Available online www.ijpras.com

International Journal of Pharmaceutical Research & Allied Sciences, 2020, 9(4):142-146

Review Article

ISSN : 2277-3657
CODEN(USA) : IJPRPM

An Overview on Supracondylar Fracture Complications and Management Approach: A Simple Review of the Literature

Ammar Yasser Alshibely[1]*, Fares Aqeel M Alaqeel[2], Adel Ali A Asiri[3], Abdullah Rafa Alshehri[3], Abdulsalam Ali A Alshehri[3], Mohammed Alhassan Almuashi[3], Emad Abdulrahman Nasser Hadal[4], Fatimah Abdulaziz Alfaim[5], Nawaf Saleh Al Hufayyan[3], Fawaz Sulayyih Alosaimi[6], Sami Aoudah Alahmari[7]

[1] Faculty of Medicine, King Saud University, Riyadh, KSA.
[2] Faculty of Medicine, Qassim University, Qassim, KSA.
[3] Faculty of Medicine, King Khalid University, Abha, KSA.
[4] Department of Orthopaedic Surgery, Security Forces Hospital, Riyadh, KSA.
[5] Faculty of Medicine, Alfarabi College of Medicine, Riyadh, KSA.
[6] Faculty of Medicine, Taif University, Taif, KSA.
[7]Orthopedica department, King Abdullah Hospital, Bisha, KSA

***Email:** Ammarbinysr @ gmail.com*

ABSTRACT

Background: *Fractures cause problems for all human beings during their life. Supracondylar fractures are the most common pediatric elbow fracture and carry significant potential for neurovascular compromise. These fractures of the distal humerus are often problematic in terms of diagnosis, treatment, and complications. Proper care requires appropriate assessment and prompt care of patients whose fractures pose the greatest risk for long-term complications.* ***Objectives:*** *We aimed to review the recent literature on supracondylar fractures along with its associated complications.* ***Methodology:*** *The PubMed database was used to select articles, were papers on imaging modalities and pulmonary embolism detection were obtained and reviewed.* ***Conclusion:*** *Supracondylar fracture of the humerus are a very common problem of pediatric age group and are associated with neurovascular compromise and compartment syndrome. A complete history with a detailed clinical examination is essential. Anteroposterior and lateral radiographic views are usually sufficient for the diagnosis. Treatment of fracture is either conservative or reduced by closing with percutaneous pinning, and surgical exploration if necessary.*

Key words: *Supracondylar Fracture, Clinical features, Diagnoses, Management*

INTRODUCTION

Supracondylar humeral fractures are relatively uncommon injuries in adults, while they are the most common fractures around the elbow in pediatric group, constituting (12–17%) of all paediatric fractures that affect children between the ages of (5–10) years. [1] These fractures have a significant risk for neurovascular injuries and compromise; therefore, they are problematic in terms of diagnosis, management, and complications. It is essential that these fractures be diagnosed early, managed fastidiously as to prevent further complications. These complications can be immediate such as: neurovascular compromise, limb ischemia, or limited limb functionality. [2, 3]. In this study, our aim is to discuss supracondylar fractures affecting pediatric group.

METHODOLOGY

PubMed database was used to select articles, and the following keywords used in the search: ((“Supracondylar fractures "[Mesh]) AND (“Diagnostic Imaging"[Mesh]) AND (“Management"[Mesh])). In regards to the inclusion criteria, the articles were selected based on the inclusion of one of the following topics; supracondylar fracture, diagnosis, clinical features, complications and management. Exclusion criteria were all other articles which did not have one of these topics as their primary endpoint.

Applied Anatomy

In children, the supracondylar region is comprised of thin, weak bone located in the distal humerus. The boarders of this region include the olecranon fossa in the posterior part, anteriorly by the coronoid fossa, and on both sides by supracondylar ridges. The medial and lateral aspects extend distally to the developing condyles and epicondyles. The trochlea is normally tilted in (4°) valgus in males and (8°) valgus in females, constituting the carrying angle of the elbow joint. Also, it is rotated (3–8°) externally, resulting in external rotation of the arm when the elbow is flexed (90°). For stable elbow motion, the trochlea must be restored to its normal position to act as a tie rod to the medial and lateral columns [4].

