



Supracondylar Humeral Fractures with Vascular Compromise

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Disclosures

- Consultant for Stryker Orthopedics
- Committee Member: POSNA, AAOS
- Committee Chair: LLRS
- Board Member: LLRS

Objectives

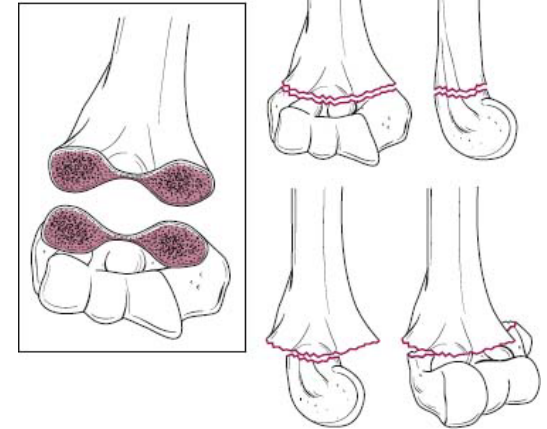
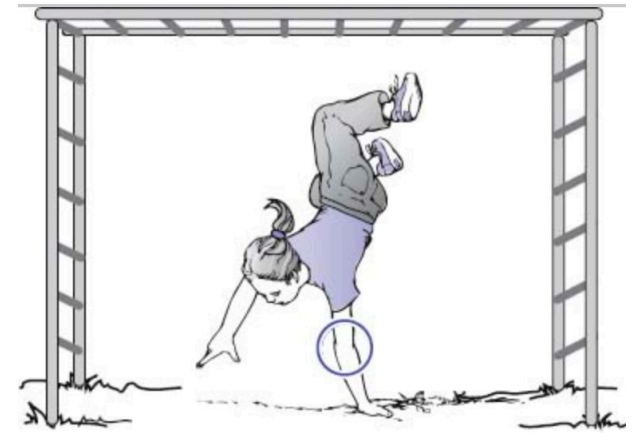
- Review the incidence, mechanism, classification of supracondylar fractures
- Discuss the decision pathway for treatment of SCH fx with vascular injuries

Background

- Supracondylar Humerus Fractures (SCH fx)
 - Most common type of pediatric elbow fracture (60-70%)
 - Peak incidence 5-8 yrs
- ~1 to 15% of SCH fx present with absent pulse
 - Only a minority of these require vascular repair
 - **Hand perfusion** (not presence of pulse) predictive of need for arterial repair

Mechanism

- Fall onto outstretched arm
 - Extension type (95-98%) of cases
 - Elbow hyperextends with olecranon serving as a fulcrum
 - → Fracture at level of olecranon fossa
- OR
- Direct force on posterior flexed elbow
 - → Flexion type pattern (2-5%) of cases



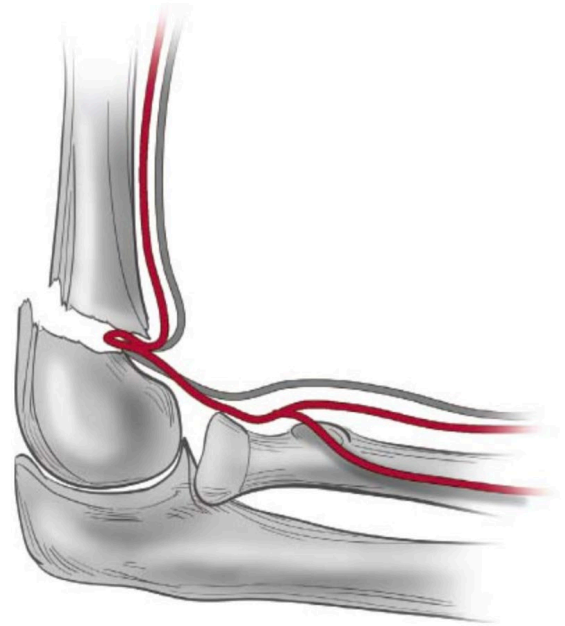
Gartland Classification

Type I	Undisplaced	Fat pad present acutely
Type II	Hinged posteriorly	Anterior humeral line anterior to capitellum
Type III	Displaced	No meaningful cortical continuity
Type IV	Displaces into extension and flexion	Usually diagnosed with manipulation under fluoroscopic imaging
Medial comminution (not truly a separate type)	Collapse of medial column	Loss of Baumann's angle

