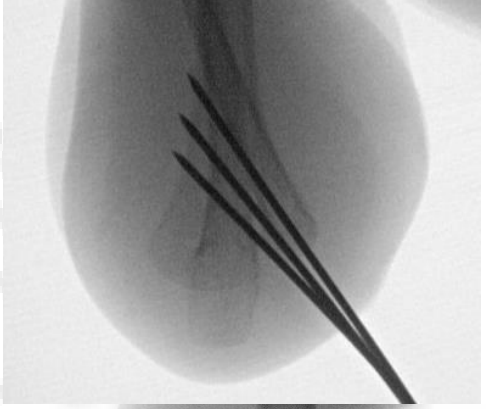

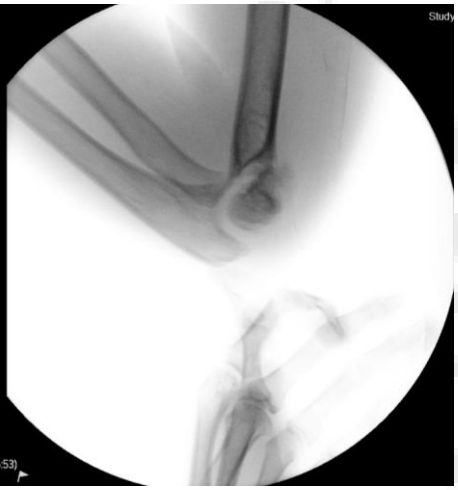

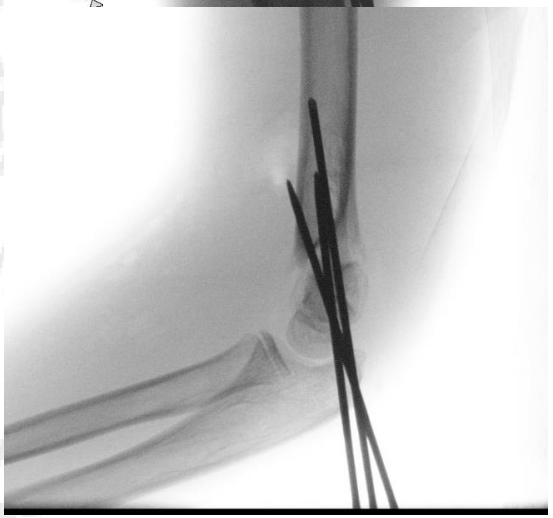

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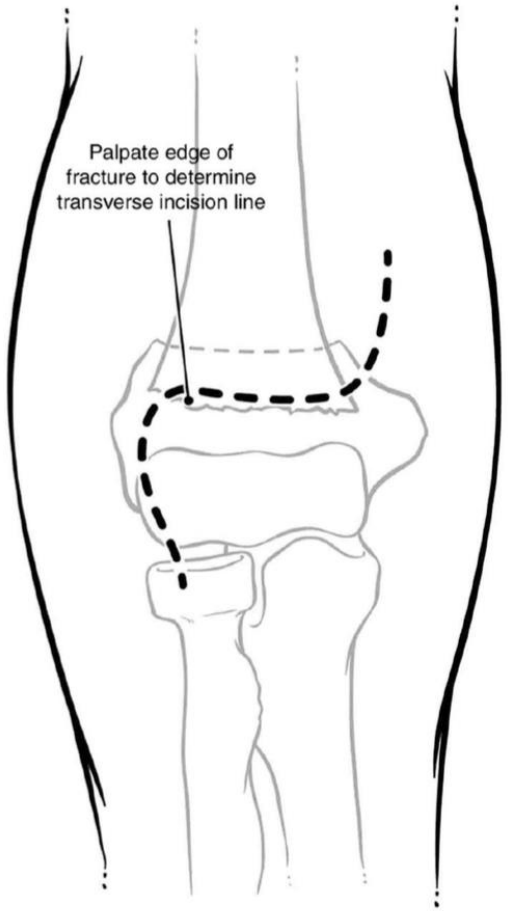
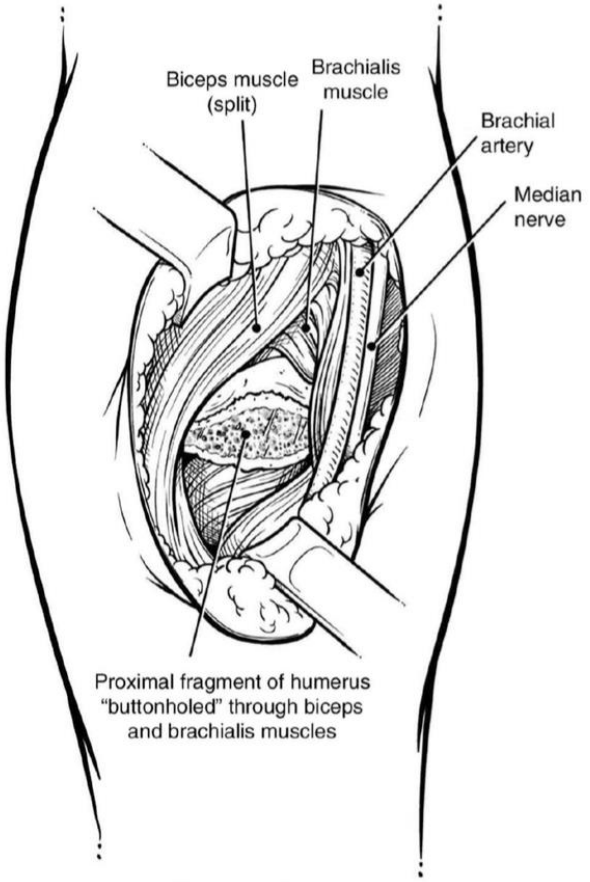
Artery/nerve exploration





