Floating Elbow In Children: Review Of Its Incidence And Outcome Of Operative Management.

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Abstract: Supracondylar fractures are a common elbow injury in children, accounting for 16% of all paediatric fractures, but combined Supracondylar fracture with ipsilateral forearm bone fracture, known as floating elbow, is not a common injury. This is a retrospective 2 year study conducted between March 2014 to April 2016. A total of 128 patients with Supracondylar humerus fracture were reviewed in the study and 4 patients were identified as floating elbow. Their mode of injury, fracture type and management are reviewed in this study.

Key words: Supracondylar humerus fractures, floating elbow, close pinning.

1. Introduction

Supracondylar fractures are a common elbow injury in children, accounting for 16% of all paediatric fractures [1] but combined supracondylar fracture with ipsilateral forearm bone fracture, known as floating elbow, is not a common injury. The incidence of this association varies between 2% and 13% [2, 3]. The term floating elbow was first coined by Stanitski and Micheli [4]. The amount of energy involved in this fracture pattern is very high and is often associated with severe soft tissue injury, which can result in neurovascular compromise or compartment syndrome. Immediate fixation of this fracture with percutaneous Kirshner wires to prevent complication and to avoid vascular complications has been reported to give good results [2, 3]. In this study we present follow up of 4 patients who were managed by percutaneous K wire fixation.

2. Materials and Method

We have reviewed all paediatric patients admitted with supracondylar humerus fracture in the last 2 years [March 2014 to April 2016]. A total of 128 patients were identified and included in the study and out of these, only 4 patients were identified as having fracture in supracondylar area with ipsilateral fractures of one or both the forearm bones. Three patients were male and one female. The age of patients ranged from 7 to 13 years with a mean of 9 years. In three cases the left upper extremity was involved while all the patients were right hand dominant. Modes of trauma in all the patients were same i.e. fall from height while playing.

All supracondylar fractures were extension type Gartland type III. Out of four patients two had open fracture injury. Details of patients [table 1]

2.1 Surgical Details

All patients were initially managed with close reduction and POP slab in extension to reduce soft tissue swelling. Distal pulses were checked after manipulation. All patients underwent surgery for definitive fixation within 24 hours of admission. All patients were taken up for surgery after anaesthesia clearance and with adequate fasting for close reduction and percutaneous K-wire fixation. Patients were put in supine position and cleaning and draping was done. Close reduction of supracondylar fracture was attempted first and followed by fixation with percutaneous K-wire. In two patients two lateral K-wires were put to hold the fracture and in two patients cross K-wires, one from lateral condyle and one from medial condyle, were put to hold the fracture. After fixing the supracondylar fracture, distal end radius fracture was fixed with two percutaneous K-wires. Postoperative distal pulses were checked in all patients.

The supracondylar pins were left in place for six weeks and the forearm pins were removed at three weeks. POP slab above elbow immobilization was continued for six weeks.

The mean duration of stay in the hospital was 3.75 days [3 to 5 days].

The results were assessed by Flynn criteria as modified by Templeton and Graham [Table 2]. [5, 6]
### Table 1. Details of patients

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Age</th>
<th>Sex</th>
<th>Mechanism of injury</th>
<th>Side</th>
<th>Clinical type</th>
<th>Garland type</th>
<th>Ipsilateral forearm injury</th>
<th>Nerve injury</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>M</td>
<td>Fall</td>
<td>Right</td>
<td>Closed</td>
<td>III</td>
<td># shaft of radius</td>
<td>None</td>
<td>ORIF with percutaneous K-wire fixation</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>M</td>
<td>Fall</td>
<td>Bilateral</td>
<td>Open</td>
<td>III</td>
<td># distal end radius</td>
<td>None</td>
<td>ORIF with percutaneous K-wire fixation</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>F</td>
<td>Fall</td>
<td>Right</td>
<td>Closed</td>
<td>III</td>
<td># Monteggia</td>
<td>None</td>
<td>ORIF with percutaneous K-wire fixation</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>M</td>
<td>Fall</td>
<td>Left</td>
<td>Closed</td>
<td>III</td>
<td># distal radius</td>
<td>None</td>
<td>ORIF with percutaneous K-wire fixation</td>
</tr>
</tbody>
</table>

Table 2. Modified Flynn criteria [5, 6]

<table>
<thead>
<tr>
<th>Loss of elbow flexion/extension</th>
<th>Loss of forearm supination/pronation</th>
<th>Loss of wrist flexion/extension</th>
<th>Change in carrying angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent: 0-5</td>
<td>0-15</td>
<td>0-15</td>
<td>0-5</td>
</tr>
<tr>
<td>Good: 6-10</td>
<td>16-30</td>
<td>16-30</td>
<td>6-10</td>
</tr>
<tr>
<td>Fair: 11-15</td>
<td>31-45</td>
<td>31-45</td>
<td>11-15</td>
</tr>
<tr>
<td>Poor: &gt;15</td>
<td>&gt;45</td>
<td>&gt;45</td>
<td>&gt;15</td>
</tr>
</tbody>
</table>

### 3. Results

All 4 patients were followed up at two weeks, six weeks and three months by the operating surgeon. The longest follow up was two years. All patients recovered full elbow range of movements at three months follow up and were rated as excellent as per modified Flynn's criteria.

