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Original article

CONSERVATIVE TREATMENT AND PERCUTANEOUS "K" WIRE FIXATION OF CHILDHOOD SUPRACONDYLAR HUMERUS FRACTURES: OBSERVATIONS OF 62 PERSONAL CASES.

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Summary

Supracondylar humeral fractures are frequent lesions during childhood. Treatment consists in a conservative approach for the compound and stable fractures; the unstable fractures are treated with a closed reduction surgery using percutaneous K-wire fixation. The authors considered 62 cases of supracondylar humerus fractures in patients between the ages of 2 and 11 years old, which occurred between 2000 and 2013. The surgical results were analyzed through post-operative X-ray examinations. The functional results were evaluated afterwards by observing the alteration of the elbow's anatomical profile, the presence or absence of a vascular-nervous deficit, the pain management, the muscular strength (MRC scale) and any eventual functional limitation. The mean follow-up was 7 years. According to the authors' experience, both the conservative treatment and the percutaneous "k" wire fixation guarantee good results and a low complication rate. For this reason, surgeon experience is crucial in relation to the fracture's nosologic overview and to the osteosynthesis surgery abilities.

Introduction

The supracondylar humerus fractures are the most frequent lesions in the elbow area during childhood, and represent about 17% of the total fractures observed¹. It is possible to distinguish flexion or extension type fractures. The extension type fractures are the most recurrent and represent, as a matter of fact, 97% of all supracondylar humerus fractures², and they occur when the child falls down with an extended elbow. The flexion type fractures are less frequent and occur by a direct trauma over the flexed elbow^{3, 4}. The approach to these fractures consists in an initial clinical evaluation of the upper limb in order to rule out any concomitant lesions in other areas, such as forearm fractures that can increase the risk of developing a compartment syndrome⁵. We also need to consider, aside from pain, the presence of a he-

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matoma, soft tissue swelling, the eventual deformation of the normal anatomical profile of the elbow, and the possible presence of “skin puckering”, which could happen with the most complex fractures, due to the compenetration of the fracture proximal shaft into the brachial muscle and involving the deep dermal tissue. In addition, it is important to exclude any concomitant vascular and/or nervous damage⁶⁻⁸. The confirmation of the diagnosis is obtained with an X-ray. The two elbow standard views, alongside with the real A/P view of the distal part of the humerus (Jones view) are impor-

tant (**Figure 1**). The initial radiography might not show definite evidence of fractures, aside from indirect elements such as the “fat pad sign” (**Figure 2**). However, when the skeletal damage is evident, in order to get a correct classification of the fracture type, other important radiological parameters must be taken into account, such as the anterior humeral line, diagnosable from the lateral view of the elbow, and should normally cross the central part of the ossification center of the “*capitulum humeri*” (**Figure 3**). The Baumann angle is measured on the elbow A/P view be-



Figure 1 : Real A/P view of the distal part of humerus (Jones view)



Figure 2 : Indirect elements of supracondylar humerus fracture : the “fat pad sign” in lateral elbow view.



Figure 3: Anterior Humeral Line: which normally should cross the central part of the ossification center of the “*capitulum humeri*” in the lateral view of the elbow



Figure 4: Baumanns Angle: obtained by the intersection of a perpendicular line to the humerus shaft with a tangential line to the lateral epicondyle ossification center in the A/P view of the elbow.

tween the long axis of the humeral shaft and the growth plate of the lateral condyle (capitellum) (**Figure 4**). An increase in the Baumann angle indicates medial tilting of the distal fragment, thus causing cubitus varus^{9, 10}. The “carrying angle”, measured between the intersection of the arm and forearm axis, is important to evaluate the physiological elbow valgus condition (**Figure 5**). The treatment consists in a conservative approach for the compound and stable fractures, while the displaced fractures are treated with a percutaneous “k” wire fixation, which is an accepted and trusted procedure. These conditions are characterized by several complications that must be identified in advance in order to avoid invalidating consequences.

Material and Methods

The Institutional review board approval was obtained for this study. All of the patients’ parents gave their written consent before enrollment to this study. The authors considered cases of supracondylar humerus fractures that were admitted to our University Hospital in the period between January 2000 and November 2013. Medical records for those patients were reviewed to confirm correct documentation. A total of 62 patients

with supracondylar humerus fractures, treated operatively or conservatively, were identified. Patients were classified according to the Gartland classification that distinguishes 3 types of fractures based on the grade of displacement (through X-rays)¹¹. Type I fractures were treated in a conservative way with an arm-forearm cast applied to a flexed elbow (90°) for a period of 4 weeks, with periodic radiographic check-ups to identify eventual fracture displacement. Type II and III fractures were treated with three different techniques with percutaneous “k” wire pinning and successive arm-forearm casting immobilization for a period of 4 weeks. Type II fractures were treated with a cross-pinning technique (**Figure 6**), or with two lateral-divergent pins. For the type III fractures, in order to obtain a good rotational stability, two lateral-divergent pins and one medial pin were used. Results were evaluated through radiographic check-ups after one month and long-term. All patients were also seen for a functional movement evaluation, an evaluation for any alteration of the normal elbow anatomic profile, an estimation of the muscular strength using the MRC scale (Medical Research Council scale)¹², an evaluation of the presence of pain and of the vascu-

