

Management of Supracondylar Fractures of the Humerous in Children

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ABSTRACT

Background: Supracondylar humeral fractures (SFH) are the most common fractures of the pediatric elbow, having a peak frequency between the ages of four and nine years. The majority of surgical therapy is percutaneous pinning and closed reduction. The present study aimed to determine the outcome of close reduction and percutaneous pinning in managing the supracondylar humeral fractures in children.

Patients and Methods: A total of 64 children presented with supracondylar humeral fractures to the Orthopaedics Unit of Bacha Khan Medical Complex, Swabi during the period from 16th February 2022 to 15th November 2022. Children with supracondylar humerus fractures of completely displaced (Gartland Type III) were enrolled whereas neurovascular injury related to open or closed Gartland type-III fracture were excluded. Under general anesthesia, close reduction was accomplished, and the elbow was immobilized in extension by the implantation of two plaster slabs. The type of fracture, injury pattern, time from injury to final therapy, surgical treatment, and consequences were all recorded.

Results: The overall mean age was 4.89±3.2 years. Of the total 64 SFH cases, there were 52 (81.3%) male and 12 (18.7%) females. Out of 52 (81.3%) children with pulseless hands, the incidence of Gartland type III and IV was 15.4% (N=8) and 84.6% (N=44) respectively. Out of 52 cases, there were 19 (36.5%) cold hands and 33 (53.5%) warm hands. The overall mean time between injury and presentation was 3.8±2.4 hours. The incidence of patients undergoing autologous interposition venous grafting, vascular reconstruction, and segmental resection and primary anastomosis was 25% (N=16), 59.4% (N=38), and 15.6% (N=10) respectively. There were no amputations, fasciotomies, re-explorations, or long-term ischemic sequelae.

Conclusion: The present study found that close reduction and immobilization with two slabs is a safer and effective method for superior outcome of managing supracondylar humeral fractures in uncomplicated type III injuries as compared to flexion approach. Additionally, Rapid vascular exploration might effectively treat both cold and warm pulseless hands.

Keywords: Supracondylar humeral fractures, Management, Children, Close reduction approach

INTRODUCTION

Supracondylar humeral fractures are the most common fractures affecting the pediatric elbow, and their proper care is critical since they can lead to catastrophic consequences [1]. Although a strong consensus on several matters concerning correct management of these fractures, dispute persists over factors such as the lack of a reliable categorization that guides treatment or predicts consequences. Extension-type fractures account for 97% to 99% of all occurrences [2]. The most common kind of displacement is posteromedial displacement of the distal fragment; nevertheless, both the radial and median nerves are impacted. Ulnar nerve injuries are more typically related with flexion-type fractures. Concurrent upper-limb fractures should always be ruled out. Distal pulse and hand perfusion should be monitored to regulate the vascular condition. Compartment syndrome should always be considered, especially if there is skin puckering, significant ecchymosis/swelling, vascular changes, or simultaneous forearm fractures [3, 4]. The most prevalent presentation of supracondylar humerus fractures, accounting for 90% of all instances, occurs between the ages of 5-7 years, and the non-dominant arm is more usually implicated [5, 6]. While the most common mechanism of injury is a fall onto the outstretched hand with the elbow in full extension, clinical presentation of these fractures is in extension for 97-99% of cases [7, 8]. The substantial risk of acute, possibly limb-threatening consequences due to the involvement of neurovascular structures necessitates constant monitoring and correct protocol management.

Distal supracondylar fracture of the humerus (SFH) in children is commonly associated with vascular injury in the form of absent distal pulses [9, 10]. In such circumstances, treating the vascular damage takes precedence over treating the fracture itself. The therapy of choice for most surgeons is immediate examination of the chilly cyanotic limb [11]. Nonetheless, the management of pink, warm, pulseless limbs remains controversial. Such injuries are frequently treated conservatively; nevertheless, some studies have also advocated for early urgent surgical surgery to avoid limb

loss and major long-term sequelae including Volkmann's ischemia contracture [12, 13]. Several investigations have assessed management techniques, with contradictory results. As a result, the present study aimed to examine the management of SFH in children.

METHODOLOGY

A total of 64 children presented with supracondylar humeral fractures to the Orthopaedics Unit of Bacha Khan Medical Complex, Swabi during the period from 16th February 2022 to 15th November 2022. Children with supracondylar humerus fractures of completely displaced (Gartland Type III) were enrolled whereas neurovascular injury related to open or closed Gartland type-III fracture were excluded. Under general anesthesia, close reduction was accomplished, and the elbow was immobilized in extension by the implantation of two plaster slabs. The type of fracture, injury pattern, time from injury to final therapy, surgical treatment, and consequences were all recorded. Each individual underwent lateral and anteroposterior X-rays during initial presentation and after reduction. Gartland classification was done for fractures categorization. During general anesthesia, patients were fully heparinized and given antibacterial prophylaxis. If necessary, a retrograde embolectomy was done. The arteries were flushed with heparinized saline prior to surgery. To restore vascular continuity, the brachial artery injured portion was removed and an interposition graft of autologous reverse venous was implanted. For the first 48 hours after surgery, heparin infusion was continued at a dosage of 25 units per kg per hour to keep the partial thromboplastin time value two times higher than its typical limit of 35-42 seconds. Over the next 5 days, anticoagulation was maintained at a subcutaneous enoxaparin regular dosage of 1 mg per kg twice a day. During six months, regular monthly follow-ups were undertaken. SPSS version 27.0 was used to analyze the data. To show qualitative data, frequency and percentages were employed, whereas numerical data was given as mean/average.

