

## **Surgical Complications**

Complications are common even with ideal management. Recently, Bashyal performed a retrospective review of 622 patients treated for supracondylar fractures and evaluated the complications associated with management. Overall, 4.2% of patients had complications. The most common complication was pin migration, which required an unanticipated return to the operating room for pin removal in 1.8% of patients. Infectious complications related to wire fixation were seen in six patients (1%). Five infections were superficial, and one additional patient required treatment of pin tract osteomyelitis and elbow septic arthritis. One patient had malunion; four others were returned to the operating room for repeat reduction and pinning. Compartment syndrome was present in three patients, and one patient had postoperative ulnar nerve injury.

## **Evolving Management Concepts**

### **Timing of Surgical Intervention**

Traditionally, closed reduction and pinning of type III supracondylar fractures was performed as an emergent procedure within several hours of admission, regardless of the time of day or night. This was done because of concerns regarding increasing swelling, the development of compartment syndrome, and increasing difficulty with achieving an adequate closed reduction. However, this practice has been challenged in recent studies.

Mehlman compared the rates of perioperative complications in fractures managed  $\leq 8$  hours after injury with those managed  $> 8$  hours after injury (52 versus 146 patients, respectively). No significant difference was noted with regard to the need for conversion to open reduction, superficial pin tract infection. Bales reported similar findings.

### **Factors Used to Determine Emergent Management of Supracondylar Humerus**

Open fracture, avascular limb, Skin puckering, Floating elbow, Median nerve palsy, Evolving compartment syndrome, Young age with Cognitive disability

Most type III supracondylar fractures to within 12 to 18 hours of injury. The arm is then carefully positioned with the elbow in 20° to 40° of flexion and placed in a long arm splint. The child undergoes neurovascular checks by the nurse at 2-hour intervals. Children who may not be reliably examined for compartment syndrome because of young age or cognitive disability are typically treated emergently.

### **Type II Fracture**

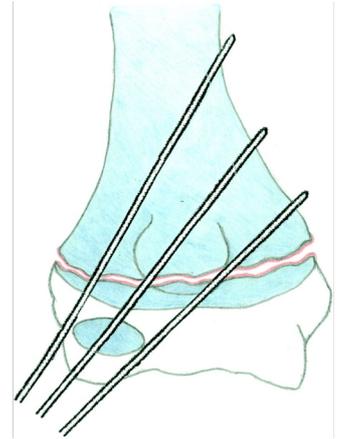
Management of type II supracondylar fractures remains controversial.

Present trend: All type II fractures be managed with closed reduction and pinning either because of the potential for displacement or to obtain anatomic reduction. O'Hara concluded that all type IIB and III fractures should be pinned after reduction.

Most type II fractures are managed primarily with closed reduction and pin fixation. The main reasons for this management protocol are concern regarding inability to maintain adequate reduction in a cast or splint, poor patient adherence to follow-up instructions, and inability to distinguish a type IIA fracture from a type IIB fracture.

## Pin Configuration

Traditionally, a crossed pin configuration has been used to stabilize supracondylar fractures after reduction. With the elbow held in flexion, one lateral pin is placed percutaneously just proximal to the capitellum in the metaphysis, and one pin is through the medial epicondyle. [Cross pinning]. However, it has been recognized that the ulnar nerve is at risk when pinning performed from the medial side.



