Original Article

Auditing the use of percutaneous pinning as a technique of fixation of unstable humeral supracondylar fractures in Sudanese children.

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Abstract:

Background:

Supracondylar fractures of the humerus in children are commonly treated with closed reduction and percutaneous pin fixation. There has been controversy regarding the optimal pin configuration in the management of supracondylar humeral fractures in children.

Objectives: To evaluate the effectiveness of closed percutaneous pinning (P.C.P.) as a treatment modality of supracondylar fractures of humerus in Sudanese children.

Patients and methods: Hospital based prospective study conducted in Khartoum teaching hospital during the period from July 2006 to March 2007. It included all children less than 14 years of age, with closed type III supracondylar humeral fracture, extension variant, who treated by closed reduction and percutaneous cross pinning.

Results: 34 patients were included in the study. Their age ranged between 4 -12 years, with mean ± SD of 7.68 ± 2.34 years. Twenty-four (70.6%) fractures were fixed with crossed pins whereas ten (29.4%) fractures with two lateral pins. The two lateral pins fixation was found to be significantly associated with loss of reduction (p=0.004).

Conclusion: PCP is safe and effective with good functional outcome in treatment of unstable supracondylar fractures. The best wires configuration is that which gives ability to extend elbow with much stability.

Keywords: Child; Humerus; Supracondylar fractures; Closed percutaneous pinning (P.C.P.); Nerve; vascular; outcome.

Hippocrates described supracondylar fractures (SCF) of the humerus in children during the third and fourth century [1].

Supracondylar fractures of the humerus are notoriously difficult to treat and are the second most common fractures in children[2]. It account for 60% to 75% of all fractures around the elbow in children[1,3-5], and remains one of the most challenging injuries for orthopaedic surgeons[6]. Supracondylar fracture of humerus is the fracture of the immature skeleton, so it is age related and primarily occurs in the first decade of life with peak at 6 years of age. There is male preponderance with a ratio to female of 2:1[1]. It most often occurs in the nondominant arm[7]. Typically most fractures are due to a fall on an outstretched hand with hyperextension of the elbow joint[5]. 70% of the fractures are due to falls from a height. Where the three years old children tend to fall off of household objects (beds, chairs etc). While, four years and older children tend to fall from playground equipment such as monkey bars, slides, and swings[8].

Supracondylar fractures are considered to have poorer results than any other type of extremity fracture[1].

There have been numerous attempts in the literature to classify supracondylar fractures of humerus. Classification systems generally

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are used to recommend treatment and predict outcomes. It also determines the stability and gives clues to the prognosis[5]. They are based on two factors: the degree of displacement and the type and location of the fracture line[9]. Gartland's classification is simplest and widely used one[10].

Cubitus varus or valgus are due to malreduction of the fracture this is in contrary to the old belief which thought to occur because of growth arrest of the distal humeral physis. Therefore, anatomical reduction is the standard technique of treatment of such fractures[3].

Treatment of supracondylar humeral fractures in children is based on the direction of displacement and the ability to obtain an acceptable closed reduction. Numerous techniques have been described, including closed reduction and application of a cast, traction (both skin and skeletal), closed reduction and percutaneous pinning, and open reduction and internal fixation[11].

Gartland extension type III fractures may present problems in their management by plaster immobilization, even after acceptable initial reduction[12]. They are inherently unstable type of fractures[13]. Chances of re-displacement in these fractures are more, thereby causing loss of reduction and increased chances of complications[12, 14].

Percutaneous pinning (P.C.P.) is the gold standard treatment for displaced supracondylar humeral fractures[7, 15], but the optimal pin configuration remains controversial[10,16]. These techniques are enhanced by the advent of newer imaging techniques and power equipments that led to further decrease in the incidence of complications[1]. Thus, with the availability of C-arm image intensifier in our hospital, we undertook this prospective study to treat all patients attending Khartoum teaching hospital with supracondylar extension type III fractures of the humerus by closed manipulative reduction and percutaneous pinning.

Patients and method:

This is a hospital based prospective study. It was carried out to assess the results of treatment by closed reduction and percutaneous pin fixation of unstable humeral supracondylar fractures in children in Khartoum teaching hospital during the period from July 2006 to March 2007.

Using conventional X-rays, we classified the fractures according to Gartland classification system of humeral supracondylar fractures.