None of the patients developed pin tract infection or myositis of the elbow. One patient developed bullae around elbow, which was managed with Vaseline gauge dressing. None of the patients in this study developed compartment syndrome. None of the patients in this study developed any neurovascular injury. None of the patients developed cubitus varus deformity.

### 4. Discussion

In 1980, the classic paper of Stanitski reported about the injury pattern called floating elbow, in which simultaneous occurrence of ipsilateral humeral supracondylar and forearm fractures is present [4]. Serious neurovascular complications can occur with these severe extremity injuries and are manageable only by prompt diagnosis and treatment. Combination of supracondylar fractures with ipsilateral forearm fractures is rare with reported incidence of 3 to 13% of supracondylar fractures [2, 3]. In the Roposch A et al [7] two-center trial, 884 children with supracondylar fractures of the humerus were retrospectively reviewed, and 47 (5.3%) were found to have associated ipsilateral forearm fractures. Harrington P et al reported only 12 such cases of floating elbow during a 7-year period [3]. Palmer et al, in their analysis of 78 supracondylar fractures, found four ipsilateral fractures of the radius and ulna, two ipsilateral fractures of the radius alone and one ipsilateral midshaft ulna fracture[8].

Serious neurovascular complications and compartment syndrome is associated with such injuries and needs prompt diagnosis and management. The assessment of neurovascular status of the extremity is difficult due to extensive swelling. In a series by Blakemore the incidence of compartment syndrome was 33% [9].

There are many ways in which this fracture combination used to be managed, ranging from conservative management to immediate surgical intervention. Earlier, supracondylar fractures were managed by closed reduction and POP slab in acute flexion. But in many patients it is seen that due to soft tissue edema it is difficult to manage these patients in cast and the chances of loss of reduction were also high. Also due to severe edema the cast with elbow in acute flexion is hazardous because of the risk of ischemia [9]. In order to overcome this problem traction method, Dunlop type was used, though results were good but longer hospital stay was required. Palmer et al [8] reviewed 78 supracondylar fractures of the humerus in children and compared four kinds of treatment: closed reduction and immobilization in a cast or splint, overhead skeletal traction, side-arm skeletal traction, and Dunlop's skin traction. They found traction to be better than immobilization in cast or splint. Fractures that create significant displacement of the distal humerus [Type III] are particularly prone to neurovascular compromise. Closed reduction and percutaneous pinning is the preferred treatment for displaced fractures [8]. Fractures with displacement treated by closed reduction and casting have a higher incidence of
residual deformity than those managed with operative reduction and pinning [10].

Many methods are used for the management of forearm fractures, ranging from closed reduction and casting, to percutaneous fixation to maintain reduction [4, 7, 11]. The chances of displacement of the forearm fractures are high when immobilized in cast alone. Biyani et al, maintained all forearm fractures in a cast and the supracondylar fracture was pinned [11]. Roposch analyzed the results of pinning of the forearm fractures and compared this with closed reduction and casting. Three of his 18 patients with forearm fractures got displaced in cast while none of the 29 cases pinned got displaced [7].

The forearm fractures were fixed first in a series by Tabak [12] followed by closed reduction and percutaneous fixation of the supracondylar fracture. Templeton and Graham treated the supracondylar fracture first, followed by reduction and stabilization of radius only [6]. Also, Stanitski recommended closed reduction and transcutaneous wire fixation of the supracondylar fracture first followed by reduction and stabilization of the forearm fracture. We also followed the same protocol as recommended by Stanitski [4]. We used crossed pins, the medial pin passed without hyperflexion of the elbow and after palpating the ulnar nerve, to prevent iatrogenic ulnar nerve injury in two patients and two lateral pins in two patients. Skaggs et al [13] do not recommend routine use of medial pins to prevent iatrogenic ulnar nerve injury. Skaggs concluded that lateral pins alone give adequate fixation for unstable supracondylar fractures with the advantage of avoiding ulnar nerve injury [13].

Criteria of Flynn et al, modified by Templeton and Graham [5, 6] was used to assess the elbow function during followup. Harrington, in a series of 12 children, found 83% good or excellent results at the time of followup [3].

5. Conclusion

Floating elbow is a rare presentation of common paediatric supracondylar humerus fracture, which usually results from high trauma energy injury and is often associated with neurovascular complication and compartment syndrome. Prompt diagnosis and early surgical management can prevent such complications. Also early anatomic reduction and fixation of both the supracondylar component and forearm fractures gives satisfactory cosmetic and functional results with no residual deformity complications.

6. References