3 Divergent lateral K wires fixation is now popular.

## Complications

### 1. Pink Pulseless Hand

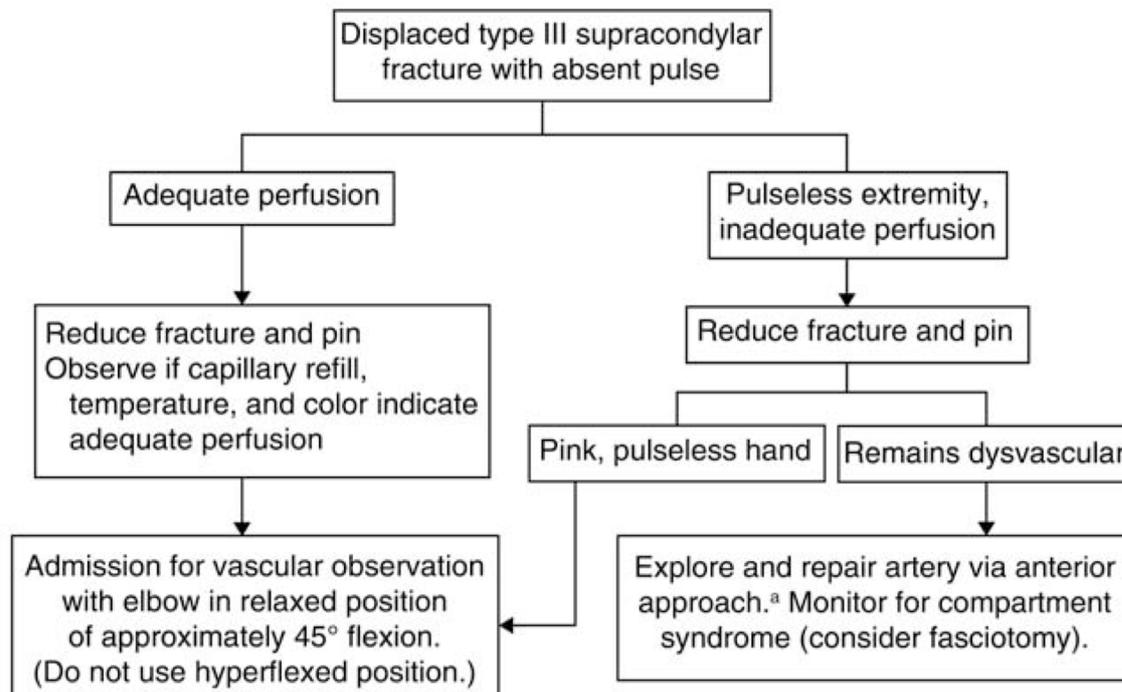
The pulseless limb associated with supracondylar fracture is one of the most distressing injuries and is associated with anxiety as lack of experience with vascular repair of small vessels among orthopods. There is lack of consensus regarding the best management of the condition. Most surgeons follow a similar treatment algorithm for this injury.

Emergency reduction is required and stabilized with pins. The vascular status is reassessed and observed for 15 to 20 minutes for signs of improvement. Regardless of the status of the pulse, if the hand is well-perfused, the arm is splinted in 40° to 60° of flexion and the circulation is closely monitored.

When circulation compromised and not improving, Explore: After inspection of the vessel, the artery is directly repaired; if that is not possible, a vein graft is used to span the defect. Prophylactic forearm and hand fasciotomies are performed in cases of reperfusion with prolonged ischemia. Unless the child has sustained multiple injuries or fractures in the same limb, arteriography is not useful and may in fact delay revascularization or exacerbate vessel spasm.

The authors of a study evaluating vascular status as long the limb remained well-perfused and functioned normally even if the radial pulse did not return.

Author suggests emergent closed reduction and pinning in children who present with pink pulseless hands after supracondylar fractures. At our institutions, scenarios requiring emergent vascular exploration include worsening vascular examination or signs or symptoms of forearm or hand ischemia. Although some have recommended exploring all limbs without a palpable radial pulse following closed reduction, it is our opinion that there is no evidence-based justification to exploration in all.



## 2. Cubitus Varus

Gun stock deformity is the common deformity. Traditionally, surgeons believed it to be primarily a cosmetic deformity.

However, O'Driscoll identified 22 adult patients who presented with pain as well as signs and symptoms of elbow instability 20 to 30 years after sustaining supracondylar fractures. "tardy posterolateral elbow instability" causes medial displacement of the elbow mechanical axis, resulting in asymmetric triceps forces that cause slow attenuation of the lateral collateral ligament. Valgus osteotomy and ligament reconstruction yields satisfactory results.

Failure to recognize and reduce varus malalignment, which is more common with Medial rotation and medial comminution of the fracture.

Post-reduction displacement

Growth disturbance has less often been implicated



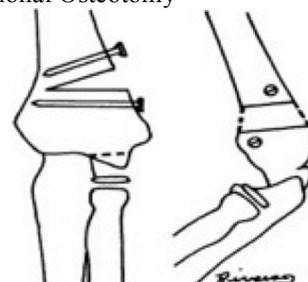
## French osteotomy

Treatment: Only coronal correction or sometimes hyperextension correction is required.

Alternatively close wedge osteotomy with K wires with K wires.



Traditional Osteotomy



### New Osteotomy

Initial transverse osteotomy: 1 cm superior to the olecranon fossa and perpendicular to the axis of the humerus.

The triangular area indicates the area to be resected.

The cubitus varus is corrected by rotating the distal fragment laterally and translating it medially after completing the initial transverse osteotomy.



