Supracondylar Humerus Fractures. -Urgency and Open Reduction

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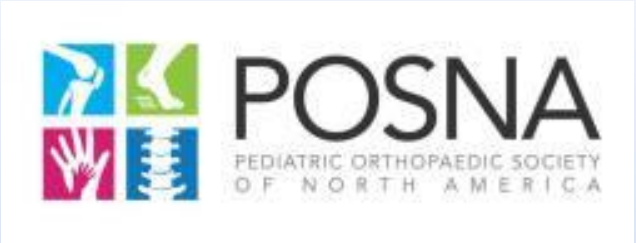
BEST CHILDREN'S HOSPITALS U.S.News & WORLD REPORT RANKED IN 9 SPECIALTIES 2014-15

MAGNET RECOGNIZED AMERICAN NURSES CREDENTIALING CENTER

POSNA PEDIATRIC ORTHOPAEDIC SOCIETY OF NORTH AMERICA

Disclosures

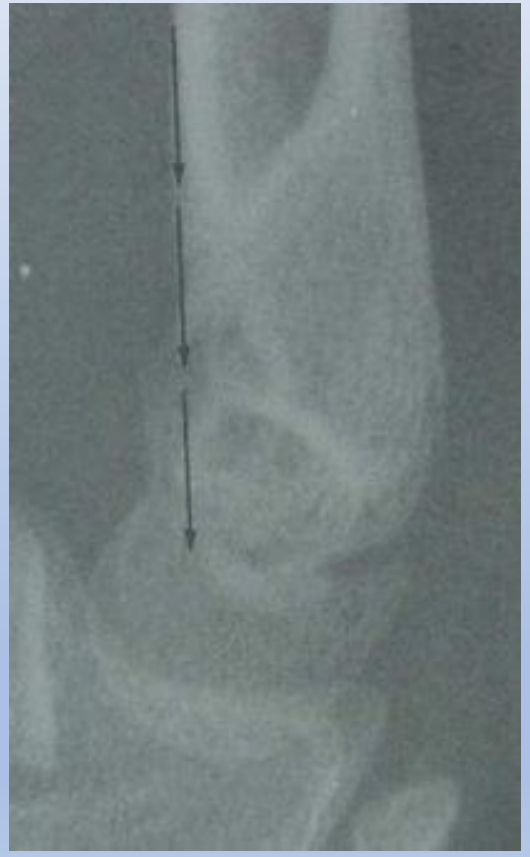


- K2M Consultant
- Medtronic Consultant
- POSNA President and BOD member
- AAP Immediate Past Chair and Section on Orthopaedics Executive Committee
- Project Perfect World Board of Directors.
- Miracle Feet Medical Advisory Board.

Learning Objectives

- When is time essential?
- When do you need to do open reduction?

