Abstract:
The objective of this study is to evaluate French technique as a method for Correction of post-traumatic cubitus varus deformity in children. Cubitus varus is the most common long term complication of supracondylar fracture of Humerus in children. Although function of the elbow is not greatly impaired, the deformity is unsightly. The normal carrying angle can be restored by supracondylar osteotomy. This operation was done in 12 patients using the technique described by French. French’s method proved safe and satisfactory.

Introduction:
Supracondylar fracture of the humerus is the most common elbow injury in childhood. (1) The peak incidence of this injury is between 5-10 years of age (2). However, although, the serious early complications of forearm ischemia and the Volkmann’s contracture are fortunately rare, the other late complication, cubitus varus, is common (3). The deformity is unsightly and although function is not greatly impaired, the child’s parents often request an operation to improve the appearance of the elbow (4). It is now widely accepted that cubitus varus after supracondylar fracture is not the result of growth disturbance but of malunion, with medial angulation of the distal fragment (5). Several methods of correction of cubitus varus have been described (6,7,8). Table (1) shows methods of corrective osteotomy at the distal humerus which have been used to correct the deformity (4,9,10,11,12,13).
Maintaining the correction after supracondylar osteotomy is a difficult aspect of the operative treatment and remains controversial (13,14). French in 1959, reported a procedure which “gives a good exposure, robs the operation of some of its dangers, provides a method for satisfactory control of the osteotomy and allows for earlier mobilization of the elbow .(4)
He was the first who describes a lateral closing wedge osteotomy held with 2 screws and a figure-of–eight wire and this remains the most popular method of correction (9). The operation usually preserves the medial cortex as a hinge to provide some stability in addition to internal fixation (15). The aim of the operation is to regain normally functioning elbow with normal or nearly normal carrying angle (16). The carrying angle is the lateral angle that the longitudinal axis of the fully supinated forearm makes with the longitudinal axis of the upper arm when the elbow fully extended; it is important to remember that the carrying angle is subject to considerable normal individual variations. Lyman Smith studied the carrying angle of 150 normal children, 80 girls and 70 boys, aged 3-11 years. He found the average carrying angle to be 6.1 degree in girls & 5.4 degree in boys.(17)

Materials and methods:
Supracondylar lateral closing wedge osteotomy for the correction of the cubitus varus was carried out in 12 children between January 2005 and April 2008 in Al- Hakeem general hospital. There were 8 boys and 4 girls all of them had malunion after a displaced type of supracondylar fracture of the humerus. The mean age at the time of injury was 5.3 years, and at the time of correction was 7.1 years, the right and left elbows were equally involved.
All fractures were caused by falls on the outstretched arm usually during a football match or a fall from bicycle.
In all but 2 cases the initial treatment of the fracture was by closed reduction and posterior plaster splint. 2 children were treated by bonesetter.
Technique of operation:
The humerus is approached through a small lateral incision directly over the supracondylar ridge, which is exposed subperiosteally. The size of the wedge is determined from preoperative radiographs and 2 screws of the Shermann type, are inserted through one cortex only, above and below the prepared wedge. When there is rotational deformity correction is done by placing the screws in different positions in the sagittal plane. The wedge is cut with an oscillating saw, leaving the medial cortex intact to be “cracked” as a hinge, there by approximating the screws, the screws are then wired together in a figure-of-eight fashion. The wound is closed and the osteotomy is protected with a back-slab (with the arm held at 90 degree) for three weeks and active mobilization is then gradually started.

Results:
French technique was done to 12 patients to correct the post traumatic cubitus varus deformity. 8 of those patients were male and 4 were female, their ages ranging from 5-10 years “mean 7.1”. The right and left side were equally involved. The mean time of follow up was 48 weeks “range 3 months – 2 years “.
Table (2) shows the results of clinical assessment in our study:

<table>
<thead>
<tr>
<th>Case</th>
<th>Carrying angle before</th>
<th>Carrying angle after</th>
<th>Complications</th>
<th>result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-35</td>
<td>+2</td>
<td>None</td>
<td>Excellent</td>
</tr>
<tr>
<td>2</td>
<td>-15</td>
<td>0</td>
<td>None</td>
<td>Good</td>
</tr>
<tr>
<td>3</td>
<td>-20</td>
<td>+11</td>
<td>Lateral bulge</td>
<td>Good</td>
</tr>
<tr>
<td>4</td>
<td>-35</td>
<td>-2</td>
<td>None</td>
<td>Excellent</td>
</tr>
<tr>
<td>5</td>
<td>-30</td>
<td>-1</td>
<td>None</td>
<td>Excellent</td>
</tr>
<tr>
<td>6</td>
<td>-25</td>
<td>0</td>
<td>None</td>
<td>Excellent</td>
</tr>
<tr>
<td>7</td>
<td>-15</td>
<td>+2</td>
<td>Scar</td>
<td>Good</td>
</tr>
<tr>
<td>8</td>
<td>-15</td>
<td>+5</td>
<td>None</td>
<td>Good</td>
</tr>
<tr>
<td>9</td>
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<td>+4</td>
<td>None</td>
<td>Excellent</td>
</tr>
<tr>
<td>10</td>
<td>-10</td>
<td>+3</td>
<td>None</td>
<td>Excellent</td>
</tr>
<tr>
<td>11</td>
<td>-30</td>
<td>-20</td>
<td>Inadequate correction</td>
<td>Poor</td>
</tr>
<tr>
<td>12</td>
<td>-20</td>
<td>+2</td>
<td>None</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

