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Functional outcome in surgical management of supracondylar fracture of humerus in children

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Abstract

Background: Supracondylar fracture of humerus is an extra-articular fracture occurring in the distal metaphyseal region of humerus. It is almost exclusively a fracture of the immature skeleton, seen in children and young teenagers. Surgical treatment is reserved only for a failed closed reduction, fractures with neurovascular injuries and open fractures. These fractures need a precise treatment approach in order to obtain satisfactory result and to avoid complications. The purpose of our study is to determine the functional outcome of the surgical management of displaced supracondylar fracture of humerus.

Methods: This is a prospective study among 30 patients of age group 5-12 years diagnosed with displaced supracondylar fracture of humerus who were operated during the period from December 2017- March 2019. All of them underwent closed/open reduction internal fixation with medial and lateral K-wires fixation followed by early mobilization of elbow. Follow up was done on OPD basis 6 months post operatively. Clinical and radiological assessment was done and Flynn's criteria was used to evaluate the final results.

Results: Out of 30 patients, 23 were males and 7 were females. The age distribution in our study was 3 to 15 years. Maximum patients in our study were from 5-12 years of age group. The mean age of the patients was 7.97 years. 22 had injury over left elbow and 8 had injury over right elbow. According to Flynn's criteria, 24 patients (80%) had excellent result, 5 (16.67%) had good result and 1 (3.33%) had fair result. None had poor outcome.

Conclusion: We can conclude that closed/open reduction with cross K-wires fixation is an excellent modality of treatment and surgery of choice in partially and completely displaced supracondylar fracture of humerus.

Keywords: Displaced supracondylar fracture, Gartland type II and III, medial K-wire, Flynn's criteria

Introduction

Supracondylar fracture of humerus is an extra-articular fracture occurring in the distal metaphyseal region of humerus. It is almost exclusively a fracture of the immature skeleton, seen in children and young teenagers [1]. It comprises of almost 65% fractures of upper extremity in 5-10 years age group [2, 3, 4]. There is a high incidence of this fracture in the first 5 years of life, it attains peak between 5 and 8 years of age and decreases afterwards [5]. According to the displacement of the distal fragment, supracondylar fractures of humerus in children are divided into two types i.e. Extension type (97.8%) and Flexion type (2.2%) [1]. The management of supracondylar fractures of humerus has evolved from a purely conservative approach to a more aggressive approach in recent years. Conservative treatment of a displaced fracture is usually associated with many complications including Volkmann's ischemic contracture, nerve injury, arterial injury, myositis - ossificans and cubitus varus deformity [6, 7]. Surgical treatment is reserved only for a failed closed reduction, fractures with neurovascular injuries and open fractures. These fractures need a precise treatment approach in order to obtain satisfactory result and to avoid complications [8]. And moreover, surgical management is preferred, most accepted and the proposed method [9]. Here we assess the functional outcome of displaced supracondylar humerus fracture following closed/open reduction internal fixation with medial and lateral K-wires fixation.

Materials and Methods

This prospective study was conducted in the Department of Orthopaedics, Sanjay Gandhi Institute of Trauma and Orthopaedics, Bangalore. This study consisted of 30 patients aged 5-12 years diagnosed with Type III and Unstable Type II – Gartland classification Supracondylar fracture of Humerus who were operated during the period from December 2017-March 2019. Patients with Pathological fractures, Compound/Type III (Gustilo & Anderson classification) open fractures, any other fractures on the ipsilateral upper limb, paralytic limb, associated Compartment Syndrome and neurovascular injury were excluded in this study.

Inclusion criteria

1. Age group 5 – 12 years.
2. Type III (Gartland classification) supracondylar humeral fractures.
3. Unstable Type II fractures.
4. Legal Guardians willing to give informed consent

Exclusion criteria

1. Pathological fractures.
2. Compound/Open Type III (Gustilo & Anderson classification) open fracture
3. Patients with any other fractures on the ipsilateral
4. Patients with paralytic limb

After hemodynamic stabilization, detailed clinical history and clinical examination was carried out. Appropriate analgesia was administered and splinted with above elbow slab. AP and lateral view radiographs taken. Gartland's classification was used to classify fractures based on radiographs. All of them were operated under general anesthesia. Closed reduction and pinning were carried out in supine position with affected limb over the side table. Whereas the open reduction and pinning was carried out in lateral position and posterior midline incision with affected elbow facing the surgeon under tourniquet applied over the proximal 1/3rd of arm. Reduction was confirmed under fluoroscopy in two views. After confirming satisfactory alignment, reduction was maintained by passing 2 K-wires of size 1.2 mm/1.5 mm, one medial and one lateral percutaneously. Above elbow pop splint in 90° elbow flexion of forearm was applied.

These patients were reviewed on 12th post-operative day on outpatient basis for suture removal in patients who underwent open procedure. Serial X-rays were done every week to check any displacement or failure. Wires were removed at 3 weeks post-operatively after X-ray confirmation of satisfactory callus formation. POP slab was discarded at the same time and patient was advised to do active elbow flexion-extension and supination-pronation exercises. Patient's attenders were advised to avoid massage and passive stretching and prevent the child for lifting heavy weights till 12 weeks post-operatively. Follow up was done on OPD basis at 2nd week, 6th week, 12th week and 6th month post operatively. At 6th month, results were evaluated according to Flynn's criteria.