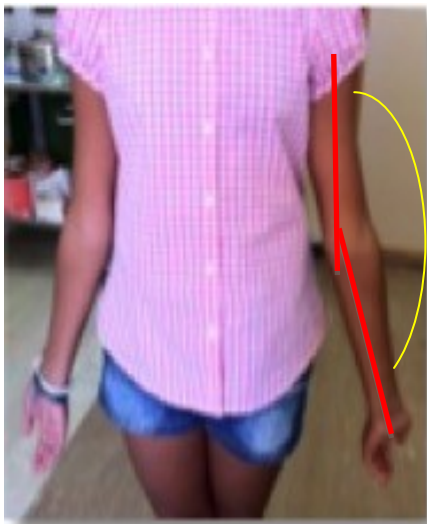


Figure 5 Carrying Angle: formed by the intersection of the arm and forearm axis



Figure 6: Post-Operative A/P view of type II fracture treated with cross-pinning technique

lar and nervous after-effects.

Results

Patients ranged between the ages of 2 and 11 years old, the average age was 6 years and half according to the literature^{13, 14}. A higher incidence was observed in males (40 cases), rather than females (22 cases). The lesions had occurred in a domestic environment for 20 patients (32%), a scholastic environment for 30 patients (49%), or outdoors for 12 patients (19%). The fractures included in this retrospective review were: 9 type I's (14%), 36 type II's (58%) and 17 type III's (28%). All type I fractures were treated conservatively; type II were treated with a cross-pinning technique in 19 patients, and with two lateral-divergent pins in the remaining 17 cases; type III received a fixation with two lateral-divergent pins and one medial pin (**Figure 7**). The mean follow-up was 7 years (range 1-13). In none of the cases a skin traction or skeletal traction was used. Among the patients with a type III fracture, in one case we observed symptoms of damage to the anterior interosseus nerve, also with paralysis of the *flexor pollicis and indicis*

longus. In two other cases we observed damage to the radial nerve, which caused the impossibility for extension of the second finger. Patients with symptoms of nerve damage have recovered the normal function within 6 months since the surgery was performed. No ulnar iatrogenic lesion caused by the medial pin positioning was observed, and in no cases it was necessary to perform any incision of the medial epicondyle in order to identify the nerve. In 5 patients treated with percutaneous pinning a superficial infection, at the point of entrance of the Kirschner wires, was observed and treated with antibiotic therapy for 1 week, and fully healed. After long-term check-ups no patients complained of any pain, the muscular strength, evaluated according to the MRC scale, was normal (5 grade) in 50 patients (80%) and slightly reduced (4 grade) in the remaining 12 patients (20%). The functional movement analysis showed a complete recovery of the pronosupination in 60 patients (97%), 2 patients had a reduction of about 10° of the pronation. The observed elbow extension was complete in 48 patients (77%), a reduction of about 20° was ob-



Figure 7: Post-Operative A/P view of type III fracture treated with two lateral pins and a medial one

served in 14 cases (23%). The total extension recovery (140° - 150°) was obtained in 50 cases after 6 months (80%). By comparison, after surgery and long term X-Rays, we didn't observe any significant alteration of the parameters such as Bauman angle and the anterior humeral line, evaluated both for patients treated with the conservative treatment and for patients treated with percutaneous "k" wire fixation, which was evidence of conservation of the sagittal and coronal alignment. On the other hand, the evaluation of the carrying angle showed a valgus condition between arm and forearm less than 10° in 31 cases (50%), less than 5° in 6 patients (9%). In the remaining 25 cases (41%), the angle resulted to be between 10° and 15° , which is within the physiological range.

Discussion

The treatment choice for the supracondylar humerus fractures in childhood is determined by several factors: fracture type, general health conditions and skeletal age of the patient, and the surgeon's skill regarding K-wire positioning. A conservative treatment is suggested for the compound fractures (Gartland I). When opting for fracture fixation by using the cross-pinning technique, or in all cases where the medial k-wire is required, it is essential to utilize expedient solutions and tricks to protect the ulnar nerve. In the literature, there are articles that show how the risk of iatrogenic ulnar nerve injury may be higher in cases of medial pin use¹⁵. These elements are in accordance with Zaltz's observations, which show how an anterior subluxation is frequent in childhood when the elbow is flexed¹⁶. For this reason, in type III fractures with medial comminution that require an elbow hyperflexion to be reduced, the authors of this article first positioned two lateral pins with the hyperflexed elbow, and, in order to guarantee the maximum rotational stability, they positioned the medial pin with the extended elbow, to reduce the risk of ulnar nerve damage. Obviously, the easiest way not to damage the ulnar nerve is to avoid the use

of medial K-wire. As a matter of fact, in type II fractures, in which there was little involvement of the medial column of distal humerus, the authors utilized 2 lateral-divergent pins, adopting this technique rather than cross-pinning, encouraged by the fact that when the pins are positioned correctly¹⁷, they guarantee a biomechanical stability equal to cross-pins¹⁸.

Conclusion

According to the authors' experience, both the conservative treatment with casting for Gartland type I fractures, and the percutaneous "k" wire fixation for the type II and III fractures guarantee good results and a low complication rate. For this reason, surgeon experience is crucial in relation to the fracture's nosologic overview and to the osteosynthesis surgery abilities.

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