The carrying angle and the range of elbow movement compared with the normal side were combined to guide the results of our series. An excellent result was one with loss of carrying angle of 5 degrees or less and loss of the range of flexion and extension by 10 degrees or less. A good result was one in which the loss of carrying angle was from 6 – 10 degrees and loss of flexion and extension was 20 degrees or less. A poor result was one in which the difference in carrying angle was over 10 degrees or the range of flexion and extension was limited by more than 20 degrees.

**Discussion:**

Despite the numerous ways described of treating supracondylar fracture, cubitus varus remains a significant problem which can only be prevented by achieving and maintaining accurate reduction. In Iraq the treatment of closed skeletal injuries especially in rural area is still quite commonly handled by bonesetters. 2 of our patients was mainly the result of this practice. It is now widely accepted that cubitus varus after supracondylar fracture is not the result of growth disturbance but of malunion of the fracture with medial angulation of the distal fragment (5,17, 18,19). Despite the use of screws near the epiphyseal plate, we have seen no evidence of significant growth disturbance or recurrence of deformity, therefore we agree with Oppenheim et al who advice to correct the deformity early in the childhood (20,23).

The high rate of complication reported in some series ( Sweeny 1975 ; Oppenheimer et al 1984 ) deters many surgeons from operating to correct traumatic cubitus varus and this reluctance is reinforced by the fact that it is performed for cosmetic reasons and hardly ever to improve the function and consistently produce good results (9 , 20 , 21) .French osteotomy appears to fulfill these criteria. The procedure is easy and with experience, can be completed within 30 minutes. There is minimal dissection and little possibility of nerve damage (9). Three types of osteotomy have been described for correction of cubitus varus deformity (table 1): a medial opening wedge with bone graft; rotation of an oblique osteotomy and a lateral closing wedge. King and Secor reported 15 cases with a medial opening wedge and bone graft. This method has the great disadvantage that it necessitates anterior transposition of the ulnar nerve.
Amspacher & Messenbaugh reported 4 cases with rotation of an oblique osteotomy. This method creates the difficulty of achieving a two-plane correction with a single cut and means that rotation is needed to correct the varus though the rotational deformity may be minimal. A lateral closing wedge is the simplest means of correction and some rotation can be added if required (4). Holding the correction can be difficult and several methods have been described (table1).

Fixation in a cast with the elbow flexed and the forearm pronated provides an unreliable hold on the distal fragment and significantly increases the risk of ischemia. Bellemore et al reported 3 cases treated by this method; in one of them; the cast had to be split for the early ischemia and in the other two remanipulation was required for loss of position in the cast. Rany reported that 3 of 8 patients treated in this way required further correction (4,22). In our study, there’s no case suffered from postoperative ischemia and there is only one case out of 12 needed further correction.

Fixation with k-wire may provide an adequate hold but is associated with complications. Bellemore et al reported 13 children treated by k-wire, 4 of them had pin track infection (2 of those had loss fixation and recurrent deformity) and 3 had unsightly scars. Rang treated 20 patients with k-wire and reported quite serious complication. An aneurysm of brachial artery, osteomyelitis, nerve palsies & loss of fixation. Sweeney reported the results of 14 osteotomies in which crossed wires were used; 5 of them had residual varus deformity (4,21,22,23). We have one case with prominent lateral bulge; Kumar K. et al use reverse V dome osteotomy to overcome this problem, but they face 9 different complications (12,24).

Hui JH. Et al proposed the medial approach to overcome the problem of unsightly scar (found in one case of our study); however, this approach has the technical difficulty of isolation of ulnar nerve and the danger of ulnar nerve palsy (25).

The French technique uses an intact periosteal hinge medially and two screws with a wire loop laterally to control the distal fragment. In our 12 patients there was no loss of fixation and in 11 of them had excellent or good correction of deformity. There is no an infection or neurovascular complications.

The technique prescribed by French compares favorably with the other methods reported for the correction of the cubitus varus deformity (4,26).

**Recommendations:**
We recommend French technique as an effective method for correction of post-traumatic cubitus varus deformity in children.

**References:**
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