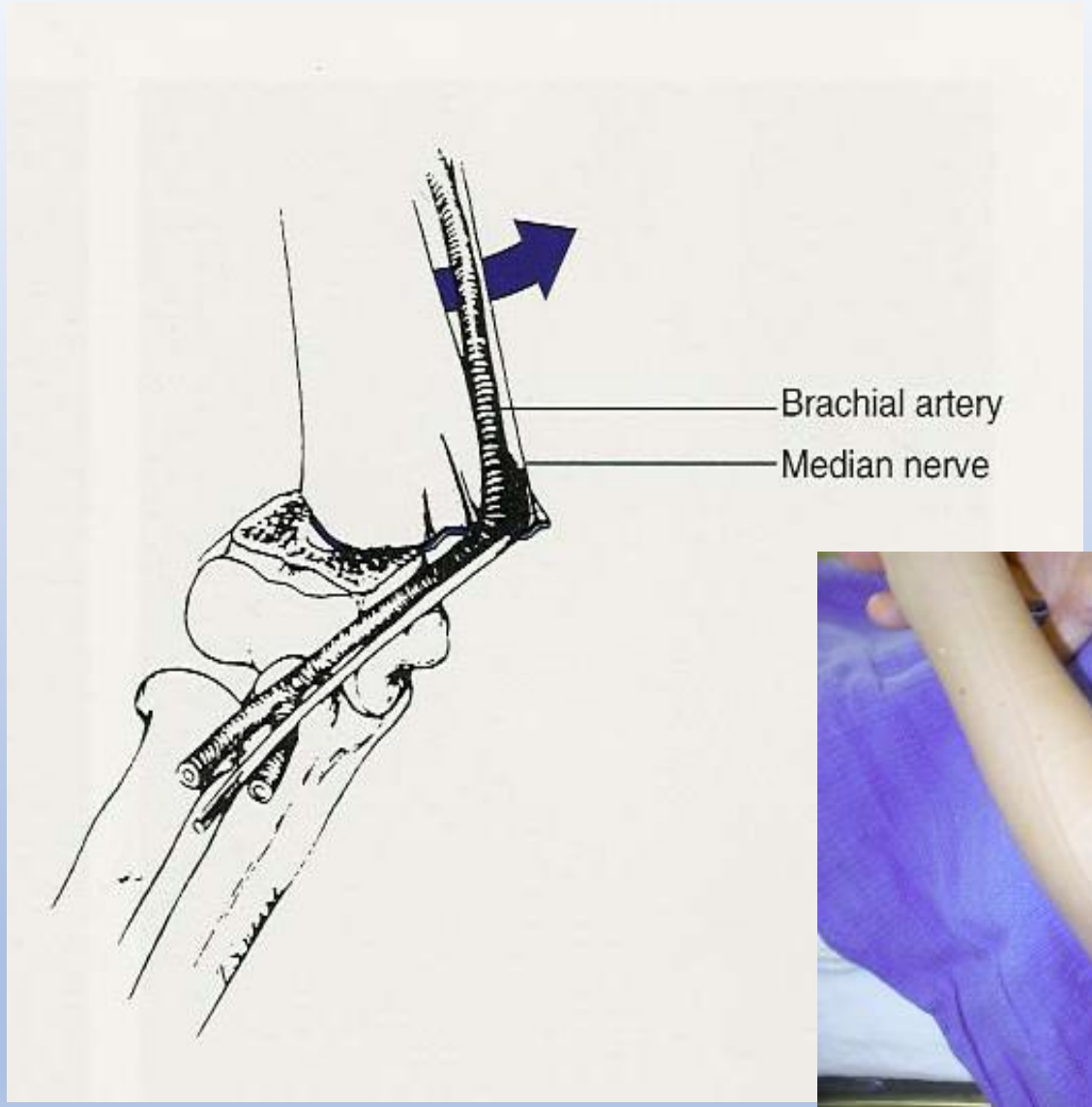
Extension Type Supracondylar Humerus Fx



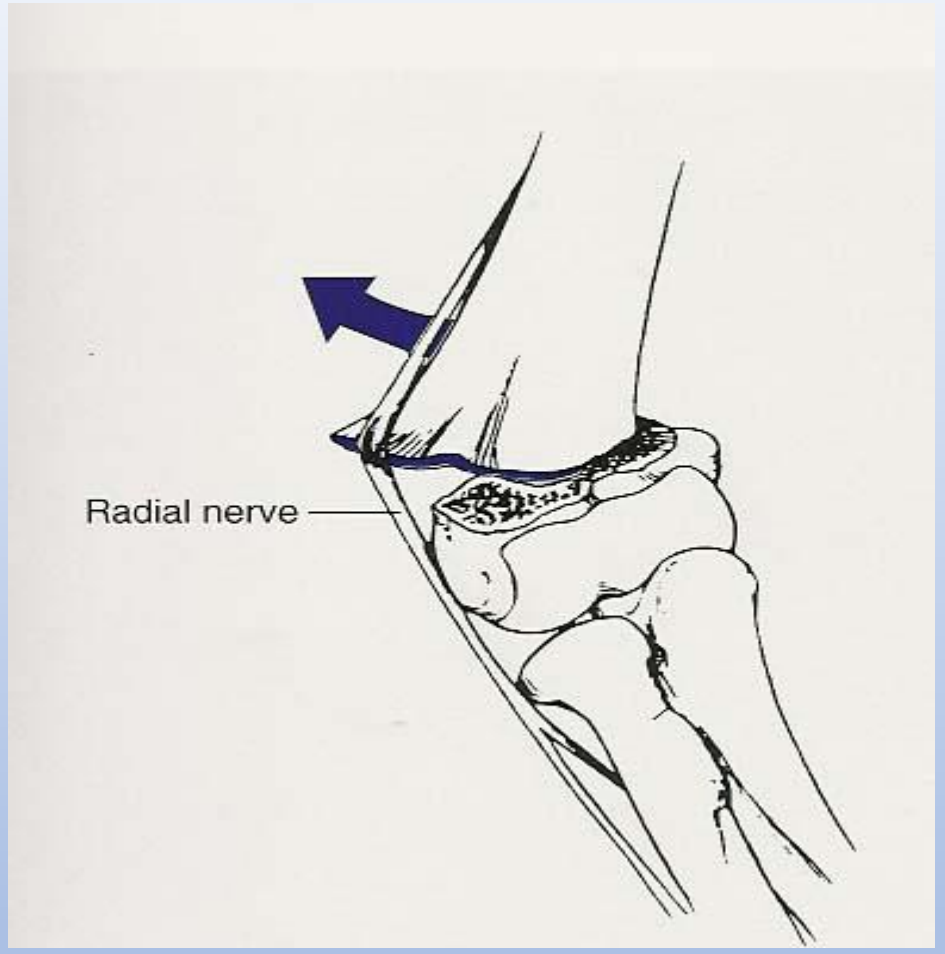
Type I

Type II

Type III



Posterior lateral displacement



Posterior medial displacement

Key Points in treating type 3 supracondylar humerus fracture

Not clear definition of emergent vs urgent. Some studies say early treatment is 8 hours, others 12 hours, from time of injury. I consider urgent as early, emergent as now.

mechanism and energy are key to treatment

Awareness of the clinical signs that indicate a more severe fracture and appropriate timing of intervention are important factors to consider to minimize the risk of complications.