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What do I do? - Ischemic Limb

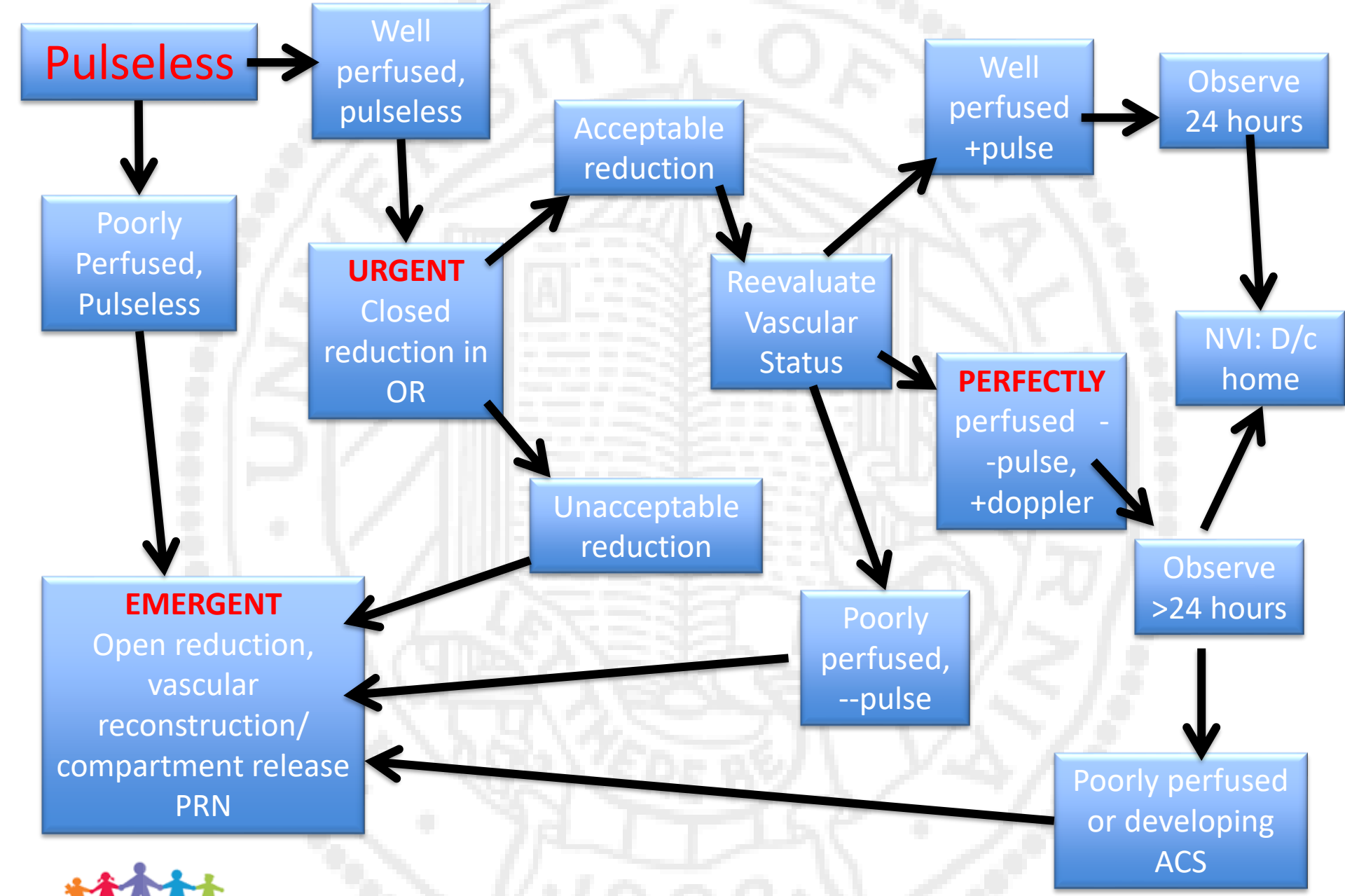
- Not perfectly pink, symmetric cap refill
  - Book emergently (1 hour)
  - Closed reduction and provisional fixation
  - Open and explore
  - Phone a friend preop (hand, vascular)