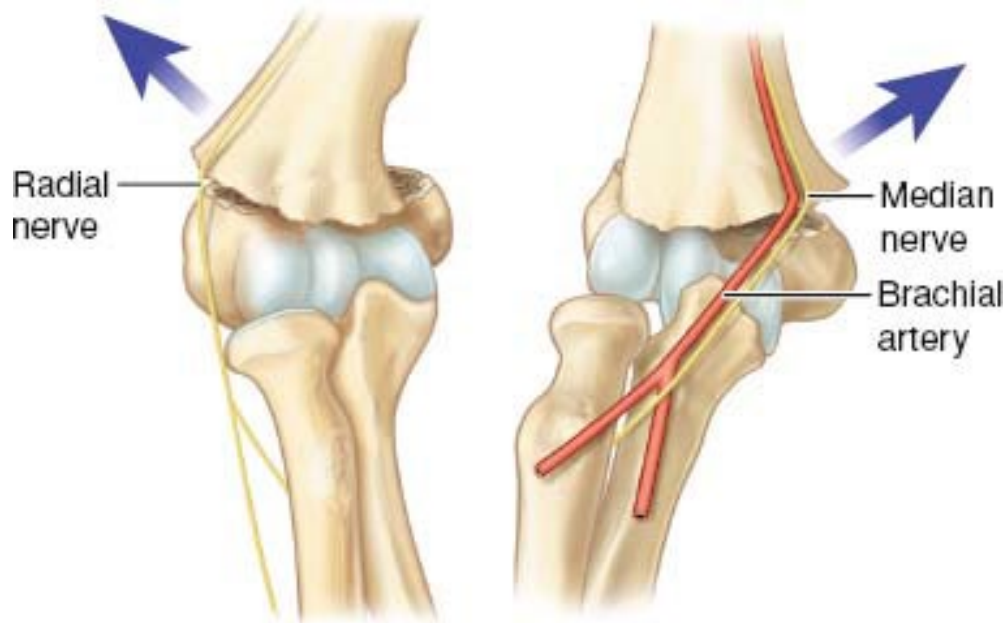


Neurovascular Injury

- Rate as high as 49%
- Vascular injury in 3-19%
 - Kinking of artery
 - Thrombosis
 - Intimal tear
 - Arterial contusion or spasm
 - Entrapment of vessel w/in fracture site
 - Traumatic aneurysm of brachial artery with subsequent thrombus formation



Direction of Displacement



Choi PD, Skaggs DL. Closed reduction and percutaneous pinning of supracondylar fractures of the humerus. In: Wiesel S, ed. *Operative Techniques in Orthopaedic Surgery*. Philadelphia, PA: Lippincott William & Wilkins; 2010

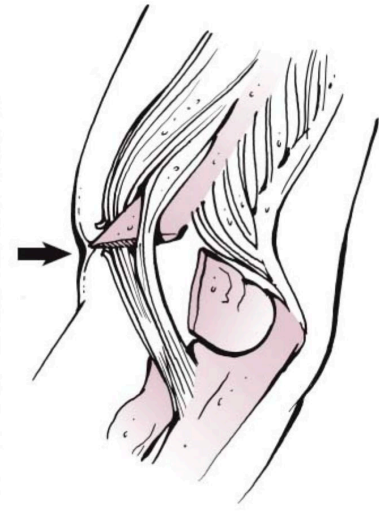
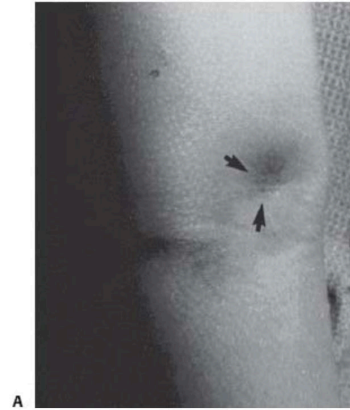
Assessment

- Comprehensive physical exam
- Clear documentation
- Vascular status
 - **Inspection of hand** (pink vs pale on palmar surface)
 - Palpation of radial pulse
 - If not readily palpable → Doppler
 - Capillary refill assessed and compared to contralateral limb
 - Angiographic study not recommended
 - Delays OR, does not alter management