Definition of a pulse: if can be detected by doppler

Sometimes open reduction is a best course.

$$F = \frac{G M m}{r^2}$$

F = force of gravity
G = gravitational constant (6.67×10^{-11})
M = mass of one object
m = mass of other object
r = distance between the two objects

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THE TREATMENT OF PEDIATRIC SUPRACONDYLAR HUMERUS FRACTURES

EVIDENCE- BASED GUIDELINE AND EVIDENCE REPORT

Adopted by the American Academy of Orthopaedic Surgeons Board of Directors

September 24, 2011

Table 44 Timing Cutoff and Fracture Types

Study	Early/Delayed Cutoff Time	Fracture types - Early	Fracture types - Delayed
Carmichael	8 hours	64% Type III, 36% Type II	29% Type III, 71% Type II
Iyengar	8 hours	100% Type III	100% Type III
Mehlman	8 hours	94% Type III, 6% Type II	70% Type III, 30% Type II
Walmsley	8 hours	100% Type III	100% Type III
Gupta*	12 hours	70% Type III, 30% Type II	34% Type III, 66% Type II
Sibinski	12 hours	100% Type III	100% Type III

*also performed analysis of Type III fractures only

Importance of Perfusion Examination

The perfusion status of the extremity should be noted. Important findings include warmth, capillary refill, and the presence or absence of a radial pulse by palpation and/or Doppler ultrasound.

POSNA study guide

General Principles type 3 fractures

These are soft tissue injuries that happen to have a fracture

Besides the fracture type, evaluate:

- Vascular status- <3 sec cap refill, warm, pink, palpable pulse (dopplerable)
- Associated nerves injuries
- Condition of soft tissue- open? Dirty?
- Ipsilateral radius or ulnar fracture?
- Degree of swelling- typical or severe

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Complications to Avoid

- Compartment syndrome
  - Minimize risk with immediate treatment of vascular injuries
  - Significant swelling, wide displacement, antecubital ecchymosis, ipsilateral fractures, and neurologic deficit are relative indications for early intervention
  - 3 A's in pediatric patients (anxiety, agitation, analgesic requirement) as potential signs of impending compartment syndrome
  - Immobilize in relative extension (≤ 70 degrees for displaced fractures) to reduce compartment pressures.
- Vascular injury- and resulting Volkmann
- Nerve injury- most are resolving neuropraxias
- Infection- urgent and appropriate treatment of open fractures
- Loss of reduction or mal reduction
- Stiffness

POSNA Study Guide

Treatment Case Example

- 7 year old boy with type 3 supracondylar humerus fracture
- Perfused hand (>3 sec cap refill) but no distal palpable or dopplerable pulse
- Anterior interosseous nerve injury
- Skin is intact (closed soft tissue envelope)
- No ipsilateral radius or ulna fracture
- Severe swelling and puckering of the skin.
- What to do? Emergent, urgent or not?

Go to AAOS AUC Appropriate Use Criteria
Plug in the data
You get an answer!

Indication Profile

Fracture Type

- Type 1 - nondisplaced
- Type 2 - extension type with cortical continuity of posterior cortex
- Type 2 - extension type with cortical continuity of posterior cortex with varus/valgus angulation
- (•) Type 3 - extension type with no cortical continuity
- Transphyseal fracture
- Flexion Type Fracture

Vascular Status (Pre-op assessment)

- Non-perfused hand (one that is cold, white, and capillary refill > 3 seconds) without palpable distal pulse
- (•) Perfused hand (one that is warm, pink, and capillary refill < 3 seconds) without palpable distal pulse
- Perfused hand (one that is warm, pink, and capillary refill < 3 seconds) with palpable distal pulse

Nerve Injuries

- (•) Associated nerve injury present
- Associated nerve injury absent

Soft Tissue Envelope

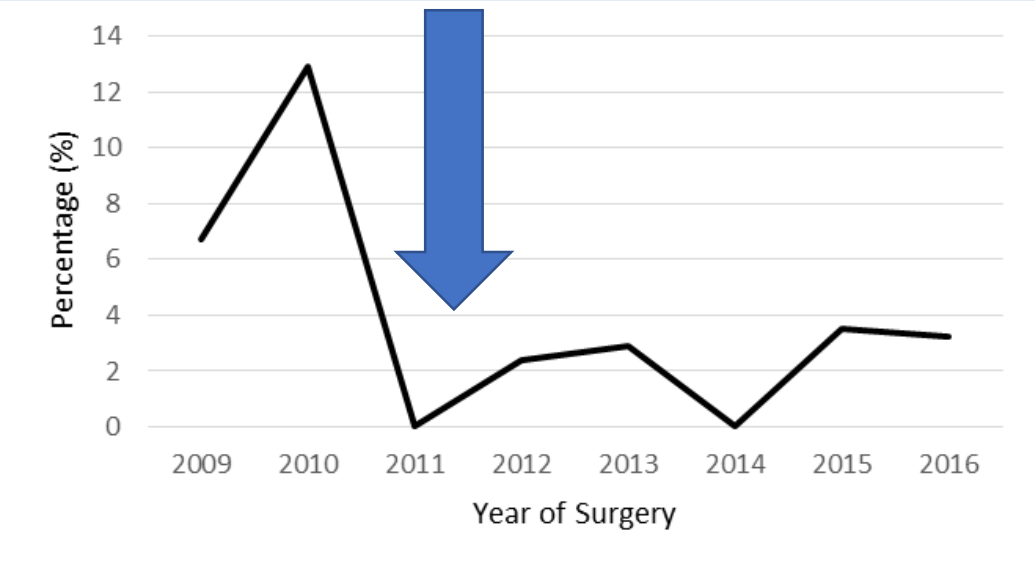
- Open soft tissue envelope - Appears uncontaminated
- Open soft tissue envelope - Concern for contamination and/or significant soft tissue injury
- (•) Closed soft tissue envelope