All children with closed type III supracondylar humeral fracture, extension variant, treated by closed reduction and percutaneous cross-pinning were enrolled into our study after accepting the informed consent by patients or their parents. Children of type I and type II extension fractures, children with associated ipsilateral forearm fractures as well as children with open supracondylar humerus fractures were excluded from study.

Pre-operative clinical examination was carried out to detect swelling, deformity, radial pulsation, capillary refilling, and nerve function of ulnar, radial, median, and anterior interosseous. The procedures were described in brief to the parents or to the patients where appropriate. Closed reductions were performed under general anaesthesia with the patients in supine position under image intensification control during which the accurate placement of k-wires (sizes from 1.6 to 2.0 mm) were done.

Postoperatively clinical examination was carried out to assess the nerves functions and vascular state, also radiographic assessment for accuracy of reduction also was performed. Post-operatively, an above-elbow plaster cast in 60 degrees of flexion and neutral rotation was retained for three weeks after which further radiographs were taken. Then wires were removed from the elbow and active exercises started. Then at the latest follow-up after nine weeks, all patients were assessed according to the criteria of Flynn for cosmetic and functional outcomes, which classify

results into four categories according to loss of motion and the loss of carrying angle.
Reduction achieved was assessed using a goniometer. Baumann's angle was measured in injured limb and was compared with that of the sound limb. In the same manner the carrying angles and the range of motion were assessed.
Also the status of the nerves, the fracture, the wound and the progress of union was evaluated. Postoperative infection was diagnosed if pus was seen tracking around the pin (pin tract infection).
Statistical processing of data was done with (SPSS). Descriptive frequencies were obtained for all variables. The one way Anova test was used to determine the effect, if any, of the use of lateral pins or cross pins on the maintenance of fracture reduction and iatrogenic ulnar nerve injury. A p-value of 0.05 or less was considered significant.

Results:
There was a total of 39 patients with closed type III supracondylar humeral fracture according to Gartland's classification were treated by closed percutaneous pinning during study period. Only 34 (27 males, 7 females) patients were available for the final assessments at ninth weeks. Remaining five patients who did not attend the latest follow up clinic for the final assessment were excluded from the study.
Twenty-seven (79.4%) patients were boys and seven (20.6%) were girls with male: female ratio of 3.8:1. The mean age ± SD was 7.7 ± 2.34, ranged between 4 -12 years.
The mechanism of injury was variable. Falling on outstretched hands was observed in 85.3% patients (Figure 1).

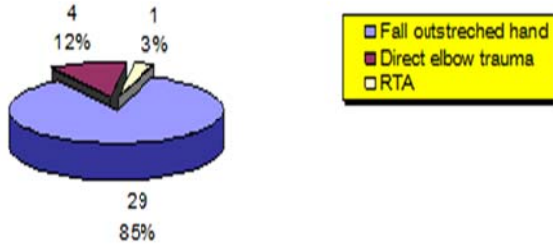

Figure 1: mechanisms of injury

Two (5.9%) patients had radial nerve affection that recovered spontaneously within nine weeks. Similarly two (5.9%) patients had absent radial pulse which returned in the immediate postoperative period. There was no compartment syndrome.
Radio-graphically the incidence of fracture displacement was posteromedial and posterolateral in thirty (88.2%) and four (11.8%) patients respectively (Figure 2).

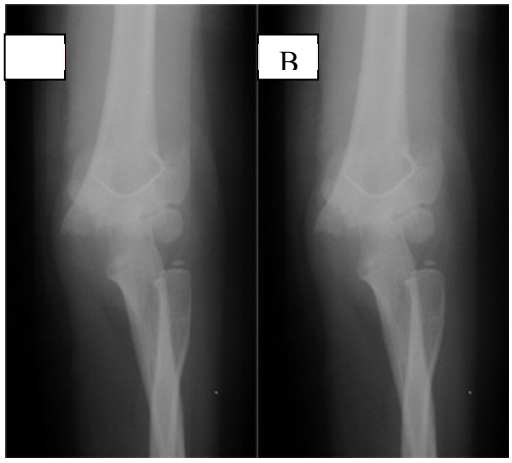

Figure 2: Posteromedial displacement of supracondylar fracture:A; AP view
B; Lateral view

Twenty-four (70.6%) fractures were fixed with crossed pins whereas ten (29.4%) fractures with two lateral pins (Figure 3: A 1, A 2 & B). The mini open incision was not used in any patient included in this study.

