CLOSED REDUCTION WITH AND WITHOUT PERCUTANEOUS PINNING IN SUPRACONDYLAR FRACTURES OF THE HUMERUS IN CHILDREN

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Supracondylar fractures of the humerus are the most common elbow fractures in children.[1,2] These fractures generally occur as a result of a fall on an outstretched hand with hyperextension load on the elbow. The distal fragment displaces backwards, making the extension type by far the most common (95%). Since supracondylar fractures have a peak incidence between 4 to 6 years, it seems there must be something unique about the anatomy of the elbow during this period that facilitates this type of fracture.

The three major features that seem to contribute to the unique predisposition of the juvenile supracondylar fracture are ligamentus laxity, the relationship of the joint structure in hyperextension and the bony architecture of the supracondylar area.[3]

Opinions vary in the literature as to the best treatment of displaced supracondylar fractures. The goals of the treatment are to obtain and maintain an adequate reduction with low incidence of complication, regardless of the mode of treatment. The purpose of this study was to assess early and late results of displaced supracondylar fractures treated by two recognized methods, which are closed reduction (CR) and casting vs. closed reduction and percutaneous pinning (CRPP).

Materials and Methods

During the period from January 1986 to October 1992, 50 patients with type 3 supracondylar fractures of the humerus (Table 1) were seen in the Emergency Department at King Fahad National Guard Hospital, Riyadh, Saudi Arabia. Thirty-four patients were male, with a mean age of 6 years, and 16 were female, with a mean age of 4 years.

The mechanism of injury was fall with hand outstretched in 48 patients, while two patients were involved in road traffic accidents.

All patients had extension type supracondylar fractures, 45 with posteromedial displacement and 5 with posterolateral displacement. There were 29 left-sided and 21 right-sided fractures. Follow-up averaged 14 months (6-22 months). Anesthesia time averaged 65 minutes (45-85 minutes). All patients were managed within 12 hours of injury in the operating room under general anesthesia, and 34 patients returned for clinical and radiological examination.

The first group of patients (group A) were treated by closed reduction and application of back slab, with elbow flexed more than 90º after accurate reduction was achieved based on standard anterior-posterior (AP) and lateral elbow x-ray, with another radiograph taken one to two days post-reduction. The patients were followed weekly in the outpatient clinic and the casts were removed between 5 and 6 weeks.

The second group (group B) was treated by closed reduction and percutaneous single medial and lateral pinning with application of back slab of about 60 degrees elbow flexion. The pins were removed in the outpatient clinic between 3 and 4 weeks without any analgesia.

The average hospital stay was three days for group A and two days for group B. One patient had open fracture treated by open reduction through the lateral approach. Three patients had absent radial pulse, which was returned after fracture was reduced. Two patients had anterior interosseous nerve injury, and two had sensory ulnar nerve palsy at the time of injury, from which they fully recovery three months after cast removal. One patient had an ipsilateral forearm fracture, which was managed by casting after closed reduction and percutaneous pinning of the supracondylar fracture. The reduction of this fracture was done under general anesthesia and image intensifier.[4] First, the side tilt (medial and lateral) was corrected, then the backward fragment was reduced. The adequacy of reduction was judged from the AP, lateral and oblique view, then applying back slab in 100º to 120º elbow flexion. If percutaneous pinning was used after accurate reduction, single medial and lateral pins were applied.

TABLE 1. *Garland's classification.*

Type 1A	Non-displaced fracture
Type 1B	Minimal displaced fracture with medial impaction
Type 2	Intact posterior cortex, with posterior angulation
Type 3	Completely displaced fracture

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Special attention was always paid when inserting the medial pin to avoid ulnar nerve damage (the ulnar groove was palpated and k-wire inserted in semi-extension position). The pins were bent and left out of the skin.

Results

Of the patients who were managed by closed reduction (CR) and casting, eight had lost the reduction one to two days post-initial closed reduction. Six of them shifted to closed reduction and percutaneous pinning, and two had repeated closed reduction. No patients had any problems after that. One patient from group A (CR) developed compartment syndrome in the forearm, which subsided quickly after a slight extension of the elbow, without loss of the initial reduction. All pin tracks healed without evidence of deep infection. One had superficial infection which subsided with care of pins and oral antibiotic.

All 18 patients managed by CR were regularly followed in the clinic on a weekly basis for three weeks, then again after three weeks to remove the cast and to have final x-ray of the elbow. Two patients had Baumann's angle between 80º and 85º 6 weeks after injury.

All patients managed by CRPP were followed in the clinic one week after reduction and 3-4 weeks at the time of removal of the pins. Two patients had a Baumann's angle between 80º and 85º degrees at the time the pins were removed. The author evaluated 30 patients (8 from group A and 22 from group B) clinically and radiologically, after an average of one year post-injury. Clinical evaluation was mainly to evaluate flexion-extension, supination-pronation, and carrying angle. We also evaluated Baumann's angle and the anterior humeral line.

In group A, one patient had cubitus varus deformity (20º) with limitation of flexion. This was one of the patients who had a Baumann's angle between 80º-85º. The other seven patients had full range of motion, with normal carrying angle clinically and radiologically.

In group B, one patient had cubitus varus deformity (17º) and showed a Baumann's angle of more than 80º at the time of pin removal. The rest of the patients in this group had full range of motion with normal carrying angle. Two patients who had increased Baumann's angle had normal carrying angle clinically. This may have been due to excessive remodelling of the distal metaphyses of the humerus, or could have been due to rotation of the arm at the time of x-ray, which gave a false reading of the Baumann angle.

Discussion

Displaced supracondylar fractures of the humerus are common in children. They are considered some of the most challenging injuries in term of treatment. The goals of treatment are avoidance of complication and achievement of functional and cosmetic results.[5] The ability to choose the best treatment for each patient requires special skills that the orthopedic surgeon must develop.[6]

One of the important factors to consider in treating this type of fracture is defining which fracture is stable at the time of reduction and will continue to be stable. The problem of defining instability at the time of initial reduction has not been solved. If it can be determined with certainty, this will definitely help in choosing the best treatment for a given condition in a given patient.[6]

One-third of patients managed by CR (8 of 24) lost reduction one to two days after the initial management, which necessitated an additional surgical procedure (repeat CR or CRPP). This may have been due to poor identification of which fracture was stable with this mode of treatment.

Compartment syndrome is a condition which may have very serious complications. Careful follow-up in patients managed by CR may avoid this devastating problem. In our series, only one patient developed compartment syndrome, which was picked up early and managed quickly, and therefore gave no problem on follow-up.

Two of 30 patients had follow-up of less than a year, but at the time of the last clinical visit, the elbows had full range of motion with normal carrying angle and normal Baumann's angle. Cubitus varus deformity is attributable to poor reduction and seldom the result of growth disturbances.[7-9] Obtaining and maintaining the length of medial column during reduction seems to be the best way of avoiding this problem.

There still seems to be a place for closed reduction and casting,[6] but patient selection and stability of the fracture is the key to successful results. It has become our practice to treat displaced supracondylar fracture with closed reduction and percutaneous pinning. We prefer this method because it shortens hospitalization time, the elbow can be splinted in a safe and comfortable position, and decreases the risk of compartment syndrome.[5,10-12]

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