Introduction:

Supracondylar humeral fractures are the most common elbow fractures in children which accounts for 3% of all paediatric fractures (1). Ninety eight percent of these fractures are extension type.

Based on Gartland classification, three types have been defined (2). Management of type III extension type fractures includes non-surgical and surgical treatments. Surgery would be closed reduction and percutaneous pin fixation as the first choice of treatment in the first 8 hours in which image intensifier is required (3, 4). If this method is not successful, open reduction and internal fixation using different approaches will be indicated.

Methods

We retrospectively reviewed 114 patients suffering type III extension type supracondylar humeral fractures. We included 98 patients who suffered closed fractures and type I Gustillo open fractures in which closed reduction were unsuccessful. Type I or II Gartland fractures, open fractures type II or III Gustillo, patients with poor skin condition and blisters as well as vascular damage were excluded from our study. Triceps sparing approach was used for open reduction and internal fixation. All surgeries were performed by one surgeon and the patients were followed up 12-24 months and were assessed clinically and radiographically.

Triceps-sparing approach: Under general anaesthesia and in lateral decubitus position, a pneumatic tourniquet in proximal end of the upper limb was used. Tourniquet pressure was set at 50 mmHg more than patient's systolic pressure (about 155 to 190 mmHg) (5).
At first, using a posterior approach, ulnar nerve was explored and preserved. By means of this exposure through medial and lateral sides of triceps tendon, maintaining extensor mechanism intact, hematoma was washed out and posterior synovial tissue was removed. After identification of fracture line and fragments, reduction under direct vision was performed. Internal fixation was carried out using two or three 1.5-2mm crossing pins which is a strong construction biomechanically (6). In case of comminution of any column and in patients older than ten years old, two or more pins were used on each side. For easy pin removal especially in medial side, the pin ends were left outside the skin. After irrigation with saline and inserting a drain, skin was closed and the elbow was splinted in 70-90° of flexion. Sutures were removed after 10 to 14 days. At 4 weeks after surgery, splint was removed. In case of radiologic union, the pins were removed: however, if there is any sign of delayed union, active range of motion was started with pins left in place to avoid stiffness and the pins were removed after healing. At 6, 12, 18 and 24 months follow up visits were performed. Generally speaking, the most important complication of this fracture is Cubitus varus due to malunion (7). Using X-ray, this deformity could be evaluated by Jones view in which direction of the X-ray beam is perpendicular to the distal humerus. In addition, Baumann angle measurements were compared with the contralateral side. Normal range of this angle is 9-26°. Basically, Baumann angle more than ten degrees or less than four degrees in comparison with the normal elbow reveals no varus and is acceptable (8).
Relationship of the anterior humeral line to the capitellum and rotational displacement were assessed on X-ray. At follow ups, time of fracture union, elbow range of motion, presence of any malunion confirmed by abnormal Baumann Angle on X-ray, heterotopic ossification, neurovascular complications and local complications such as pin infection and pin loosening as well as wound dehiscence were evaluated.

**Results:** As it has been revealed on Table 1 and 2, mean age of our patients was 6.4 years old (3-12), boys to girls ratio was 2.06 and right to left side was 2.26. In 82% of patients fractures happened on dominant side and 7% of patients suffered type 1 Gustilo open fracture. The average time from injury to surgery was 50.16 hours.

Fracture union was confirmed radiologically at 4 and 6 weeks follow up in 57% and 41% of patients respectively and the rest (2%) healed 8 weeks after surgery.

The Mean time of follow up was 14.3 months (12 to 24). Elbow range of motion measurement was performed using a goniometry. Mean lack of extension was 3.5° and its maximum was 15° (0 to 15°). Mean Baumann angle difference compared to the normal side was 2.4° (0-6°).

The rate of complications was 19.3%, including, pin tract infections (7%), pin loosening (3%), heterotopic ossification (4%), and wound dehiscence (1%). There were 4 cases (4%) transient anterior interosseous nerve palsy, two of which were documented before surgery, the other two were noticed after surgery and all of them resolved after 3 to 10
weeks spontaneously. There were no major complications such as malunin, nonunion, vascular injury, nerve damage and deep infection.

Table 1: Characteristics of the patients.

Table 2: Results.

Discussion

According to a systemic review performed by Mazzini et al there is no consensus for the most acceptable approach along with the least complications in supracondylar humerus fractures in children. (9). Terry Canale and James H. Beaty recommended using an anterior approach for extension-type supracondylar fractures and a posterior approach for flexion-type ones (8). Skaggs and Flynn also agrees with this concept mentioning direct visualization of the brachial artery and median nerve as well as the fracture fragments as some advantages of this approach (16). However, we believe using posterior approach allows us to reach and see the fracture site easily and fast, without any X-ray exposure and jeopardizing the neurovascular components and extensor mechanism, providing more acceptable surgical scar.

Aktekin et al compared the results of open reduction and percutaneous pinning using this triceps-sparing method in 23 cases with 32 patients who underwent closed reduction and percutaneous pinning (12). They concluded the preference of closed reduction to open reduction which is definitely the most acceptable conclusion.

Shawkat A also found very satisfactory results using the Triceps-sparing approach in 14
neglected pediatric supracondylar humerus fractures (13). Rizk AS obtained very
satisfactory results using this approach in 15 children who had neglected displaced
supracondylar and distal humeral fractures.

According to Sibly TF et al, compared to closed treatment, less than 10 degrees range of
motion restriction happened after open reduction using posterior approach consisting of
inverted V incision in Triceps. They concluded that posterior approach does not result in
major loss of elbow range of motion (15).

Although some people believe in anterior approach in management of extension type
supracondylar humerus fractures in children, using posterior approach provides us
excellent visualization of fracture site without the need to
exposure and possible jeopardizing anterior neurovascular elements. (13, 16)

Functional performance of elbow in all patients was good with no major complication,
requiring application of competent skill and knowledge in treating these patients.

The limitation of our study was low number and lack of control group which should be
considered to get more precise conclusions.

**Conclusion**

Triceps-sparing approach for open reduction and internal fixation of pediatric displaced
supracondylar humeral fractures provides an easy access to fracture site and good
exposure without using image intensifier. Leaving the elbow extensor mechanism intact,
protection of Ulnar nerve and an acceptable surgical scar are the other advantages of this
approach.
References


Triceps-Sparing Approach in Supra-Condylar Humeral Fractures in Children