What do I do? – Pink Pulseless

- Urgent, not emergent
- If closed reduction yields perfectly perfused with normal Doppler signal, and anatomic reduction → leave it, serial exams
- If any of those things aren't true → open
- If child has dense median nerve sensory deficit preop and pink pulseless → open
- Admit >24 hours, continuous pulse ox, hole in bivalved cast for doppler (vs plaster splint), serial NV exams, monitor pain med requirement and pain scores

What do I do? – Pink w/Abnormal Doppler

- Perfectly pink with poor doppler signal (rare)
  - Tough one!
  - Warm the room. Warm the patient. Wait.
  - If absence of normal doppler, OPEN
    - Often find that gentle detethering the soft tissues will restore the pulse
    - Papaverain in case of spasm



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A perspective:

"The main consideration when taking care of children who have a perfused hand but no palpable radial pulse in association with a supracondylar humeral fracture is to avoid catastrophe"

-Mercer Rang in "Children's Fractures"

”Art” of Judicious Imaging in Kids

- Definitely: Don’t get post cast x-ray (fluoro images sufficient)
- Maybe: Get 1 week x-ray to check for loss of reduction (type 3 only)
- Pin removal x-rays only help with type 3 (in case needs further casting)
- Consider: no follow up xrays for type 2
- No further xrays after “pins out” xray.

Thank you

Questions?

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State of the art

- Timing of admission (24 hours)
- Type 2A, ? Type 2B? Non noperative
- **Gartland Type IIa Supracondylar Humerus Fractures: Outcomes of Attempted Nonoperative Management**
- Pandemic changes – not monkey bars. Furniture and trampolines! PMID: 35620129
- Don't transport type 2 by ambulance ($$$). Private car no different PMID: 35543599
- Imaging: don't get post cast xrays. Get 1 week to see loss of reduction. Pin removal xrays only help with type 3 (in case needs more casting). Take pins out first
- Don't even need 1 week postop visit – just see them to remove pins PMID: 34759191

- Still don't know about : Crossed pins/lateral pins same functional/radiographic outcomes PMID: 35317252, but another study shows all lateral pins have higher rotational malunion (especially with PL or PM displacement PMID: 34987664
- Medial pinning in large series is very safe with ulnar nerve injury in 0.43% (10x lower than previously thought) PMID: 34673662

- PMID: 35200212
- Don't need to give abx for CRPP PMID: 35200212 (0.5% infections)
- Higher conversion to open with lower fractures
- Study out of ghana shows that kids with type 2 and 3 sch fx treated after late presentations (>24 hours, even several days) did well – no difference in outcome to those treated <24 hours emphasizing safe treatment of late presenting fracturesPMID: 34746657