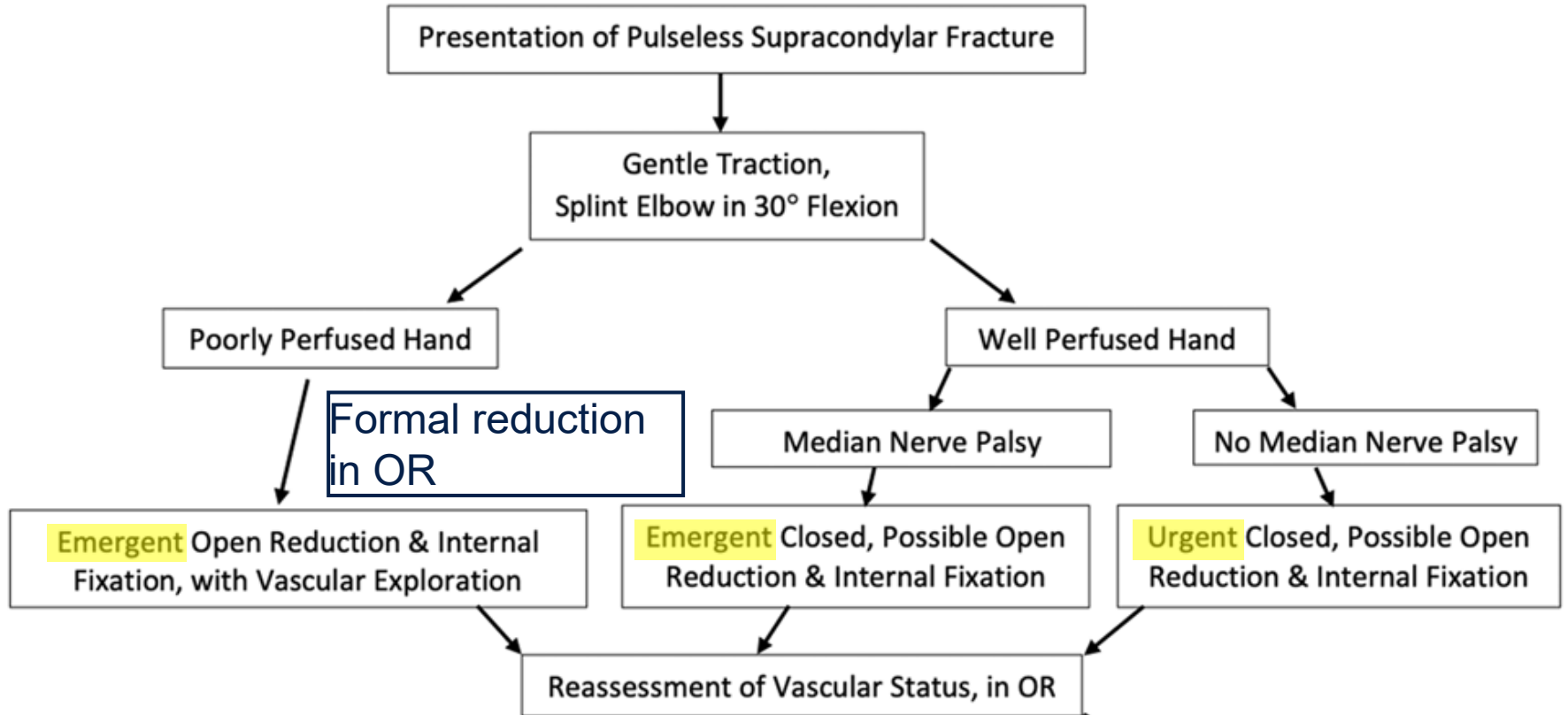
Assessment

- Complete motor and sensory examination
 - Median
 - Posterior interosseous
 - Anterior interosseous
 - Ulnar
 - Radial
- Higher incidence of nerve palsy in patients without radial pulse
 - AIN >> PIN > Ulnar Nerves
 - 31 vs 9 %