The supracondylar region give rise to attachment of various muscles which are responsible for moving the distal limb to the region. Other structures that lie in proximity include the brachial artery and nerves of the upper limb: the median, ulnar, and radial nerves. Injury to this region potentiate injury the soft tissue and neurovascular structures. The brachial artery runs superficial to the brachialis muscles in the anteromedial aspect of the humerus. Injury is caused by a proximal or distal fragment of a fractured humerus, depending on the mechanism of the injury. The median nerve runs parallel to the brachial artery. The ulnar nerve crosses the elbow posterior to the medial epicondyle and is not typically injured in these fractures. The radial nerve runs between the brachialis and brachioradialis muscles before crossing the elbow and penetrating the supinator muscle, and then branches into the posterior interosseous nerve [5].

Etiology and Mechanism of Injury

Classically, fall on an outstretched hand (FOOSH) is the most common cause of distal humerus fractures, followed by direct trauma. Fractures can be classified as extension or flexion injury. Extension injury is the most common between of the two, accounting for (95%) of all supracondylar fractures, resulting in a FOOSH injury with elbow hyperextended, resulting in a distal fragment shifting in posterolateral or posteromedial direction. Flexion fractures are caused by a direct trauma to the posterior aspect of the flexed elbow, resulting in the distal fragment shifting in the anterolateral direction [6].

Clinical Features

General Approach

Patients will typically complain of elbow pain, swelling, and very limited to no range of motion at the elbow. Mostly, the history will be that of a FOOSH injury. Determining the origin of pain is important, whether due to a fracture itself or as a result of muscle ischemia. The general approach is to initially inspect the injured limb and perform a brief neurovascular examination, emphasizing limiting the movement of the arm, passively or actively, until the fracture displaced by radiography is ruled out [3].

Examination

On inspection, determination whether the fracture is open or closed should be noted first by inspecting the anterior and posterior sides carefully. Open fractures usually manifest as a wound in or above the level of antecubital fossa. Displaced fractures may have an S-shaped dimpling in the antecubital fossa with marked swelling, whereas nondisplaced fractures often have minimally swelling. Prominent ecchymoses on the anteromedial aspect of the arm may indicate brachial artery bleeding. Neurovascular examination should be performed after the inspection and should be done before the closed reduction of the limb, by evaluating the radial and brachial pulses, in addition to the sensory and motor functions of the median, ulnar, and radial nerves should be assessed prior to any intervention; always compare with the normal side. The presence of a normal pulse in the radial and brachial arteries is a reassuring sign. However, it does not rule out a vascular injury. If any of these are palpable, Doppler ultrasound should be used to determine the presence of distal perfusion. Capillary filling should be evaluated because it provides evidence of distal perfusion; further diminished or absent pulses with poor distal perfusion are signs of ischemia, especially when associated by pain in passive extension of the fingers. Patients with the latter signs should be opted for immediate re-vascularisation [7]. If the patient cooperates, the nerve function test is easily performed. Administration of IV analgesia before testing to relieve the pain will improve the results of this examination. This test can be divided into motor and sensory functions. The 'OK' sign, thumb's up sign, and the finger spread against resistance are useful for determining the median, radial, and ulnar nerve motor functions, respectively. For sensory examination, the two-point discrimination test provides enough evidence of sensory function. It should be tested on the palmar side of the index finger to determine median nerve function, the dorsal web space for radial nerve function, and the little finger for ulnar nerve function. The majority of nerve injuries are neuropraxias and permanent loss of function occurring rarely [5].