Procedure Recommendations

✓ Emergent - Closed reduction with pinning and immobilization with lateral pinning	8
✓ Emergent - Closed reduction with pinning and immobilization with cross pinning	7
✓ Emergent - Open reduction and pinning and immobilization	7
Urgent - Closed reduction with pinning and immobilization with lateral pinning	5
! Urgent - Closed reduction with pinning and immobilization with cross pinning	5
! Urgent - Open reduction and pinning and immobilization	6
✗ Immobilization with cast or splint without reduction	+ 1
✗ Reduction with subsequent casting at 70-90 degrees	+ 1
✗ Reduction with subsequent casting at > 90 degrees	+ 1

2009 -2016 study at Children's Mercy Hospital Percentage that deviated from AUC

CPG 2011



Out of 585 patients:

- 560 (95.7%) "appropriate"
- 25 (4.3%) "maybe appropriate"
- 0 "rarely appropriate"

Significant decrease in the proportion that deviated from the guidelines ($p = 0.0076$)

Treatment for type 3

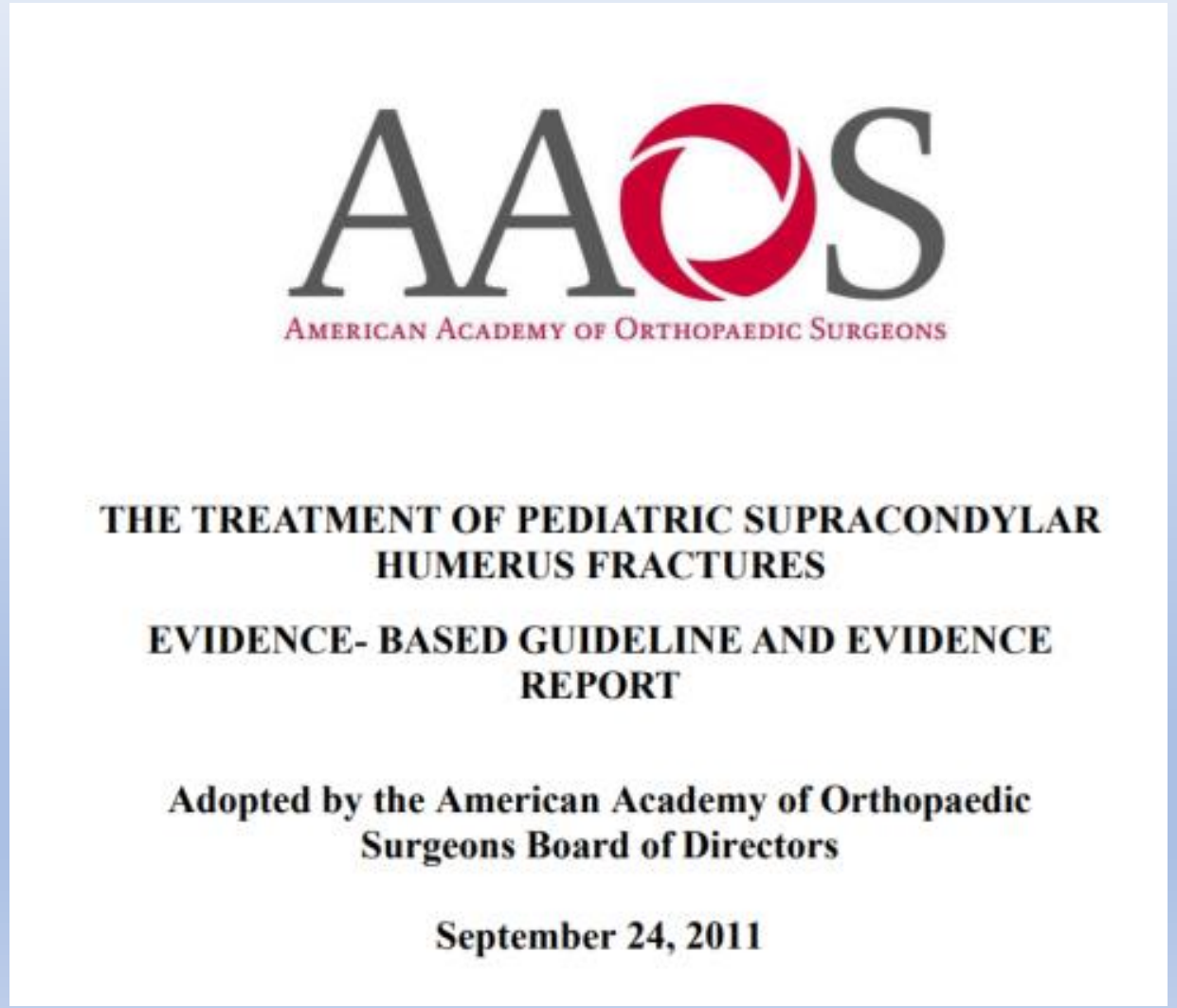
- Type 3 – Treatment consists of closed reduction and percutaneous pinning. Timing of intervention is a key point. In the presence of vascular compromise or compartment syndrome, emergent intervention is essential
  - POSNA study guide

So when do you?