Skin Evaluation

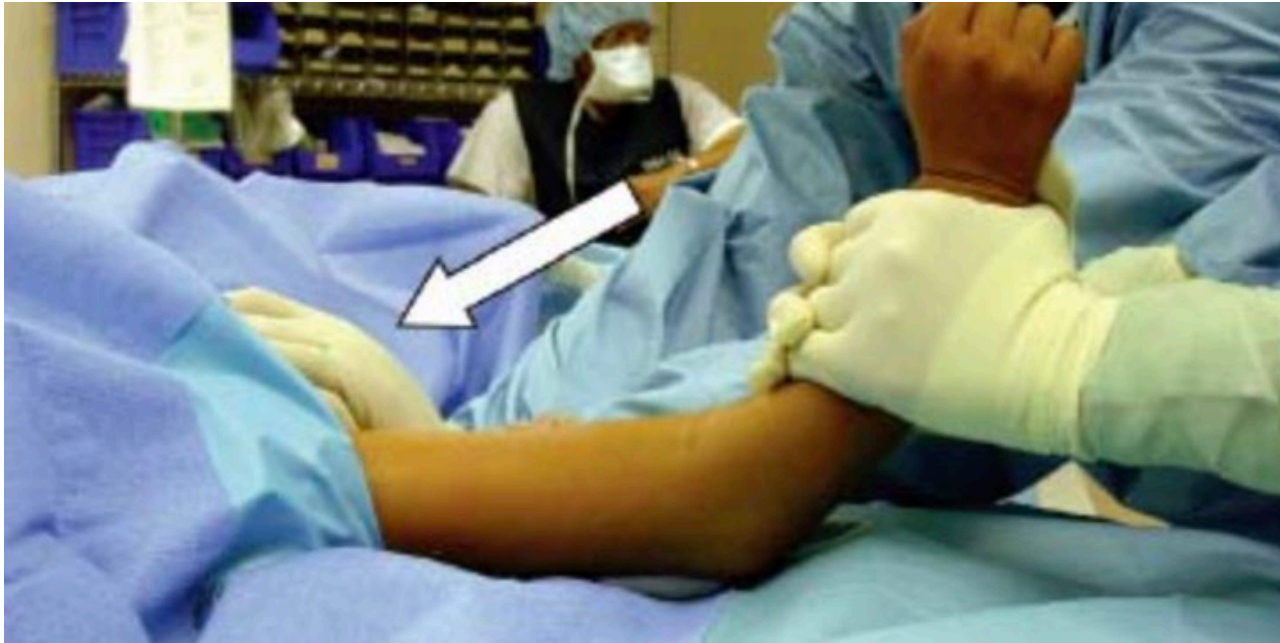


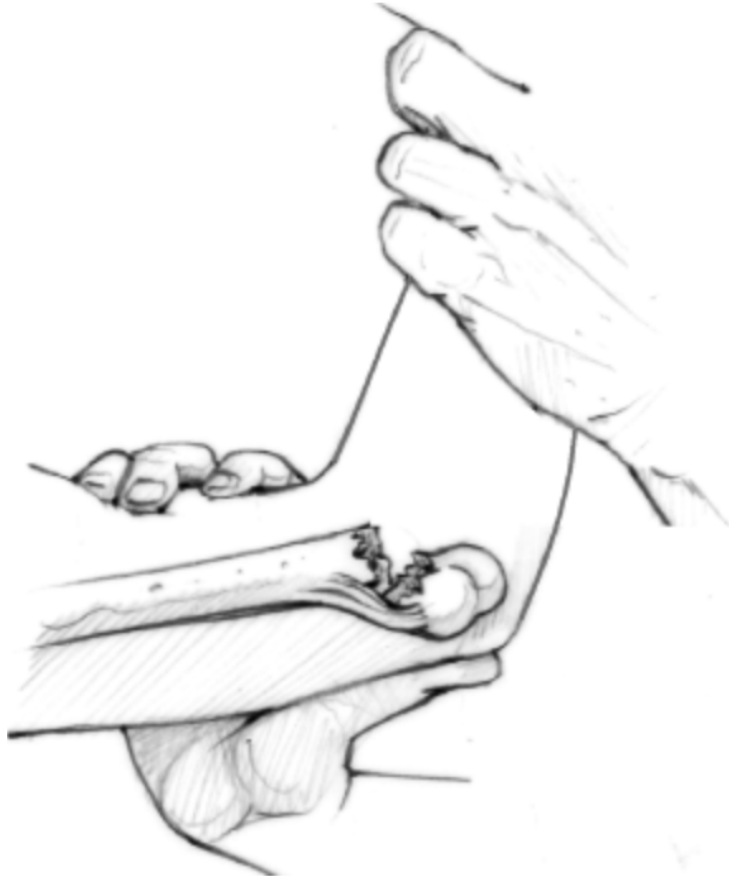
- Open Fractures (rare)
- Skin puckering/ecchymosis over antecubital fossa
 - Proximal fragment may have pierced brachialis muscle