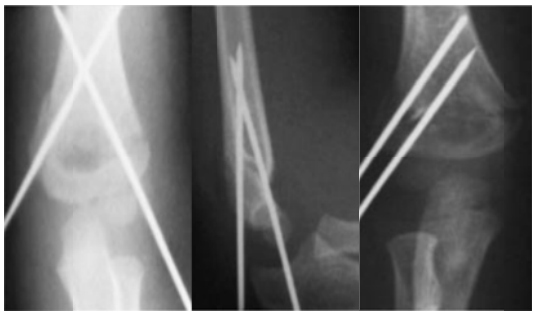

Figure 3:
A 1: AP view of Cross wires from medial and lateral aspects
A 2: Lateral view of Cross wires from medial and lateral aspects
B : Lateral entry wires

Postoperatively one (2.9%) patient had ulnar nerve injury which recovered completely within nine weeks during follow-up. There was no significant risk of iatrogenic nerve injury with the use of the cross pins (p=0.527).

Pin tract infection was noted in one patient (2.9%). There was no deep infection.

Among patients treated with two lateral pin, loss of reduction was seen in three (8.8%) of them.

The two lateral pins fixation was found to be significantly associated with loss of reduction (p=0.004). All the fractures united without varus or valgus deformities. The elbow flexion was limited by 5°-20° in six (18%) patients. Using the criteria of Flynn et al , functional outcome in terms of range of movement was excellent in (82%) patients, good in four (12%), fair in one (3%) and poor in one (3%)

Discussion:

Fracture reduction and percutaneous fixation is the most commonly accepted treatment of displaced supracondylar fractures of the humerus in children[15, 17].

In this study the mean age of the patients with type III supracondylar fracture was 7.7 years and oldest was 12 years old. This is in agree with others[6,14,18].

The falling was the commonest cause of fracture and constitute about (85.3%) of cases. This is comparable to that of Farnsworth et al[8].

Nerve injury or impairment can be associated with long term morbidity, but the majority of nerve deficits associated with supracondylar fractures are neuropraxias and resolve with time[19].

In our population preoperative nerve injuries were two (5.9%) radial nerve injuries. This is also agreeing with others[20]. These occurred with posteromedial displacement and resolved within nine weeks after the injury.

Post operative ulnar nerve injury was detected in one patient (2.9%) who presented with severe elbow swelling that was treated with medial and lateral cross pins which was statistically not significant (p > 0.5). It was transient and recovered nine weeks post injury. This was found to be lesser than the incidence reported elsewhere[21].

Vascular injury and out-flow impairment are perhaps the most important injuries leading to the most feared complication e.g. compartment syndrome.

The findings on examining the radial pulse are difficult to interpret. The absence of a pulse is not necessarily a dangerous sign and its presence not a guarantee that ischaemia will be avoided[22]. The incidence of preoperative vascular injury was 2.5%, as two patients presented with absent radial pulse that returned after reduction.

Kallio et al stated that the failure of fixation is well documented with the use of two lateral parallel pins, and reported loss of fixation in eleven (14%) of eighty patients in whom only two lateral parallel pins had been used[23]. The tendency to use this method of fixation was to avoid pinning of the ulnar nerve[24]. In this study, loss of the reduction was encountered in three patients (8.8%) stabilized with two lateral parallel k wires. One patient underwent open reduction and k wires fixation surgery. Re-reduction was achieved and replacement of the k wires was done in two patients. Zionts et al investigated the torsional strength of various pin configurations in adult human cadavers with simulated supracondylar fractures[25]. We also found that two crossed pins were 37% stronger than two parallel lateral pins. With numbers available, the assumption that lateral pins were associated with fixation failure was strongly significant (p= 0.004).

Going with literature only one child (2.9%) presented with a pin-tract infection seven days after surgery[26]. The child was treated with antibiotics while the pins were in situ. The pins were removed two weeks following surgery, and the infection resolved. Cast immobilization was continued for one additional week.

The range of motion at nine weeks of follow-up was comparable with others[26]. In this study the poor result occurred in one patient who underwent open reduction.

Conclusion:

Unstable supracondylar Gartland type III can be treated successfully with a technique of closed reduction and percutaneous pinning, thus avoiding open reduction. It is an effective and reliable closed method for the treatment of unstable supracondylar humeral fractures as it seems to offer stable fixation of the fracture, short immobilization, few operative complications and good end results. However, because of the small number of patients, the true need for open reduction of these fractures cannot be predicted.

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