- When to sit back and coast?
- Have to emergently treat a fracture?
- Open a fracture and explore

What does the evidence say to do?

14 recommendations- 4 related to timing and opening



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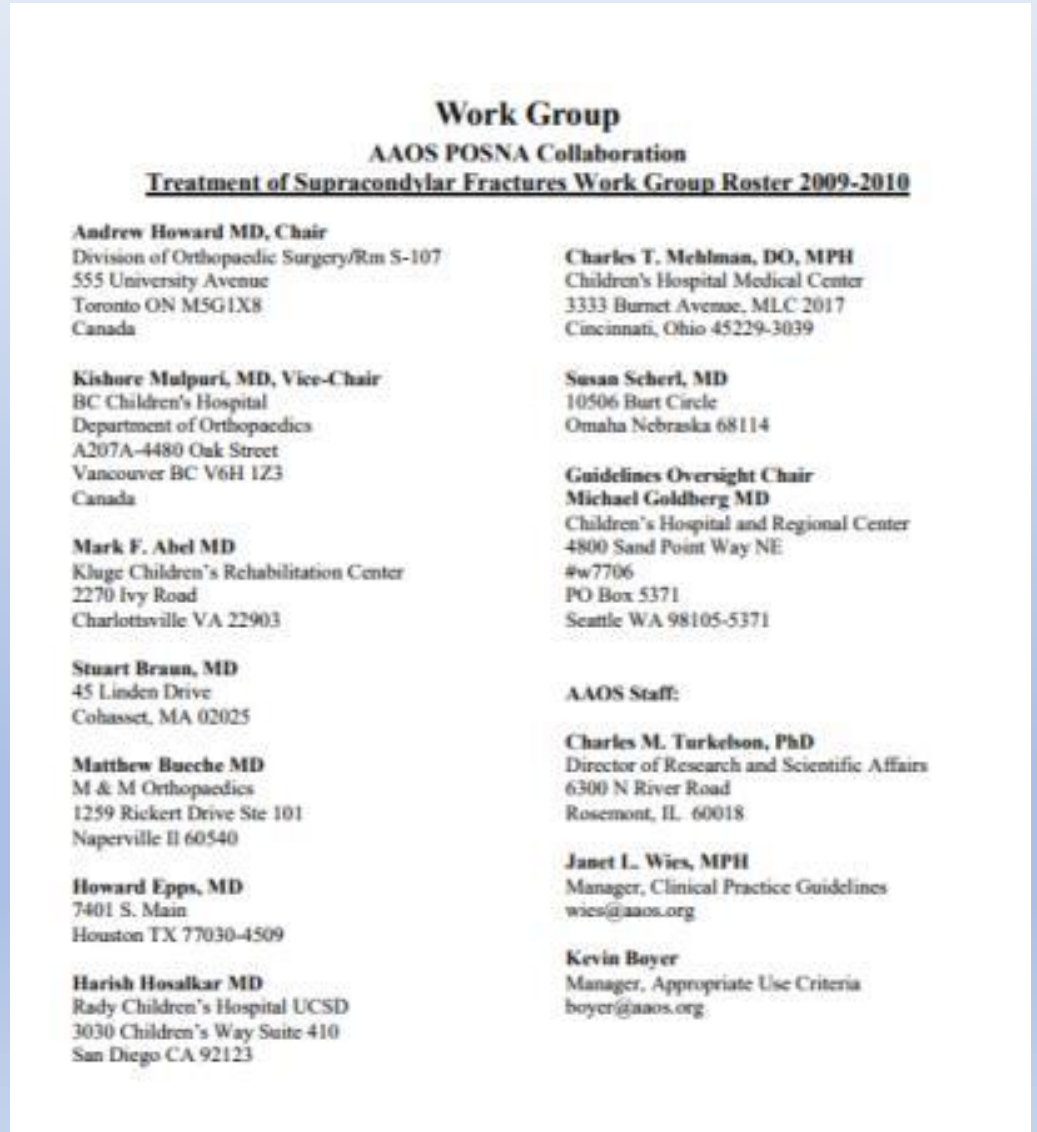

Work Group

AAOS POSNA Collaboration

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If fracture does not reduce?

You may choose to open the fracture to get better reduction

6. The practitioner might perform open reduction for displaced pediatric supracondylar fractures of the humerus with varus or other malposition after closed reduction.

Strength of Recommendation: Limited

Description: Evidence from two or more "Low" strength studies with consistent findings, or evidence from a single "Moderate" quality study recommending for or against the intervention or diagnostic. A **Limited** recommendation means the quality of the supporting evidence that exists is unconvincing, or that well-conducted studies show little clear advantage to one approach versus another.