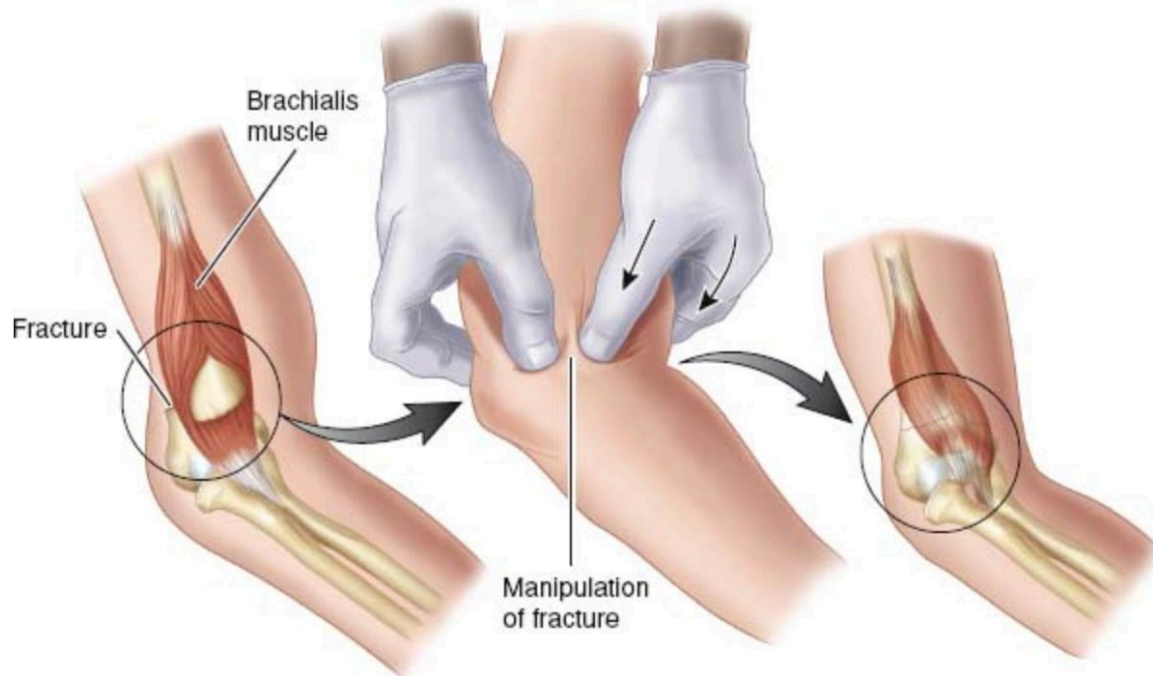


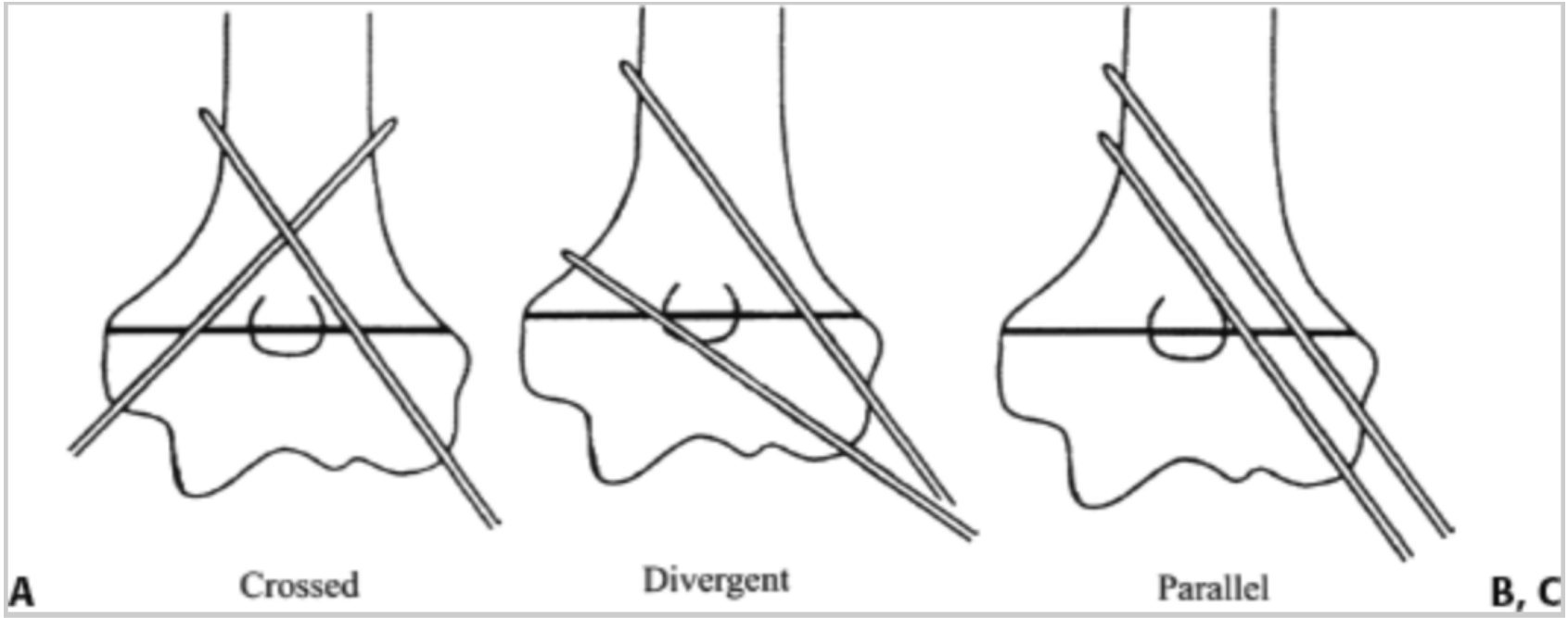
Special Case: Pulseless with Median Nerve Injury

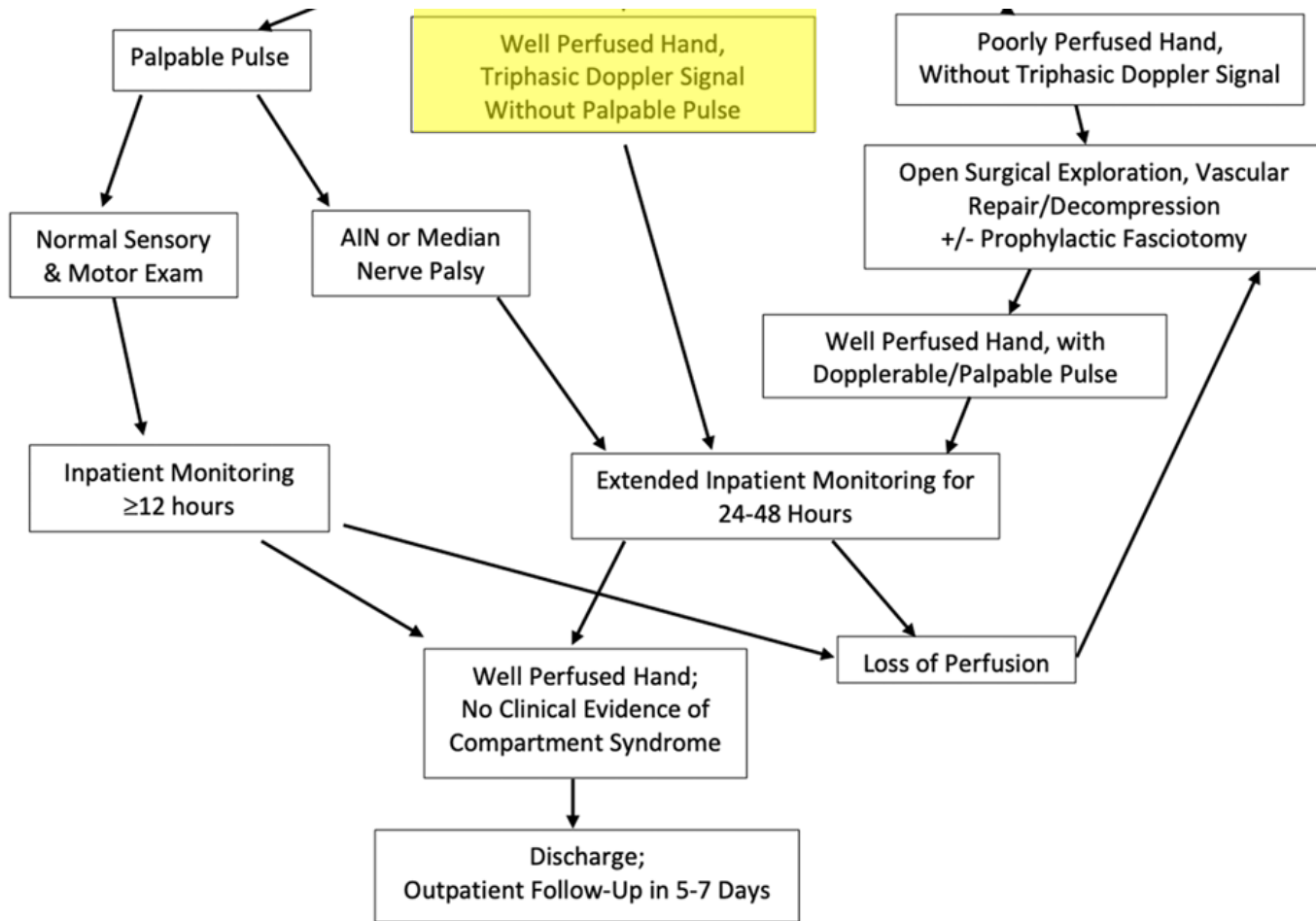
- With injury to both brachial artery and nerve
 - Assume significant soft tissue damage
 - Higher risk for compartment syndrome
- Pain of compartment syndrome may be masked by nerve injury
- Low threshold for vascular exploration and/or compartment release