Radiographic Assessment

Patients should receive appropriate analgesia before radiographs to ensure optimal quality. AP and lateral radiography are usually sufficient to diagnosis and classification of supracondylar humeral fractures. Physicians should assess the anterior humeral line (Fig 1), which should intersect the middle third of the capitellum ossification center, and Baumann's angle (Fig 2), formed by the intersection of a line drawn down the humeral shaft axis and a line drawn along the physeal line of the lateral condyle, normally $(70–75)^{\circ}$. These two have been shown to be simple, reliable, and repeatable for assessing the presence of supracondylar fractures. Other signs may include the posterior fat-pad sign, which is always pathological. To end a radiographic assessment, always look for other injuries including: proximal humerus fractures, fractures of the radius, fractures of the distal forearm, and fractures of the wrist [7]. Extension fractures can be classified using the Gartland classification into three types based on radiographic evidence (Table 1) (Fig 3). In type I, the fracture is minimally displaced and is usually occult, with both the anterior and posterior lines intact. Type II fractures are mostly posteriorly displaced, but the posterior cortex is intact. In type III, there is complete displacement of the distal segment, usually in the posteromedial direction, with cortical disruption, in a similar manner, flexion fractures can be classified in the latter method. A Type I is non-displaced or minimally displaced fracture. Type II is an incomplete fracture with the anterior cortex intact, these fractures are completely displaced by the cortical disruption [8].

Table 1. Gartland supracondylar Fracture Classification.

Gartland Grade	Fracture Displacement	Management
Type I	No displacement	Conservative
Type IIa	Angulated in the sagittal plane, but with posterior cortex intact and no translation or rotation	Conservative
Type IIb	Angulated in the sagittal plane, with rotation	Operative Intervention
Type III	Complete displacement	Operative Intervention

Management

Treatment of supracondylar fractures depends on the Gartland's classification and the patient's neurovascular status. If the patient has an absent pulse or compromised distal perfusion, closed reduction should be attempted first in hopes of restoration of blood flow. However, this is rarely effective and, in most cases, closed reduction fails to restore blood flow. In these cases, emergent operative exploration of the brachial artery and vascular repair should be performed. The same concept applies to cases where the pulse exists before attempting to reduce and became absent after closed reduction. In some special cases, the patient could have an absent pulse, but distal perfusion is maintained, sometimes referred to as the "pink, pulseless hand". In these cases, most surgeons recommend urgent closed reduction and pinning, followed by close monitoring rather than open exploration. The pulse in majority of these cases will return within 24-hours of closed reduction [9]. In type I fractures, treatment is mostly with a collar and cuff sling or posterior splint and sling. The elbow joint should be maintained at 90° flexion with the forearm in a neutral position for 3-4 weeks. Type II fractures can be managed in the same way without any evidence of rotation [8]. For type III and type II fractures with rotation evidence, surgical management should be chosen over conservative options in order to minimize healing time, complication rates, and return to normal function [10]. Surgical options include closed reduction with percutaneous pinning. Open reduction and exploration can be attempted if closed reduction fails, in the presence of open fractures, or with associated neurovascular compromise [4, 7].

Complications

Complications of supracondylar fractures can be occurring early or late, as a result of causative injury, or can be iatrogenic in nature. These include vascular injuries, compartment syndrome resulting in Volkmann's ischemic contracture, nerve injuries, cubitus varus, fishtail deformities, postoperative infections, and stiffness [5].

Vascular injury is most common in type II and III fractures. Radial pulse is absent in 6-20% in all cases of supracondylar fractures. However, this rate drops to about 3-4% after closed reduction with or without percutaneous pinning. The brachial artery is common if the distal segment is displaced in posteromedial direction [11]. Compartment syndrome can develop early or late. In early compartment syndrome, vascular injury and primary swelling can lead to an increase in forearm compartmental pressure within 12-24 hours, resulting in ischemia and a threatened limb. Late compartment syndrome can develop from inappropriate application of cast if it was used in management. Volkmann's ischemic contraction occurs if compartment syndrome is not picked up initially and treatment is delayed. The contracture result in fixed flexion of the elbow, pronation of the forearm, flexion of the wrist, and joint extension of the metacarpal-phalangeal joint [12]. Early signs and symptoms include abnormally severe pain compared to the patient's status, limited and painful limb movement, and pain in passive stretching of the forearm muscles. The diagnosis is mainly clinical and treatment includes relief of all sources of external pressure and fasciotomy to decompress on all affected compartments [5]. The majority of neural injuries are neuropraxia type, in which the damage is minimal and improvement is seen rapidly within a few hours; only in a few cases develop permanent deficit such as neurotemesis. The frequency of neurological deficit after these fractures is (10–20%) and increases to (49%) in type III. The nerve affected depends on the direction of displacement; While posteromedial displacement is associated with radial nerve injury, a posterolateral displacement presents with median nerve injury, and a flexion fracture commonly shows ulnar nerve injury. Most neuropraxias will persist for (2–3) months. In addition, surgical exploration should be offered to patients with persistent neural deficit for more than 3 months [5].