Implications: Practitioners should exercise clinical judgment when following a recommendation classified as **Limited**, and should be alert to emerging evidence that might negate the current findings. Patient preference should have a substantial influencing role.

If Presents with Poor Perfusion?

Then do emergent closed reduction

7. In the absence of reliable evidence, the opinion of the work group is that emergent closed reduction of displaced pediatric supracondylar humerus fractures be performed in patients with decreased perfusion of the hand.

Strength of Recommendation: Consensus

Description: The supporting evidence is lacking and requires the work group to make a recommendation based on expert opinion by considering the known potential harm and benefits associated with the treatment. A **Consensus** recommendation means that expert opinion supports the guideline recommendation even though there is no available empirical evidence that meets the inclusion criteria of the guideline's systematic review.

Implications: Practitioners should be flexible in deciding whether to follow a recommendation classified as **Consensus,** although they may give it preference over alternatives. Patient preference should have a substantial influencing role.

Pale, Pulseless Hand

- Emergent operative reduction and pinning of the fracture
- If no restoration of perfusion, immediate brachial artery exploration
- If trapped in the fracture then release the pins and repair it.
- If the artery is injured or torn then repair it.

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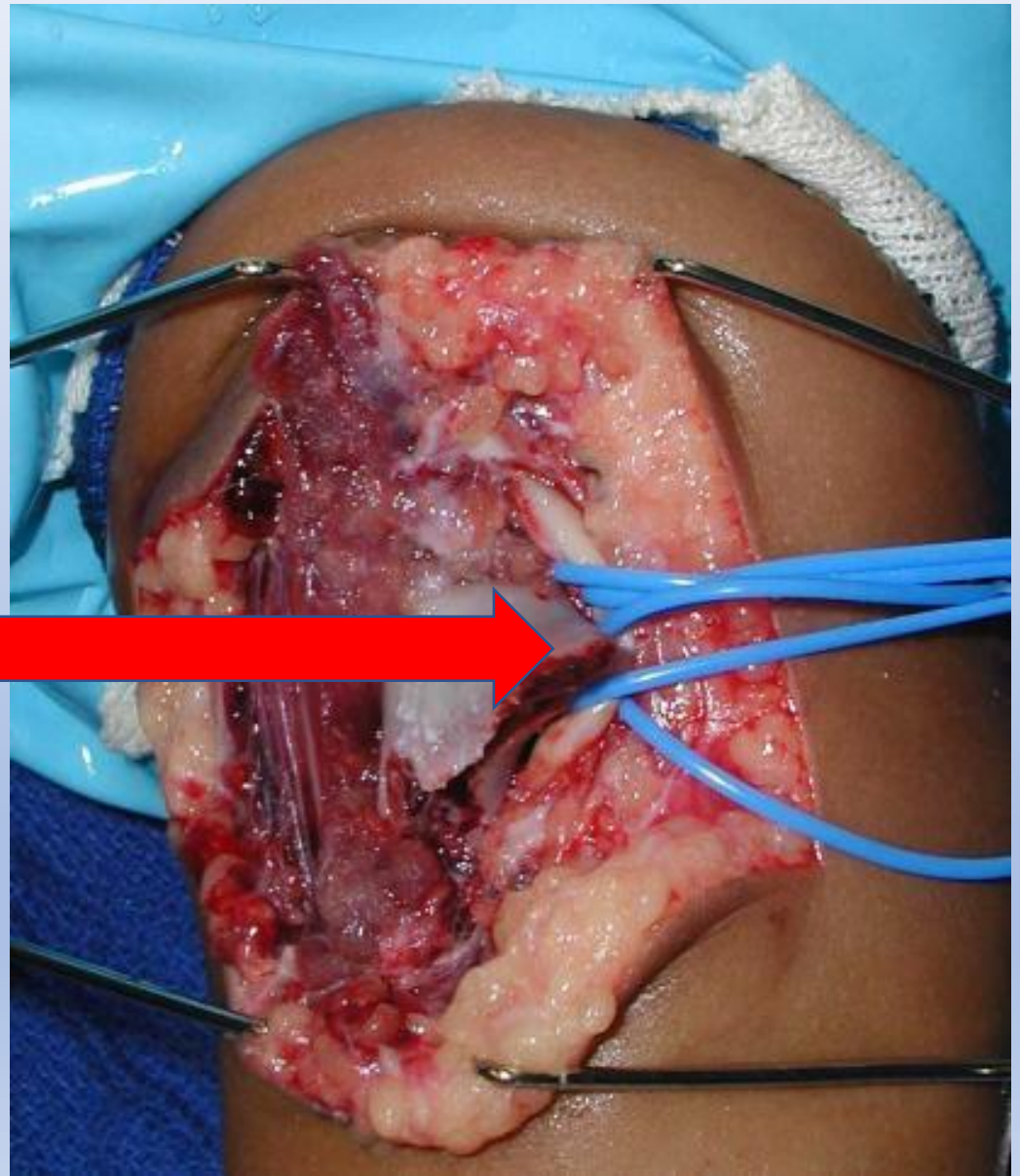