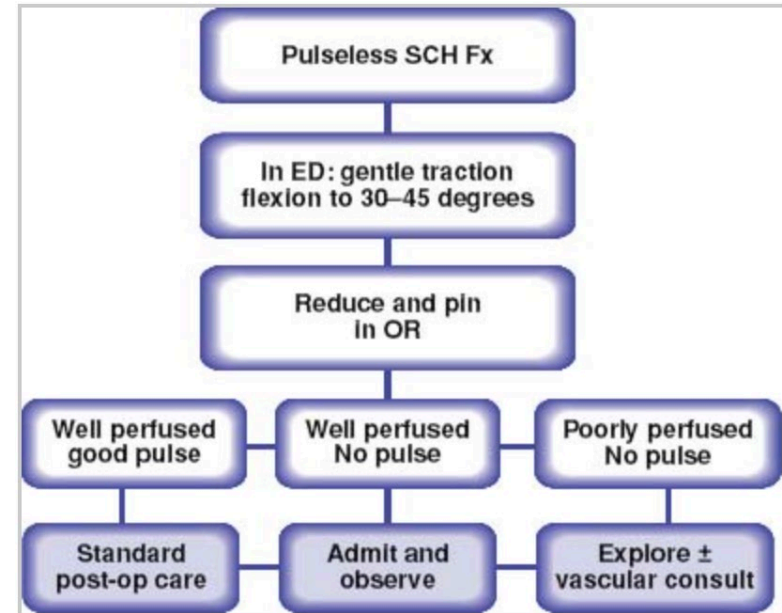


Pink Pulseless Hand (Good Distal Perfusion)

- **“Watch and Wait”**
 - Collateral circulation
 - Return of palpable pulse
 - Arterial spasm
 - Limited clinical evidence of long-term sequelae
 - Cold or exercise induced tolerance