Cubitus varus (gunstock) deformity is an angular deformity that results from a fracture with varus malunion—leading to loss of elbow carrying angle. While this deformation is not usually associated with functional limitations, it is a cosmetic defect. Fracture surgical treatment leads to reduces the incidence of this deformity. Fishtail deformity of the distal humerus develops after lateral trochlear avascular necrosis complicates fracture healing. Typically, patients present years after the fracture with elbow pain. Abnormalities associated with former deformity include: narrowing of the elbow joint, synovitis, osteophytes, and radial head subluxation [13]. Postoperative stiffness is a rare complication, resolving spontaneously after a period of six months. Infections are mostly superficial and can be treated with oral antibiotics [5].

CONCLUSION

Supracondylar fracture of the humerus are a common orthopedic condition in children. A thorough history with a detailed clinical examination is essential. AP and lateral radiographic views are sufficient for diagnosis. Treatment is either conservative or closed reduction with percutaneous pinning depending on the classification of the fracture. Surgical exploration is attempted in complicated cases. Complications include vascular injuries, compartment syndrome resulting in Volkmann's ischemic contracture, nerve injuries, cubitus varus, fishtail deformities, postoperative infections, and stiffness.

REFERENCES

1. Khoshbin A, Leroux T, Wasserstein D, Wolfstadt J, Law PW, Mahomed N, Wright JG. The epidemiology of paediatric supracondylar fracture fixation: A population-based study. Injury. 2014;45(4):701-708.
2. Ozcan M, Altinoz O, Erem M, Ciftdemir M, Copuroglu C, Turan F. Prognosis and risk factors of nerve injuries in displaced pediatric supracondylar humerus fractures. Niger J Clin Pract. 2020; 23(5): 647-653.
3. Hubbard EW, Riccio AI. Pediatric Orthopedic Trauma: An Evidence-Based Approach. Orthopedic Clinics of North America. 2018.
4. Waters PM, Skaggs DL, Flynn JM, Rockwood CA. Rockwood and Wilkins' fractures in children. In: 9th ed. 2020.
5. Leticia MR. Evaluation and management of supracondylar fractures in children. In: Boutis K, editor. UpToDate. Post TW (Ed), UpToDate, Waltham, MA; 2020.
6. Attum B, Thompson JH. Humerus Fractures Overview. Stat Pearls. 2018.
7. Hill CE, Cooke S. Common Paediatric Elbow Injuries. Open Orthop J. 2017; 11:1380–1393.

8. Saeed W, Waseem M. Elbow Fractures Overview. StatPearls. 2019.
9. Kropelnicki A, Ali AM, Popat R, Sarraf KM. Paediatric supracondylar humerus fractures. British Journal of Hospital Medicine. 2019.
10. Delniotis I, Delniotis A, Saloupis P, Gavriilidou A, Galanis N, Kyriakou A, Potoupnis M, Tsiridis E, Ktenidis K. Management of the Pediatric Pulseless Supracondylar Humeral Fracture: A Systematic Review and Comparison Study of "Watchful Expectancy Strategy" Versus Surgical Exploration of the Brachial Artery. Annals of Vascular Surgery. 2019;55:260-271.
11. Garg S, Weller A, Larson AN, Fletcher ND, Kwon M, Schiller J, Browne R, Copley L, Ho C. Clinical characteristics of severe supracondylar humerus fractures in children. J Pediatr Orthop. 2014; 34(1):34-9.
12. Hosseinzadeh P, Hayes CB. Compartment Syndrome in Children. Orthopedic Clinics of North America. 2016.