Fig 1: Pre op Radiograph

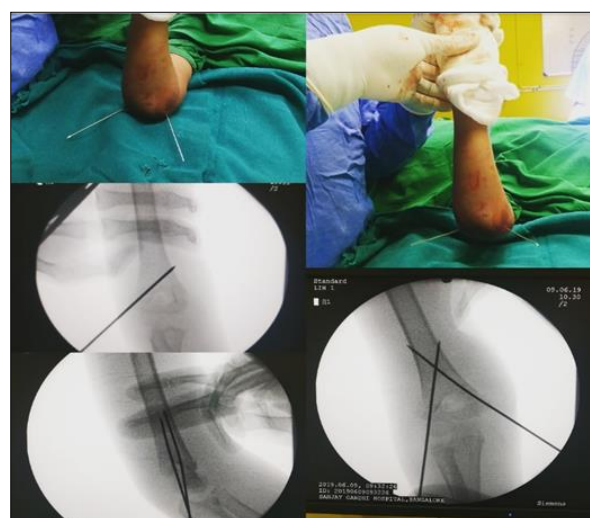


Fig 2: Patient positioning, k-wires insertion and per-operative c-arm images of closed reduction technique



Fig 3: Immediate post-operative radiograph



Fig 4: 3 months follow up radiograph

developed pin-tract infection which was managed conservatively while 1 patient developed Cubitus Varus deformity. We have used Flynn’s criteria for our final result and moreover none of our patient had movement loss and loss of carrying angle of more than 15 degrees. So according to Flynn’s criteria, our 24 patients (80 %) had excellent result, 5 (16.67%) had Good result and 1 (3.33%) had fair result. None of our patient had poor outcome.

Table 1: Age Distribution.

	Frequency	Percent
0-4	4	13.3
5-8	15	50.0
9-12	9	30.0
>12	2	6.7
Total	30	100.0

Table 2: Type of fracture

	Frequency	Percent
Type II	10	33.3
Type III	20	66.7
Total	30	100.0

Table 3: Flynn’s criteria– Results

	Frequency	Percent
Excellent	24	80.0
Fair	1	3.3
Good	5	16.7
Total	30	100.0



Fig 5: 3 months follow up range of movements

Results

Out of 30 patients, 23 were males and 7 were females. The age distribution in our study was 3 to 15 years. Maximum patients in our study were from 5-12 years of age group. The mean age of the patients was 7.97 years. 22 had injury over Left elbow and 8 had injury over Right elbow. The mode of injury distribution was, 26 had self-fall and 4 met with a road traffic accident. 10 had TYPE II fracture and 20 had TYPE III fracture according to Gartland’s classification. 21 underwent closed reduction of the fracture and 9 underwent open reduction followed by k-wires fixation. Out of 21 patients who underwent closed reduction, 9 were having TYPE II fracture and 12 were having TYPE III fracture. Similarly, out of 9 who underwent open reduction, 1 patient was having TYPE II fracture and 8 patients were having TYPE III fracture. Out of 30 patients, 27 patients didn’t have any complication through the whole follow up. 2 patients

Discussion

Supracondylar humerus fractures are fractures of immature skeleton seen among children and young teenagers [10]. Initially all these fractures were treated conservatively with plaster and cast applications. Slowly it has evolved from conservative management into surgical management over the ages. Initially surgical treatment was reserved only for a failed closed reduction, fractures with neurovascular injuries and open fractures. But due to increased complications associated with conservative management such as inability to hold the fragments in alignment, compartment syndrome, increased chances of non-union, cubitus varus, Volkmann’s ischemic contracture, nerve injury, arterial injury, myositis – ossificans [11, 12], surgery is the most preferred mode of treatment. And, moreover, displaced supracondylar fractures are difficult to reduce; maintenance of reduction is also difficult and there is frequent involvement of neurovascular structures [13, 14]. The main aim of management of supracondylar fracture of humerus is to achieve satisfactory functional and cosmetic result. Avoiding and managing the post-operative complications is also challenging. Definitive fixation as soon as possible proves to be very important. Gender distribution with male predominant was similar to Wilkins KE *et al* (62.8%) [1], Sharma *et al* (83.3%) [15], Fowles *et al*. (81%) [16]. In our study 100% of the patients had satisfactory outcome. As per Flynn’s criteria, 80% of our patient had excellent outcome, 16.7% of the patients had good outcome and 3.3% of the patients had fair outcome. None of our patients had a poor outcome of the surgical management. Final outcome had similar results of excellent outcome compared to Aronson *et al* (61.5%) [17], Karapinar *et al*. (80.3 %) [18]. Only 2 patients had pin tract infection which was managed well and 1 patient had 6 degrees of cubitus varus deformity at the end of the follow up period i.e. 12 weeks. Complication rate was similar

to study of Karapinar *et al.* (8.2%)^[18]. Proper anatomical reduction can give excellent functional as well as clinical outcome. It can be done by both percutaneous as well as open techniques of K-wire fixation. We used Cross K-wires in our

study. This technique provides stable fixation provided they are introduced following the proper guidelines. Early mobilization of elbow and achievement of good range of movement are benefits of this technique.

Table 4: Comparison of final outcomes between our study and various other studies

Study	Sample size	Flynn's criteria			
		Excellent	Good	Fair	Poor
Aronson <i>et al.</i> ^[17]	20	16 (61.5%)	9 (34.5%)	1 (3.8%)	0
Sharma <i>et al.</i> ^[15]	80	12 (13.3%)	54 (60%)	15 (16.67%)	9 (10%)
Karapinar <i>et al.</i> ^[19]	61	49 (80.3%)	7 (11.5%)	2 (3.3%)	3 (5%)
Our Study	30	24 (80%)	5 (16.7%)	1 (3.3%)	0

Conclusion

Supracondylar fracture of humerus is more common in childhood because of the peculiar anatomical characteristics of distal humerus in this age. So, after comparing our results with other studies we can conclude that closed/open reduction with cross k-wires fixation is an excellent modality of treatment and surgery of choice in partially and completely displaced supracondylar fracture of Humerus.

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