Versus

- Open approach to establish patency of brachial artery

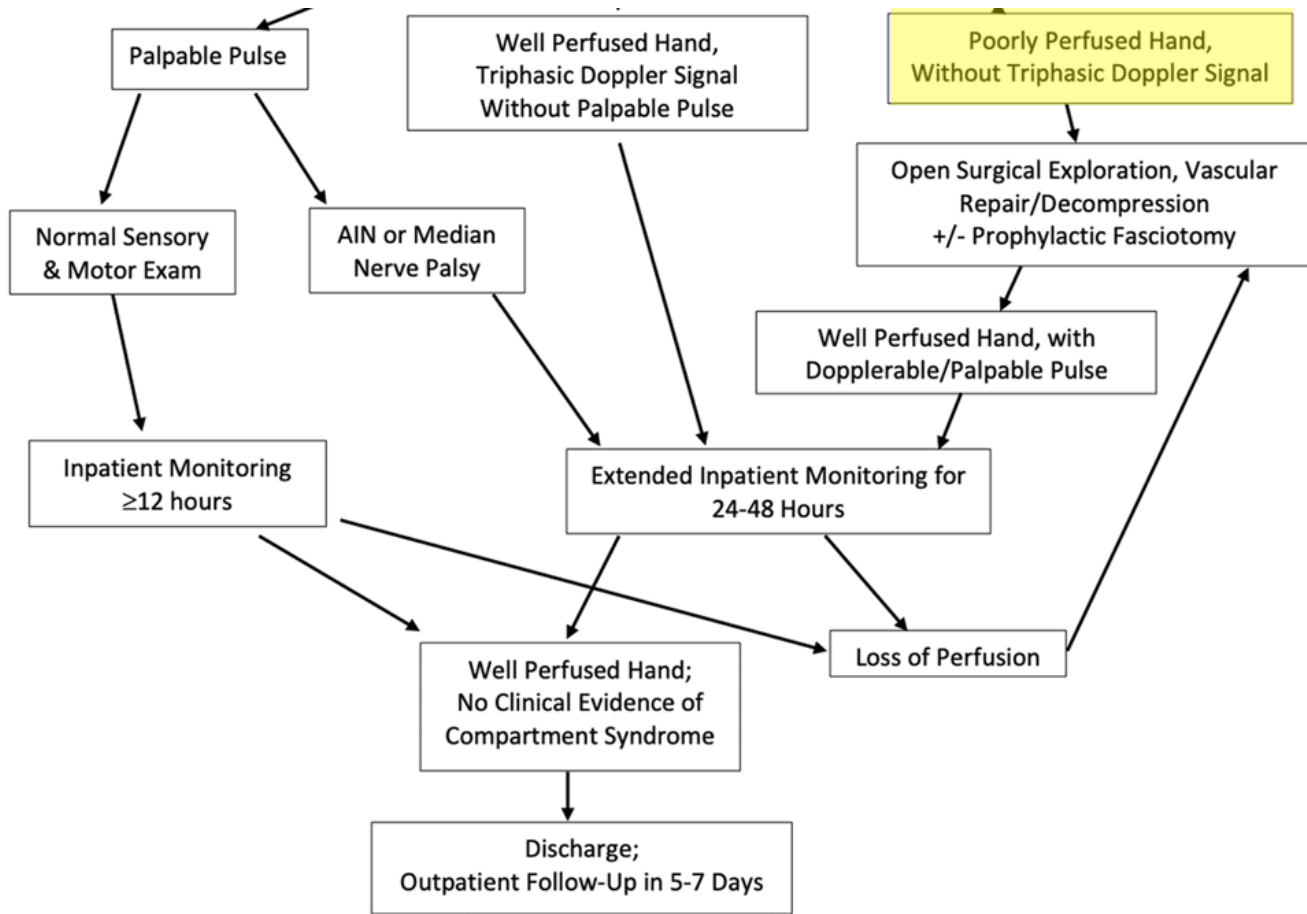


Individualized approach

- clinical findings at initial presentation
- **quality of distal perfusion** including doppler signal
- associated median nerve injury
- availability of a surgeon with microvascular skill-set
- access to vigilant post-operative monitoring
- open discussion of the pros and cons of various treatment options with the family is prudent

Protocol for Post-reduction Pink (perfused), Pulseless hand

- Admit for observation for at least 24 hrs
- Monitor for compartment syndrome
 - 3 As (Increasing anxiety, agitation, and analgesic requirement)
- Low Threshold for return to OR

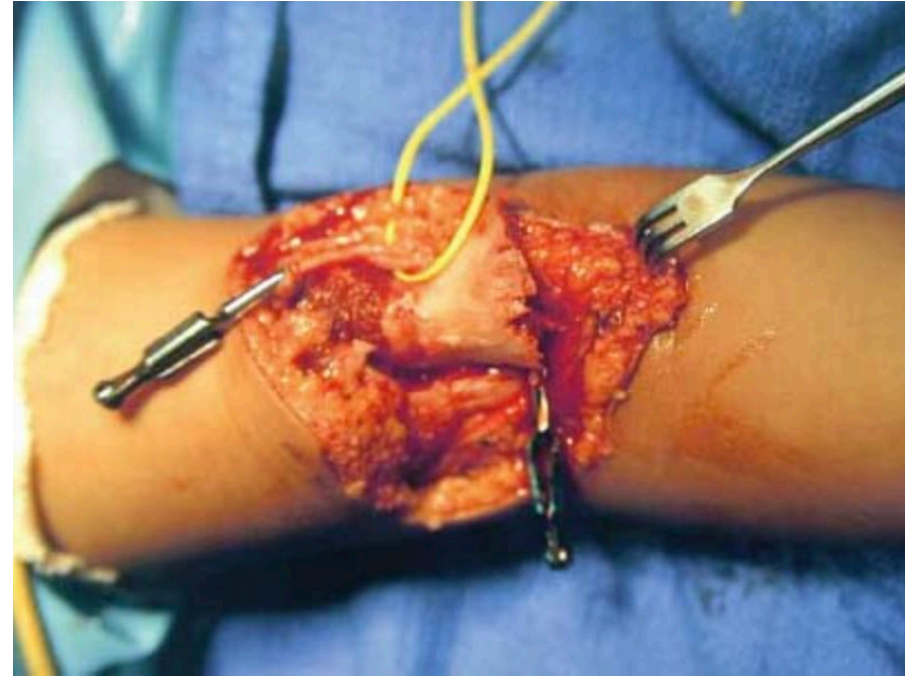


Post-reduction White (Poorly Perfused) Pulseless Hand

- If pulse before fracture reduction
 - Assume artery/surrounding tissue trapped at fracture site
 - Pins pulled
 - Artery explored
- If not adequate perfusion before fracture reduction and hand remains poorly perfused
 - Urgent arterial exploration

Open Technique for Vascular Exploration

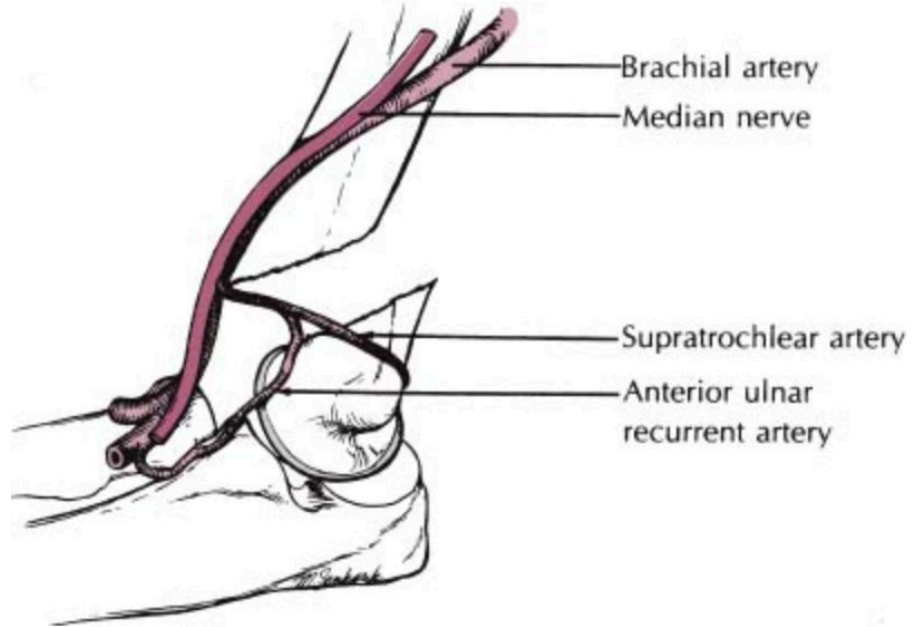
- Transverse incision in antecubital fossa
- Distal and proximal extension can be performed with z-limbs if necessary
- NV bundle may be superficial and difficult to identify