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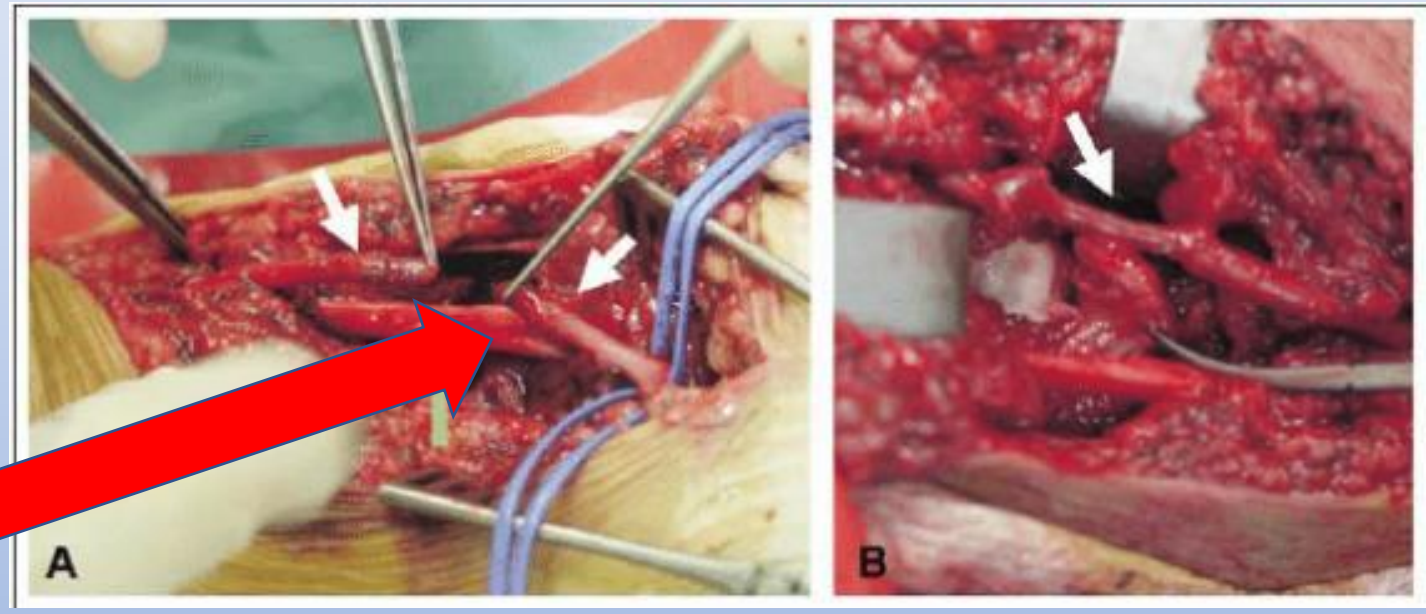

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But don’t do this!

If absent pulses and poor perfusion post reduction pinning?

Explore the site

8. In the absence of reliable evidence, the opinion of the work group is that open exploration of the antecubital fossa be performed in patients who have absent wrist pulses and are underperfused after reduction and pinning of displaced pediatric supracondylar humerus fractures.

Strength of Recommendation: Consensus

Description: The supporting evidence is lacking and requires the work group to make a recommendation based on expert opinion by considering the known potential harm and benefits associated with the treatment. A **Consensus** recommendation means that expert opinion supports the guideline recommendation even though there is no available empirical evidence that meets the inclusion criteria of the guideline's systematic review.

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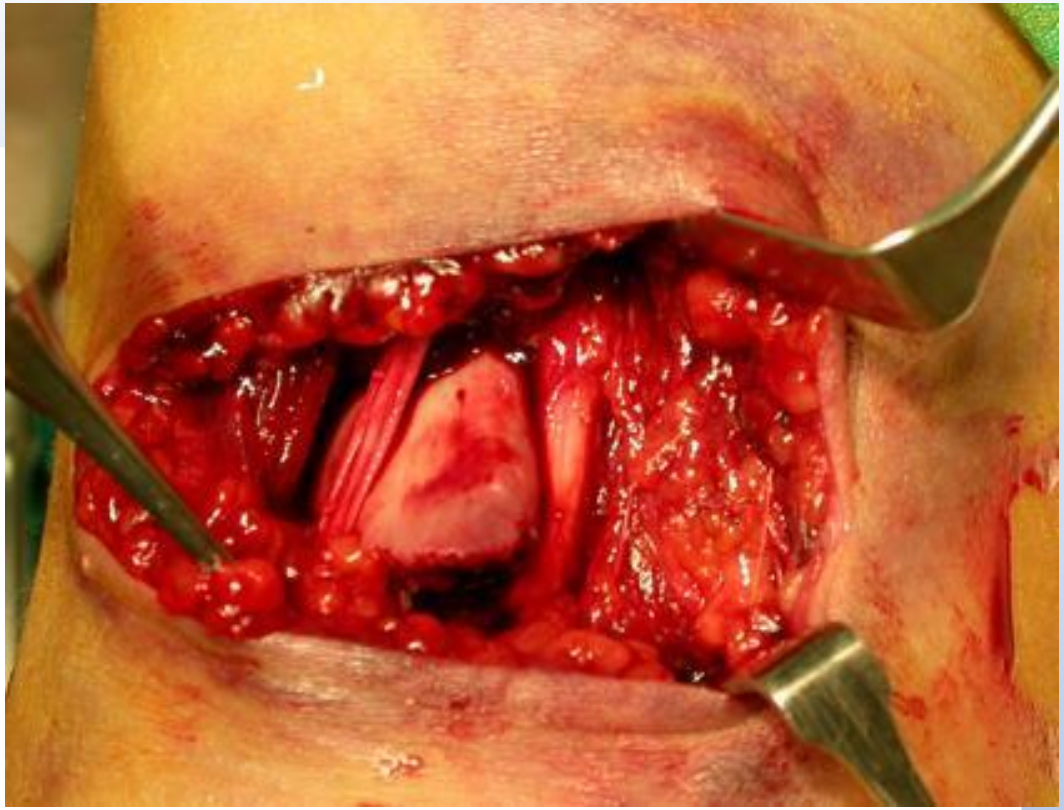