RESULTS

The overall mean age was 4.89±3.2 years. Of the total 64 SFH cases, there were 52 (81.3%) male and 12 (18.7%) females. Out of 52 (81.3%) children with pulseless hand, the incidence of Gartland type III and IV was 15.4% (N=8) and 84.6% (N=44) respectively. Out of 52 cases, there were 19 (36.5%) cold hand and 33 (53.5%) warm hand. The overall mean time between injury and presentation was 3.8±2.4 hours. The incidence of patients underwent autologous interposition venous grafting, vascular reconstruction, and segmental resection and primary anastomosis was 25% (N=16), 59.4% (N=38), and 15.6% (N=10) respectively as illustrated in Figure-1. There were no amputations, fasciotomies, re-explorations, or long-term ischemic sequelae. The prevalence of vascular injury varies according to the kind of Gartland fracture is shown in Table-I. The pattern of brachial artery vascular injuries in children with supracondylar humeral fractures is represents in Table-II. Methods used to treat arterial injuries are shown in Table-III.

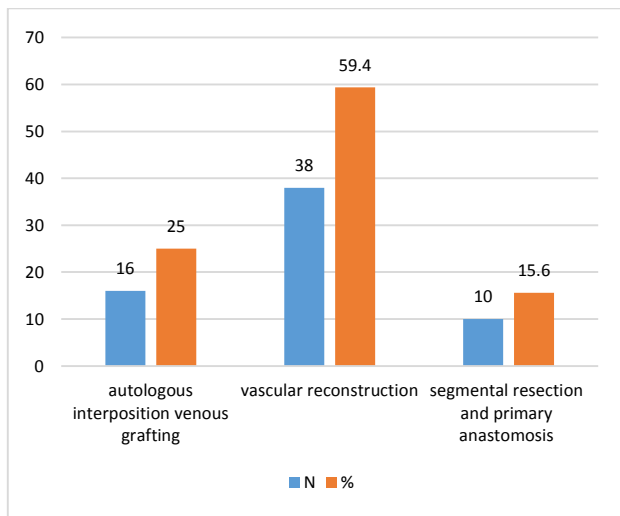


Figure-1: incidence of patients underwent autologous interposition venous grafting, vascular reconstruction, and segmental resection and primary anastomosis

Table-1: prevalence of vascular injury varies according to the kind of Gartland fracture

Gartland Types	Male N (%)	Females N (%)
Gartland type I	0 (0)	0 (0)
Gartland type II	0 (0)	0 (0)
Gartland type III	6 (9.4)	3 (4.7)
Gartland type IV	46 (71.9)	9 (14.1)

Table-2: pattern of brachial artery vascular injuries in children with supracondylar humeral fractures (N=38)

Pattern of brachial artery vascular injuries	Frequency	Percentage
Segmental contusion and thrombosis	26	68.4
Kinking with minimal contusion	10	26.3
Complete transection	2	5.3

Table-3: Methods used to treat arterial injuries

Method's performed	Frequency	Percentage
Segmental resection and interposition venous graft	19	50
Segmental resection and primary anastomosis	10	26.3
Embolectomy	6	15.8
No vascular intervention	3	7.9

DISCUSSION

The present study mainly investigated the management of supracondylar humeral fractures and found that as compared to the flexion technique, close reduction and immobilization with two

slabs is a safer and more successful strategy for addressing supracondylar humeral fractures in simple type III injuries. Supracondylar humeral fractures, particularly type I and II injuries, can be effectively managed conservatively by the traditional method of full elbow flexion with excellent results [15, 16]. Displaced type III fractures are treated surgically, but surgical facilities are not accessible everywhere, and standard conservative care for children with SFH is linked with several problems. Acute flexion of the elbow causes additional vascular compromise in an already swollen elbow and raises the risk of Volkmann ischemia, whereas anything less than acute flexion threatens decrease loss. This method has been demonstrated that deformity of cubitus varus increased up to 14% that expand the slab from inside and leads to loss of reduction [17, 18].

SFH among children frequently cause injury accounting for 16% of pediatric fractures [19]. The fracture is caused in 97% of cases by a fall on the outstretched hand with the elbow completely extended, resulting in an extension fracture [20, 21]. In the current investigation, majority of patients were injured while falling on their outstretched hand. Other causes for such falls are sport activity, slipping, and motorcycle accidents. Injury of such type leads to significant neurovascular injuries. The prevalence of vascular injury reported in various studies varied from 12% to 15% [22, 23].

The brachial artery is the principal artery implicated in SFH, and injury pattern ranges to severe conditions such as perforation, thrombosis, laceration, and transection from simple contusion [24]. The majority of these instances are diagnosed clinically. It is debatable whether further diagnostic methods should be used to examine circulation in a pulseless hands clinically.

Vascular injuries in supracondylar fractures manifest clinically as either a chilly, pulseless cyanotic hands. According to previous study, the incidence of chilly, pulseless leg was 38.1% whereas pink pulseless hands was 61.8% [25]. Furthermost prior investigations indicated that patients with chilly, cyanotic, pulseless limbs seek early care from a vascular surgeon [26, 27].

According to some researchers, vascular vasospasm in children is severe and may take up to 24-48 hours to resolve [28]. Additionally, children have a far reduced risk of getting thrombosis in a kinked channel than adults [29]. Moreover, vascular exploration may harm collateral circulation, which is necessary for a viable extremity [30].

CONCLUSION

The present study found that close reduction and immobilization with two slabs is safer and effective method for superior outcome of managing supracondylar humeral fractures in uncomplicated type III injuries as compared to flexion approach. Additionally, Rapid vascular exploration might effectively treat both cold and warm pulseless hands.

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