**Recommended correctional osteotomy** in children with substantial residual cubitus varus following supracondylar elbow fractures. Ideally, the surgery is done  $\geq 1$  year after injury, when elbow range of motion has stopped improving and when the child is old enough to cooperate with postoperative instructions. Preferred option is to perform lateral closing wedge osteotomy and pin fixation through a lateral or posterior approach. Technique modification (eg, dome osteotomy, step-cut osteotomy) may be required in children with severe sagittal plane or rotational deformities.

### **3. Compartment Syndrome**

Compartment syndrome is a rare complication of supracondylar fracture.

Children with type III supracondylar fractures are observed in the hospital for 12 to 24 hours postoperatively to allow for early detection of impending compartment syndrome. Neurovascular checks and surveillance for signs and symptoms of increasing pain are done at 2-to 4-hour intervals until discharge.

Patients with suspected compartment syndrome are typically returned to the operating room for measurement of compartment pressures. Management involves volar forearm fasciotomy performed through an extensile approach from the elbow to the wrist. Excellent results have been reported in 90% of patients if decompression is performed within a mean of 30.5 hours after diagnosis.

### **4. Volkman's Ischaemic contracture**

Very rare due to early reduction and fixation and increased awareness of this condition.

Still seen in developed countries

Here due to persistent ischaemia, muscle tissue is replaced by fibrous tissue. Anterior superficial compartment is commonly involved. Depending on involvement of muscles, they are grouped under Tsuge Classification.

Treatment includes release of ischaemic muscles, tendon transfers and soft tissue cover with flaps

### **5. Nerve complications**

Incidence of nerve injury: 8%

Anterior interosseous nerve is the most

With Posterolateral displacement: Median nerve is more common and brachial artery: With Posteromedial displacement: Radial Nerve

Iatrogenic due to pinning from medial side: Ulnar nerve is commonly involved. With cross medial pin, fixing with elbow in flexion 18% Ulnar nerve palsy; and fixing with elbow in Extension 4%

Neuro: Birch. JBJS 88: 99 [do not reflect incidence of nerve damage]

32 referrals of neurology with displaced supracondylar fracture: Ulnar nerve 19, Median and radial N 8 each

22 improved non-operatively by 6 months. Of the 10 patients: 6 patients underwent neurolysis and 4 required grafting.

In most patients, neurologic deficit identified at the time of injury is temporary and resolves within 6 to 12 weeks. A change in the neurologic examination postoperatively is more concerning and may indicate that the affected nerve was injured during surgery [medial pinning]. Controversy is to whether urgent exploration in case of ulnar nerve palsy or continue observation. Present trend is to stabilise with additional pins laterally and remove medial pin.

## 6. Heterotopic Ossificans

More common with fracture dislocation of the elbow than a supracondylar fracture.

X ray: AP & lateral; If not clear: oblique and valgus extension overload view

CT : preoperative planning

Classification:

I. Anterior HO: Coronoid; Humeroulnar; Humeroradial

II Medial and lateral collateral ligaments

III Posterior HO: Olecranon fossa

Humeroulunar bridge

Posterolateral approach is commonly employed and debride the the olecranon fossa. Trepine the olecranon fossa. Then approach anteriorly to remove HO from the brachialis

Factors for development of HO

1. More with repeated manipulation
2. Oil message as in developing countries
3. Delayed ORIF [ > 5 days]

Usually: no treatment necessary

Prevention

Occasionally excision when HO matures

Timing of surgery: Until it is metabolically quiescent

In the past 1-2 years: because of recurrence

Present: early excision + NSAID +/- radiation and early ROM [Usually by 4 months]

Scaleni block is useful for early mobilisation

Rx: Resection of the ectopic bone + Release contracted capsule until normal ROM is restored. Preserve anterior band of MCL and LCL and orbicular ligaments

1. Incision [plan]
2. Decompress any compromised nerve
3. Resect HO
4. Excise anterior +/- posterior capsule and leave ligaments intact
5. Clear the coronoid fossa and olecranon fossa
6. Excise 1 cm of proximal olecranon
7. Debride anterior lip of the coronoid

### **Summary**

Supracondylar humerus fracture is the most common elbow fracture in children.

Evaluation and management of this fracture continue to evolve, particularly in regard to pin configuration, pink pulseless hand, cubitus varus, and compartment syndrome.

It is imperative that orthopaedic surgeons who manage supracondylar humerus fractures in children keep abreast of these updates and incorporate them into their treatment algorithms.

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