- Arterial Kinking
 - Entrapped adjacent soft tissues (fascial band)
 - Incarceration of artery in fracture
 - arterial adventitia attached to proximal metaphyseal spike pulling artery into fracture site
- Dissect proximally and distally along brachial artery
- Identify artery and median nerve
- Arterial injury (transection/direct injury) generally at level of supratrochlear artery

Arterial Injury

- The supratrochlear branch that arises from the anterior ulnar recurrent artery may bind the main trunk of the brachial artery against the sharp end of the proximal fragment.

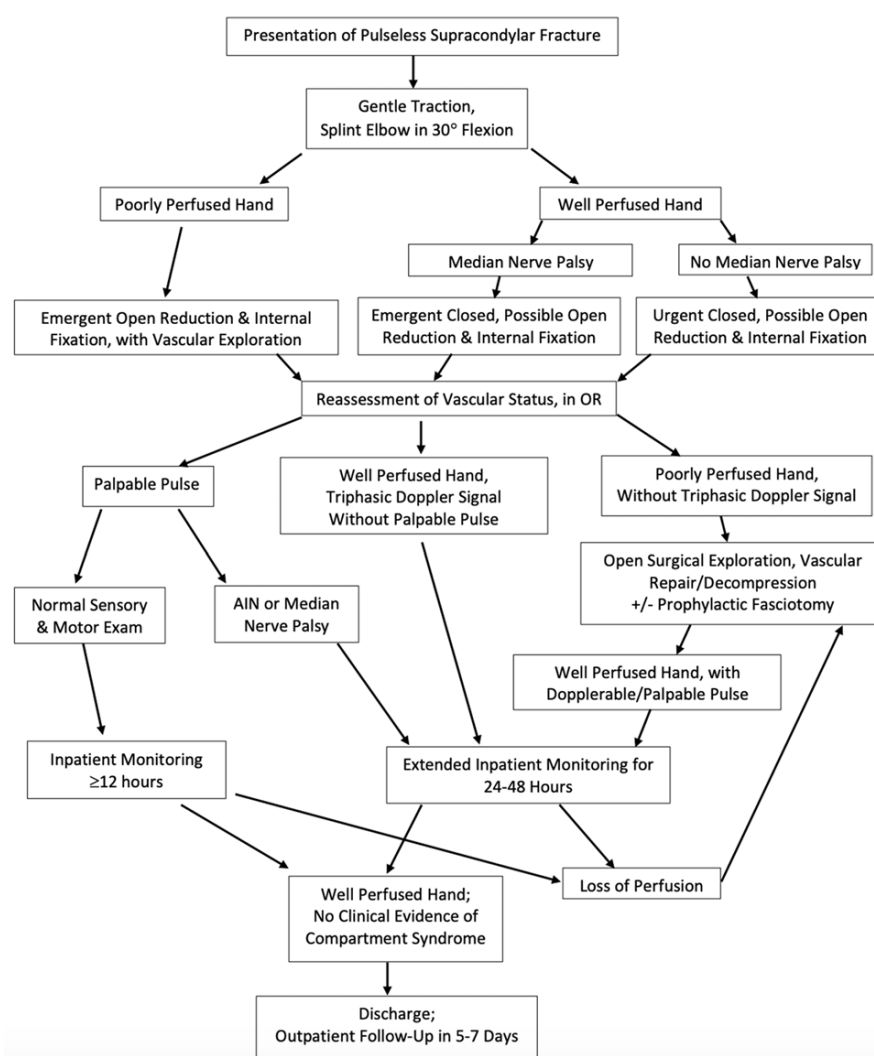


Arterial Spasm

- May be relieved by:
 - Direct application of papaverine or local anesthetic
 - Warming
- If hand still poorly perfused
 - Collateral flow not sufficient to maintain hand perfusion
 - Most likely intimal injury and occlusion
 - Vascular reconstruction by appropriate specialist
 - Injured portion of vessel excised and reverse vein graft inserted

Arterial Transection/Direct Injury

- Vascular Reconstruction
 - Consult (hand, plastic or vascular surgery)
 - Prophylactic release of forearm fascia for prolonged ischemia



References

Indian Journal of Orthopaedics (2021) 55:47–54
<https://doi.org/10.1007/s43465-020-00273-6>



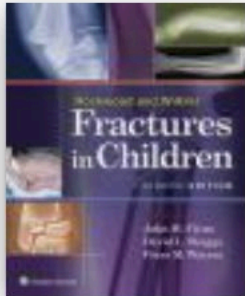
REVIEW ARTICLE



The Pulseless Supracondylar Elbow Fracture: A Rational Approach

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BOOK

Rockwood & Wilkins' fractures in children

Flynn, John M., editor.; Skaggs, David L., editor.; Waters, Peter M., editor.
2015

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Thank you! Questions?