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APPROPRIATE USE CRITERIA: PEDIATRIC SUPRACONDYLAR HUMERUS FRACTURES WITH VASCULAR INJURY

Indication Profile

Vascular Status

- (●) Patients with a suspected vascular injury after closed reduction and pinning
- ( ) Patient had vascularity restored. The patient will be admitted and observed.

Perfusion

- (●) Perfused hand (one that is warm, pink, and capillary refill < 3 seconds) with dopplerable distal pulse
- ( ) Perfused hand (one that is warm, pink, and capillary refill < 3 seconds) without dopplerable distal pulse
- ( ) Non-perfused hand (one that is cold, white, and capillary refill > 3 seconds)

Submit

Pr... Recommendations

✓	Continue In-Hospital Observation without intervention	+ 8
	Same-day discharge	- 5
!	Warm the extremity	5
!	Immediate transfer to facility with vascular or microsurgery services	4
✗	Removing fixation	2

Lots of studies but all low power

EXCLUDED STUDIES

Table 70 Excluded Studies Considered for Recommendation 8

Study	Year	Title	Reason for Exclusion
Choi PD;Melikian R;Skaggs DL;	2010	Risk factors for vascular repair and compartment syndrome in the pulseless supracondylar humerus fracture in children	Very Low Quality, Low Power, <10 patients in comparison
Blakey CM;Biant LC;Birch R;	2009	Ischaemia and the pink, pulseless hand complicating supracondylar fractures of the humerus in childhood: long-term follow-up	Very Low Quality, Low Power
Mangat KS;Martin AG;Bache CE;	2009	The 'pulseless pink' hand after supracondylar fracture of the humerus in children: the predictive value of nerve palsy	Very Low Quality, Low Power, <10 per group in comparison
Noaman HH;	2006	Microsurgical reconstruction of brachial artery injuries in displaced supracondylar fracture humerus in children	Very Low Quality, Low Power
Ghasemzadeh F;Ahadi K;Rahjoo A;Habibollahzadeh P;	2002	Absence of radial pulse in displaced supracondylar fracture of humerus in children	Very Low Quality, Low Power
Sabharwal S;Tredwell SJ;Beauchamp RD;MacKenzie WG;Jakubec DM;Cairns R;LeBlanc JG;	1997	Management of pulseless pink hand in pediatric supracondylar fractures of humerus	Very Low Quality, Low Power
Copley LA;Dormans JP;Davidson RS;	1996	Vascular injuries and their sequelae in pediatric supracondylar humeral fractures: toward a goal of prevention	Very Low Quality, Low Power

Pink Pulseless Hand

- Pink, warm hand with capillary refill symmetric to the contralateral side
- Radial pulse NOT palpable
- AND Normal radial pulse (triphasic) NOT audible with Doppler ultrasound

Pulse absent/hand perfused after reduction?

Use your judgement to open or not.

9. We cannot recommend for or against open exploration of the antecubital fossa in patients with absent wrist pulses but with a perfused hand after reduction of displaced pediatric supracondylar humerus fractures.

Strength of Recommendation: Inconclusive

Description: Evidence from a single low quality study or conflicting findings that do not allow a recommendation for or against the intervention. An **Inconclusive** recommendation means that there is a lack of compelling evidence resulting in an unclear balance between benefits and potential harm.

Implications: Practitioners should feel little constraint in following a recommendation labeled as **Inconclusive,** exercise clinical judgment, and be alert for emerging evidence that clarifies or helps to determine the balance between benefits and potential harm. Patient preference should have a substantial influencing role.

Problems with evidence based recommendations

- Early, emergent and urgent time periods are not defined.
- Some scenarios with AUC don’t make sense. ok to not wash out contaminated open fx, really?
- Needs real life data to determine if recommendations are really working properly.
- Legal concerns if you stray too far.

Summary- From AUC

Try using the AAOS AUC but understand it is not perfect!

AUC does not define what is early treatment, urgent or emergent

Emergent

- No perfusion- open treatment if cannot restore perfusion with closed.
- No pulse, perfused, nerve out- use your judgement to open
- Contaminated open fracture- open treatment

Urgent

- No pulse, but perfused- use your judgment to open
- Open fracture, not contaminated- open treatment

You may want to open the fracture if cant get adequate reduction

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